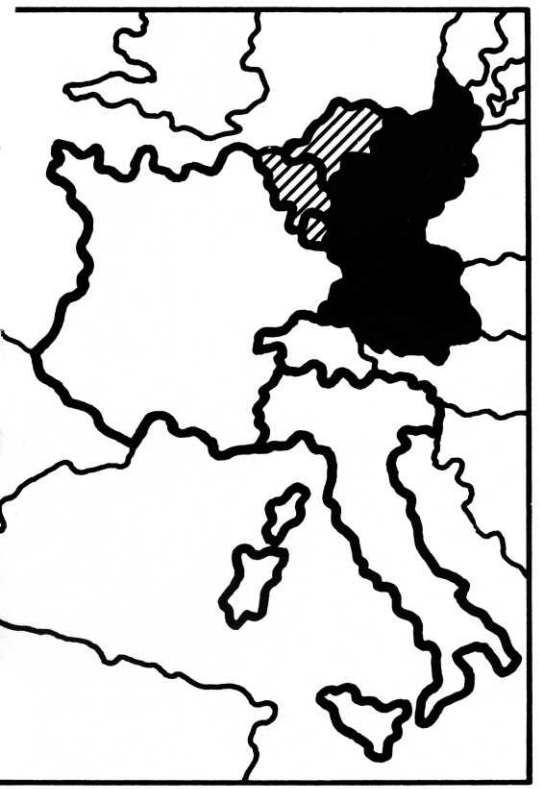
RESEARCH REPORT NO. 1

THE GRAIN-LIVESTOCK ECONOMY OF WEST GERMANY

WITH PROJECTIONS TO 1970 AND 1975

George E. Rossmiller

INSTITUTE OF
INTERNATIONAL AGRICULTURE
Food · Nutrition · Rural Development
MICHIGAN STATE UNIVERSITY



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The Grain-Livestock Economy of West Germany
With Projections to 1970 and 1975.

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Foreword

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

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

The Grain-Livestock Economy of France with Projections to 1970 and 1975 by Michel J. Petit and Jean-Baptiste Viallon

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 made possible through a contract with the Economic Research Service of the U.S. Department of Agriculture. The views expressed in this study are the authors and do not necessarily reflect those of the USDA.

The studies of the grain-livestock economy of West Germany, Italy, and France 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 Rome and Perugia, Italy, under the direction of Professor M. Bandini

Institut National de la Recherche Agronomique Paris, France, under the direction of Professor D. Bergman

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

Direct supervision of each sub-project 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 at Michigan State University.

As a member of the European Economic Community,[1] West Germany is directly affected by the implementation of the Common Agricultural Policy of the EEC. Under this common policy farmers in one member country are in direct price and cost competition with those in all other member countries and insulated from third country competition by a common tariff wall. The Common Price Policy, along with general technological advance and structural development, will determine the product mix and production level of EEC agriculture.

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 products in the 1965/66 marketing year are members of the EEC. The interaction of the supply-demand re-

[1] Other members are Belgium, France, Italy, Luxembourg, and Netherlands.

lationships within the EEC will directly affect the future level and mix of U.S. agricultural products and production inputs exported to that area.

The objectives of this study are twofold -- to describe the present state and past trends of agriculture in West Germany, and to project agricultural production to 1970 and 1975 with particular emphasis on the grain and livestock sectors.

I wish to acknowledge with thanks the assistance provided by various individuals in the Institut für Landwirtschaftliche Betriebslehre, Göttingen, by individuals in the Economic Research Service, USDA, and by colleagues who worked on other phases of the total project.

In particular, I want to acknowledge the contribution by Dr. Peter von Harder who wrote the preliminary manuscripts for the chapter on agricultural capital and technology and a major portion of the chapter on agricultural real estate. Together we developed the procedure and methods used in collecting and assimilating the data necessary to fulfill the study objectives. Further he has been involved throughout the project -- advising, reviewing and critiquing the study and its progress.

Dr. Hans Ruthenberg collected the data and produced a manuscript which became the framework for the chapter on agricultural labor. Dr. Detrich von Rotenhan most ably filled the gap created when Peter von Harder officially left the project. Three members of the Institute at Göttingen -- Dr. Manfred Köhne, Dr. Gerriet Müller and Mr. Schiever-Ahrens -- prepared manuscripts for direct use by the author in developing this study. I did not in all cases heed the arguments employed in these manuscripts, and in fact, I assume sole responsibility for the text of this document including the conclusions and recommendations.

Michigan State University
March, 1968

George E. Rossmiller

HIGHLIGHTS OF PROJECTION RESULTS

One objective of this study was to project grain and livestock production in West Germany to 1975. The results of these projections are as follows:

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 almost constant but the composition of grain surface will shift to include increased barley and wheat surface offset by decreased rye, oats, and mixed grain surface. The food-feed grain balance will shift somewhat in favor of feed grain.
2. Output in the cattle sector is expected to increase substantially. Milk production will increase at a more rapid rate than consumption, thus aggravating the already existing surplus. Beef and veal production increases, although large, will not keep pace with consumption; thus the existing deficit will widen slightly by 1975.
3. Pork output is expected to increase faster than consumption. The present domestic production deficit will become a slight surplus by 1975, unless policy changes are effected.
4. With the shift of poultry production to large scale commercial enterprises, a large increase in poultry output is expected. Consumption increases are rapid during the early part of the projection period but slow slightly after 1970. The deficit increases to 1970 and then declines as the rate of consumption increase slows.
5. Egg production will also be centered in large scale commercial establishments by 1975. Both production and consumption are expected to increase with the egg deficit decreasing and then becoming rather constant by 1975. Benelux suppliers, particularly the Netherlands, will continue to supply those portions of the German market in which they have a transportation advantage.
6. The United States can expect to increase exports of feed grains to West Germany but food grain and poultry exports will decrease. For several reasons the U.S. should not expect to fill any part of the beef or veal deficit in West Germany.

Chapter 1

German Agriculture in Perspective

Climate, Soil, and Production Areas

The Federal Republic of Germany has a temperate and a mostly oceanic climate which because of the Gulf Stream influence is much more moderate than one might expect from its location. Average annual precipitation is about 30 inches with extremes between 20 and 80 inches. Since nearly two-thirds of the land area is mountainous, the growing season for agricultural crops is rather short. Along the seacoasts and in the central valleys and basins, however, a much more favorable micro-climate is found for the cultivation of crops. The soils of the level lands, the hills, and the foothills range from sand to loam while the soils in the middle and high mountains range from sandy loam to loamy clay. In the mountain areas, soils tend to lack lime and fertility and are also subject to heavy erosion. Thus, these soils are used extensively for woods and grassland. The less productive soils are usually planted to rye, oats, and potatoes while the more productive soils of the Main and Nekar River basins, southern Bavaria, the Baltic seacoast, the northern portion of the central mountain highlands, and the northern areas are used for crops such as wheat, barley, sugar beets, and forage.

Although all German farms can be classified as multi-enterprise units with little or no full specialization, the cropping enterprises in the northern part of the country tend more heavily toward the root crops such as potatoes and sugar beets along with rye while the southern area enterprise mix is more heavily weighted toward wheat and barley. Table 1 presents a comparison of the land area and population density of West Germany and that of the total European Economic Community for the year 1963/64. As can be seen, Germany has about 20 percent of the agricultural land of the EEC and about 32 percent of the population. The land area of Germany is about the same as

Table 1. Population and Agricultural Land in West Germany Compared to the Total EEC - 1963/64

	Germany	EEC	Germany As Percent of EEC
Population (in 1000)	57,910	178,460	32.4
Total Land (1000 Ha)	24,853	116,774	21.3
Agricultural Land (1000 Ha)	14,090	71,684	19.7
Persons Per Square Kilometer of Total Land	233	153	152.3
Persons Per Square Kilometer Agricultural Land	411	249	165.1
Square Meters Agricultural Land Per Person	2,433	4,017	60.5

Source: EEC Statistical Office as cited in *Statistisches Jahrbuch über Ernährung, Landwirtschaft, und Forsten*, 1965, Table 445.

Table 2

Contribution of the Agricultural Sector to the Total Economy in Germany 1950-1965 in Million DM and as a Percentage of Gross Domestic Product in Nominal and Real Values

Year	Gross Domestic Product (Nominal)	Gross Agricultural Product (Nominal)	Agricultural Contribution to GDP %	Gross Domestic Product (Real 1954 Prices)	Gross Agricultural Product (Real 1954 Prices)	Real Agricultural Contribution to Real GDP %	Real Agricultural Contribution / Nominal Agricultural Contribution
1950	97,820	9,090	9.3	112,790	9,850	8.7	93.5
1955	180,830	12,510	6.9	177,340	11,820	6.7	97.1
1956	199,000	13,100	6.6	189,530	11,890	6.3	95.4
1957	216,390	13,510	6.2	200,320	12,180	6.1	98.4
1958	231,210	14,470	6.2	206,670	12,980	6.3	101.6
1959	250,750	15,000	6.0	221,070	13,350	6.0	100.0
1960[1]	279,420	15,680	5.6	240,320	14,010	5.8	103.6
1960[2]	296,640	15,860	5.3	254,980	14,170	5.6	105.7
1961	326,600	15,730	4.8	269,170	14,330	5.3	110.4
1962	354,880	15,830	4.5	280,180	13,650	4.9	108.9
1963	377,360	17,280	4.6	289,860	15,060	5.2	113.0
1964	414,600	18,150	4.4	309,400	15,680	5.1	115.9
1965	449,700	17,988	4.0	323,200	15,190	4.7	117.5

[1] 1960 and prior, Saarland not included

[2] 1960 and later, Saarland included

Source: *Statistisches Jahrbuch über Ernährung, Landwirtschaft, und Forsten*, 1965, Tables 17, 18, and own calculations.

that of Oregon. Approximately 57 percent of the total land area is agricultural. Of the total agricultural land, about 40 percent is in permanent grassland and the rest or just over one-third of the total surface is cultivated. Population density is well over the average for the EEC area with 233 persons per square kilometer of total land and 411 persons per square kilometer of agricultural land. German population density is only exceeded by that of the Netherlands and Belgium. In 1965, West Germany was 78 percent self-sufficient in food production if production from imported feeds is counted, otherwise they were about 65 percent self-sufficient.

Agriculture in the German Economy

Table 2 presents the historical position of the agricultural sector relative to the total German economy. The nominal value of gross domestic product increased by slightly over four and one half times between 1950 and 1965 while the gross agricultural product approximately doubled. The agricultural contribution to gross domestic product was 9.3 percent in 1950 and 4 percent in 1965. In terms of real (1954) prices, the gross domestic product almost trebled between 1950 and 1965 while the gross agricultural product increased by about one-half. The real agricultural contribution to real gross domestic product in 1950 was 8.7 percent and in 1965 was 4.7 percent. Thus, the agricultural sector in West Germany, as in most developed countries, is becoming less important with respect to the total economy. Table 3 presents the comparison of gainfully employed persons in the total economy relative to persons employed in agriculture during the 1960-1965 period. Total gainfully employed persons increased from 26.2 million in 1960 to 27.2 million in 1965, while persons employed in agriculture decreased from the 3.6 million in 1960 to 3.0 million in 1965. The percent of total gainfully employed persons employed in agriculture has shown a stable rate of decline from 13.8 percent in 1960 to 10.9 percent in 1965.

Table 3. Total Gainfully Employed Persons and Gainfully Employed Persons in Agriculture in Germany 1960-1965 in thousands.

Year	Total Gainfully Employed Persons	Gainfully Employed Persons in Agriculture	Percent of Total in Agriculture
1960	26,247	3,622	13.8
1961	26,591	3,546	13.3
1962	26,783	3,383	12.6
1963	26,880	3,230	12.0
1964	26,979	3,084	11.4
1965	27,153	2,966	10.9

Source: *Statistisches Jahrbuch über Ernährung, Landwirtschaft, und Forsten*, 1965, Tables 11, 12, 13.

The number of farms in West Germany has also been rapidly decreasing. In 1965, 1.45 million farms were counted with an average size of 9 hectares.

Figure 1. The EEC Market Regulation Scheme

Commodities \ Arrangements	Target Price	Threshold Price	Sluice Gate Price	Free at Frontier Price	Import Levy	Supplementary Levy	Import Duty	Provision for Market Intervention	Provision for Export Refunds	Quota	Quality Standards	Producers Organization	Initial Date	Date of Unification 11/
Grain and grainproducts	x	x		x	x			x	x				1-8-'62	1-7-'67
Rice and riceproducts	x 1/	x		x	x			x1/	x				1-9-'64	1-9-'67
Pigs and pigmeat			x		x	x		x9/	x				1-8-'62	1-7-'67
Poultry and eggs			x		x	x			x				1-8-'62	1-7-'67
Milk and dairyproducts	x2/	x		x	x			x10/	x				1-11-64	1-4-'68
Beef and veal			x3/	x	x		x	x	x	x4/			1-11-64	1-4-'68
Sugar and Sugarbeets	x	x		x	x			x	x	x5/			1-7-'67	1-7-'68
Oilseeds	x							x	x				1-7-'67	1-7-'67
Olive oil	x	x		x	x			x	x				1-11-66	1-11-66
Fruit and vegetables			x6/	x		x	x	x	x	x7/	x	x	1-8-'62	1-7-'68
Wine							x			x8/	x		1-8-'62	1-11-69

1 In France and Italy

2 Only in case of milk

3 Guide price

4 Levy free import quotum for frozen beef

5 Production quotum

6 Reference price

7 Import quotum applicable only through a safe guard clause procedure

8 Import quotum

9 In case of carcasses, backs and bellies

10 Only in case of butter

11 From 1 July 1967 the European Guidance and Guarantee Fund takes full responsibility for financing the common agricultural policy, the income of the fund will then consist of:
a) 90% of the proceeds of the levies on imports from outside the community;
b) direct contributions by national governments on the following scale (in percentages of the required sum in 1967/1968 and 1968/1969): France 32.0%, Italy 20.3%, Belgium 8.1%, W. Germany 31.2%, Netherlands 8.2%, Luxembourg 9.2%.

Source: Netherlands Agricultural Ministry, Selected Agri-figures of the EEC. August 1967, p. 47.

The distribution is very heavily oriented toward the smaller farm however, since one million of those farms were under ten hectares in size.

Common Agricultural Policy

The common agricultural policy, under which Germany is moving along with the other countries of the EEC, is primarily a market regulation and price support policy. Figure 1 presents the EEC market regulation scheme for various agricultural products.

In the case of grains, the target price is established in the area of greatest deficit. This has been determined as Duisberg, Germany for the EEC area. Derived target prices are then established in outlying areas of the community based primarily on the transportation cost differential between the base target area (Duisberg) and these outlying market points. A variable levy is established at the borders and is the difference between the world market price of the commodity and the internal price surface. An intervention price based on the target price in various marketing points throughout the community is established, and the intervention agency must stand ready to buy unlimited quantities of the commodity when the price falls below the intervention price level. The intervention agency may dispose of the commodity by selling it on the domestic market when the price rises above the target price, selling it on the world market, or in the case of wheat, selling it as feed after a denaturing process.

The policy differs considerably for the different types of livestock. A guide price is established for beef and veal with provisions for local market intervention in cases where the average price of principal markets remained below an established level for a specified length of time. For the grain conversion products -- pork, poultry, and eggs -- a sluice gate price is established in order to determine import levies but provisions for market intervention are operative only for pork. A target price is established for milk and market intervention consists of buying butter.

The main impacts of the EEC policy on agriculture include (1) a shift in the internal grain price surface based on the single target price in the deficit area and all derived target prices in the outlying portions of the country based primarily on transportation cost and (2) a widened market area since the borders between member countries do not constitute barriers to flows of agricultural commodities as they once did, and therefore, farmers in one country are in direct competition with those of another.

German Agricultural Policy and the Transition to the CAP

The main objectives of German agricultural policy at least since the establishment of the Green Plan in 1956, include an income goal which would allow the agricultural population to share in the increasing level of living enjoyed by the rest of the economy and to facilitate the German agricultural competitive position against incorporation into the European Economic Commun-

ity. The disparity between agricultural and nonagricultural incomes has been the most critical policy issue because the rising level of the general economy has pressured to widen the gap. Maintenance of the viable family farm is the primary objective of the structural policy. An attempt has been made to direct the policy in such a way as to create full-time family farms of those which are sufficiently large enough to begin with, and for the holdings which are too small to make into viable family farms, the pressure is toward making them true part-time farms where at least a portion of the family works elsewhere or resources are released to other farms of sufficient size to handle them.

The whole agricultural policy area of West Germany can be categorized into two separate types of programs. The first are the structural reforms and related programs. These include land consolidation programs, movement of farmsteads out of congested villages, improvement of farm road systems, drainage, purchase and resale or rent of farms that become vacant in order to increase farm size and improvement of farmsteads within the village when they cannot be moved outside.

Along with the programs which are directed specifically toward the agricultural sector are certain programs aimed at creating employment opportunities outside of agriculture. Regional development programs which attempt to promote industrial interest in rural areas through tax and credit incentives as well as programs to help certain areas promote tourism have been developed. Also, along this same line are vocational training and retraining programs for agricultural workers to prepare themselves to move into industrial type jobs. The improvements gained under the structural reform programs are of a long-run nature. Political as well as economic considerations dictate that other programs are necessary which show a more immediate result. We therefore find a body of price and income support programs.

These direct aids are of two types. On the one hand, we find aids for the purpose of outright increase of agricultural incomes. One example of this type program is a price equalization system to maintain a uniform milk price throughout the country. Consumption subsidies are granted as well as purchases of butter and powdered skim milk by the government to support the price. Under the CAP, the milk price will be based on local market conditions and only butter will be purchased by the intervention agencies to support the price. The general level of milk prices will be about the same under the CAP as they were in Germany before its introduction.

Another example is the income support provisions for grain which established prices supported at different levels in four separate regions of the country with transportation subsidies and milling regulations as the support provision. The price level in the different regions was established primari-

ly on political rather than economic grounds and therefore the southern parts of the country had the higher prices. When the CAP comes into effect, the high prices in the south will be replaced by much lower prices in accordance with the derived target price provisions of the CAP. Thus, we find both a general lowering of the grain prices in Germany and a shift in relative prices among regions. A final example of the income increasing facet of the direct aid program was, until 1964 when it was discontinued, a reduction of fertilizer prices.

On the other hand, are those aids which are geared to compensate the German farmer for certain institutional barriers such as import regulations and tax systems which tend to discriminate against him *vis à vis* his counterparts in the other member countries of the EEC. These include the subsidy on diesel fuel and an agricultural products exemption from the turnover tax. Until 1963 this also included an equalization payment for eggs to offset feed grain prices which was discontinued as a step toward bringing the German marketing system in line with the Common Agricultural Policy.

According to the OECD, direct aids to agriculture over the past several years have accounted for more than 20 percent of the farm labor income in Germany. They find that the total amount of direct aids per hectare is higher on small farms than on large farms, but the aid per farm is directly correlated with size.[2]

Thus, we find on German farms a changing technological level, a changing structural situation encouraged by governmental programs, and a changing level and set of relationships in the price structure as the country moves under the Common Agricultural Policy of the EEC. These three phenomenon acting both individually and collectively, have in the past and will continue to have in the future an impact on the level and mix of agricultural production. In the following chapters, we will examine each of these phenomenon in more detail and their impact on production levels and mix will be assessed.

Method of Organization

Development of the projections in all cases began with extrapolation of the historic trends through the use of regression analysis and/or graphic interpolation of time series data. These trend results are then adjusted on the basis of a detailed analysis of the effects of farm structure adjustment, technological change, and changes in relative prices and costs.

The foundation for these projection adjustments is the analysis of German agriculture found in Chapters 2 through 5. Chapter 2 presents the historical developments and present situation with respect to agricultural real estate. Market as opposed to productivity value is discussed, as well as the

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[2]OECD, *Low Incomes in Agriculture*, Agricultural Policy Report, Paris 1964.

changing tenure arrangement and the implications of farm structure on production. Finally the programs to correct agricultural structure problems are detailed.

On the basis of the discussion in Chapter 2, farm numbers and farm hectares by farm size group are projected in Chapter 3. Changes in crop and livestock production associated with change in farm structure are calculated by imposing the 1960 cropping and livestock patterns by farm size group on the 1970 and 1975 hectare distribution by farm size group. The analysis clearly points up the fact that farm structure does affect crop and livestock production patterns but changes so slowly as to become the most important limiting factor in the changing mix and level of agricultural production.

Chapter 4 discusses the changing scene with respect to agricultural labor, the impact of forces exogenous to agriculture, and the effects on agriculture production and farm income.

Technological change and capital restrictions are discussed in Chapter 5. The differential impact of technology by type of enterprise and the interaction of technological innovation and farm structure are analyzed with regard to the impact on the level and mix of agricultural production.

Chapters 6 and 7 present the production projections to 1970 and 1975 for crops and livestock respectively. The influences of farm structure as the limiting factor interacting with the effects of technological change and relative price and production cost shifts are analyzed on a commodity by commodity basis. The individual supply projections are developed by adjusting the results of the first approximation trend results to take into account the influence of differential changes in structure, technology, and price.

Chapter 8 presents the summary and conclusions.

Due to differences in farm size, technological level, crop and livestock patterns and variations in yields in different areas of the country, we found it necessary to take a regional analysis approach for both the description and projection portions of the study. In choosing our regions, we had to compromise to a size which would yield the maximum homogeneity within each region but still keep the number of regions small enough to permit reasonably rigorous analysis in the time period allotted to the study. The compromise finally yielded an eight-region breakdown based on political boundaries of the *Länder* or "states" as we shall call them throughout the study. For data collection purposes our regional boundaries necessarily follow state lines.

Wherever possible, data is presented on a state by state basis but in some cases only national statistics were available. Many of our historical series extend back to 1955. Since Saarland did not revert back to German control until 1 January, 1957, it is not included in national totals prior to that date. Unless otherwise specified for data from 1957 on, West German statistics include Saarland but do not include West Berlin. Throughout the

study the names of the regions or states are denoted in German. Appendix A is a map of West Germany with the state boundaries, and thus the regions which are the subject of our inquiry, delineated. Unless otherwise stated, all data listed for Schleswig-Holstein include data for the city state of Hamburg, and Niedersachsen includes data for the city state of Bremen.

Finally, since the northern EEC grain deficit area includes Belgium, Luxembourg and the Netherlands along with Germany; since we refer in the projection chapters to the productive capacity of these countries; in relation to certain agricultural products and also in order to provide complete country projection coverage for the total EEC area in conjunction with the other reports in the series; it became necessary to provide parallel supply response projections for the Benelux countries. These projections along with the necessary base data, descriptive and analytical material are presented in Appendix E.

All area, yield, and production statistics are presented in the metric system and most value and price data is in terms of the German currency, the Deutschmark. Conversion tables and abbreviations are presented in Appendix B.

Chapter 2

Agricultural Real Estate

Introduction

To understand some of the production and policy problems that German agriculture faces today and the types of difficult decisions which must be made in the future, we must try to analyze agricultural real estate as a productive factor in an economic framework. The entry point for this analysis must be that area which is most difficult to explain in an economic framework -- the market value of agricultural real estate. Once started, we are led into rental values and arrangements, village structure, buildings, and fragmentation as they affect production and finally to the corrective programs undertaken to deal with the problem.

Real Estate Market Values[1]

German agriculture of today has evolved from a beginning in which almost the total population was self-sufficient farmers. Periods of poor crops in this type of situation do not merely mean higher prices but rather an absolute reduction in the amount of food available for the family to consume. Prolonged shortages meant direct increases in death rates and decreases in birth rates.

In more recent times, food shortages induced by two world wars along with a collapse of the monetary system following each also contributed to the strong position of land as an asset in the German society. When the economic system collapsed, the main assets which retained value were those held in the form of goods -- primarily art treasures, precious metals, jewels, and land. Land had the further advantage of providing both food and shelter to its holder. Land thus became a preferred form in which to hold wealth. "One never knows," they say, "but if something happens again at least we will have a place to go and something to eat -- we will survive."

Two groups of farmers are distinguishable in Germany. The distinction in all cases is not clear but in the extreme the two groups are characterized by their outlook toward their chosen occupation. One group can be characterized much like our own commercial farmers. They are in the business to show a profit with the aid of the latest technology at their disposal and a highly developed managerial skill and knowledge. The other group includes the farmer who thinks of agriculture first as a way of life and the tradition of his family and only second as a business to be run for profit. But the distinction with regard to rapport with the land is generally only a matter of degree. Both groups have a long family tradition of farming and in countless cases can trace their landed heritage back through many generations.

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[1]The material in this section is based primarily on discussions with Dr. T. Heidhues, Dr. J. Elterich, Dr. E. Neander, Dr. W. Brandes and others.

Further, although the rate has slowed to a trickle with the erection of the wall, since the end of World War II West Germany has sustained a very large influx of East German refugees, a proportionate share of whom are farmers. The majority of these farmer refugees came into West Germany with the intent of becoming residents and continuing their farming occupation. Those who had property in the eastern sector lost it when they came west. Government policy has been to help these refugees relocate in West Germany with low interest rate loans and even to the extent of compensating those with proof of their claims for property left behind.

Finally, with approximately 58 million people living on a surface area of about 96 thousand square miles (about the size of Oregon or twice the size of Pennsylvania) the competing uses for the land are very strong. The growing population, the rural exodus and the additional industrial capacity necessary to sustain a rising level of living create strong pressures for land to be bid away from agricultural uses.

The above are the principal factors contributing to the present state of the farm real estate market. Due to the preferred position of land as a form of wealth, the yearly real estate turnover through sales over the past several years has run about 1/2 percent. The supply side is very inelastic.

The demand side has been very intense for several reasons. Expanding industry and housing developers around urban areas bid strongly for land held by established farmers. Most of these dislocated farmers don't even look at alternative investment opportunities but prefer to buy another farm and are willing to pay for it up to what they received from the urban developer for their old one.

The governmental policy toward farmer refugees puts at their disposal relatively large amounts of money for the purchase of farm units. Thus, this group has also been able to compete favorably on the demand side of the farm real estate market.

Finally, the farmer expansion buyer is in the market even though he, like the others, cannot rationalize the prices he is willing to pay purely on the basis of the productive value of the land in agriculture. All those on the demand side of the agricultural real estate market are willing to sacrifice a substantial return on their investment when compared with other investment alternatives for noneconomic reasons. That is, security, status, and tradition associated with land ownership are valued highly enough by agricultural buyers in the real estate market that they are willing to sacrifice a substantial monetary return in order to achieve them. The question is just how much of a differential in monetary return is involved and how does this affect agricultural production.

We are abstracting here from the potential capital gains, particularly of a speculative nature, associated with the holding of land over time which should in any detailed analysis be included. However, the omission is not as

serious as it appears on the surface. Many of the alternative investment opportunities would also provide a capital gain. For our purposes here, we will assume that the land and alternative investment capital gains are similar in magnitude. With the high non-farm economic growth rate it is doubtful that land capital gains would exceed non-land capital gains, so this assumption establishes the relationship between land and non-land investments which will depict land at its most favorable with respect to relative capital gains. The result of this assumption is to rephrase the first part of our question to ask, "what is the rate of return on land investments and how does this compare with similar alternative investments, *ceteris paribus*?"

Farm real estate sales data are very difficult to obtain since they are not collected by any of the governmental statistical offices. Therefore, it became necessary to rely on answers given by knowledgeable people in the farm management institutes of several German universities, farm management consultants, extension personnel in the various states, and governmental officials. The concensus of opinion gathered in this manner yielded the following range of market values for agricultural land. For agricultural purposes the range of sale price estimates was between 800 and 2550 dollars per acre with the average lying between 1300 and 1550 dollars per acre. For urbanization in rural areas, the range quoted was from .85 to 2.00 dollars per square yard while for urbanization in urban and industrial areas the range was from 5.25 to 12.50 dollars per square yard with special cases priced as high as 45 dollars per square yard.[2]

In order to proceed to more complete answers to our questions, we must detour at this point and discuss the German farm unit standard value index and agricultural land rental. After this discussion, we will be in a position to draw conclusions bearing on the economic role of land in the production process.

Farm Unit Standard Value Index (*Einheitswert*)[3]

Until about 1920, taxation and thus the assessment of property was carried out by local areas using different assessment methods. After World War I, when the tax function was taken over by the central government a new uniform assessment system was needed. In 1925, a new law centralizing the property assessment function to the central government was passed. In 1934, the law was revised and expanded to call for an evaluation of all agricultural land.

The main purpose was to achieve comparable values according to a uniform system as a basis for assessing property and inheritance taxes. Secondary

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[2]Prices collected by Dr. D. von Rotenhan from estimates by himself and other scholars.

[3]The discussion here draws heavily on an unpublished paper by Dr. M. Köhne, *Die landwirtschaftliche Einheitsbewertung*, 1965.

purposes included a basis for determining rental prices and use in farm credit transactions. (Notice that no mention is made of sale price guidelines). The law was again revised in 1965 to include certain refinements in procedure.

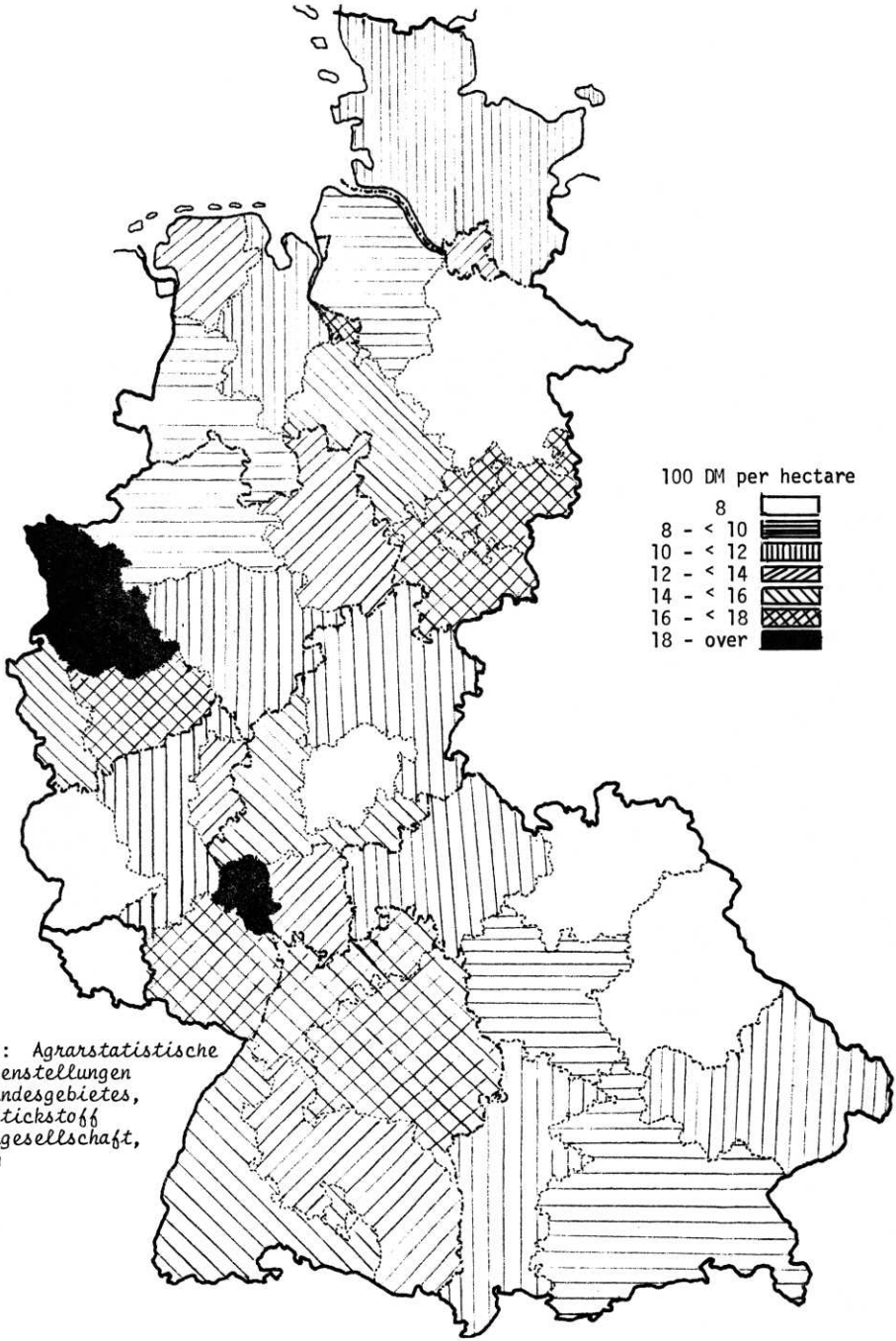
The method of determining the farm unit standard value starts with the productive capacity of the land. Benchmark farms are chosen and the profit potential based on the land productivity determined with the best being assigned a value of 100 and the others evaluated and assigned values relative to this best farm. Different soil types, conditions, and land uses are evaluated within each farm on this basis and a farm unit value calculated on the basis of the 100 percent farm having a net profit potential accruing to the land of 207 DM per hectare. An interest rate of 5.5% is assumed for capitalization of the profit potential into per hectare value, this being 3726 DM (377 dollars per acre) for the 100% farm. Land values based on this system then range from 377 dollars per acre on the best farm to a low group of farms averaging about 80 dollars per acre.

Then a system of additions and subtractions from the productive value are employed to adjust for between farm differences in extent of fragmentation, internal transportation situation, accessibility to markets, distances to the various parcels of land in the farm unit, mechanization potential, and conditions of residence and buildings. The basic productivity indices in use today are those calculated back in the 1930's while the adjustments mentioned above are kept up to date as nearly as possible. Many questions as to the validity of the methods may be asked -- questions such as; can changes in technology be taken into account?, doesn't the net profit potential change when prices and costs change over time?, can management be completely disregarded as is assumed by the method?, and the more basic question, how useful is the whole concept if it is insensitive to temporal changes affecting the production and profit potential of land?

Yet the farm unit value index or *Einheitswert* is in wide-spread use for determining rental values and in farm management calculations as a basis for allocation of resource returns in addition to its use by the tax assessor. Figure 2 shows the average *Einheitswert* in DM per hectare by *regierungsbezirk* (region). From the above discussion, we may question both the absolute level within any region as well as the relative values between the regions. Since the variables which affect the absolute levels include those which affect the relative levels plus the general trends in price and cost development, and since those variables affecting relative levels are more of the structure and technology variety which tend to develop both more slowly and in response to price and cost, we may conclude that the *Einheitswert* has more merit in a relative than in an absolute application.

During the past several years rental prices and the extention of credit have broken their tight ties with the *Einheitswert*. Presently land used as collateral for farm credit is valued by credit sources at two to two and one

Figure 2. Average Farm unit standard value index (Einheitswert) per hectare by region in West Germany in 100 DM per hectare - 1955



Source: *Agrarstatistische Zusammenstellungen des Bundesgebietes, Ruhr Stickstoff Atkiengesellschaft, Bochum*

half times its *Einheitswert*. Rental prices as we shall see in the next section are beginning to exceed the *Einheitswert* established guidelines by substantial amounts. Unfortunately, in the allocation of income to resources, farm management calculations still tend to be tied quite closely to the *Einheitswert* in pricing the land resource. The implications of these trends will become clear in the final section of this chapter.

Agricultural Land Rental and Tenure Arrangements

In 1960, 20% of the agricultural land in Germany was rented. The economic significance of rented land is greater than implied by this figure. This becomes apparent when we find that 55% of all farms rent at least a portion of their land.

Cash rent is the primary form of reimbursement. When an entire farm is rented, buildings and installations are usually included. Normally livestock, machinery, and operating capital are provided by the tenant. This arrangement is advantageous to the tenant with respect to the degree of control he is free to exercise over his capital components, but it does require a substantial capital commitment. Cases where the landlord furnishes the livestock and machinery are quite infrequent and are not found on the better farms. As a result of the general trends in today's agriculture which include a substantial increase in the capital component, farm tenancy is increasingly unable to fulfill the function it once did as a step in the agricultural ladder.

In comparison to share rent, cash rent has the advantage that the tenant can operate his farm relatively free from landlord interference. Because the landlord is precluded from influencing operating decisions, the contract stipulates the limits within which farm organization may be altered and the acceptable condition of the property at the end of the lease period. For example, the contract may stipulate the minimum number of livestock which must be kept in order to insure an adequate supply of manure to maintain soil fertility. Virtually all contracts forbid the sale of manure. In certain areas the amount of land allotted to grain, green manure and fodder crops is specified, again to maintain soil fertility.

If the management of the farm deviates greatly from the conditions agreed upon before the rental period ends, the contract may be broken through provisions of the lease law.[4] A major portion of this lease law, however, is concerned with protection of the rights of the tenant. Under certain conditions, notification of termination can be declared invalid before a court. A substantial portion of land owners are reluctant to lease their land because they consider the present lease laws too protective of the tenant with not enough safeguard for the owner. Both custom and law are evolving and appear to be moving in a direction which is dispelling some previous owner

[4] A. Fritzen, *Pacht*, Stuttgart, 1962.

fears. Over time this should mean a more active rental market.

Two classifications of land leasing can be distinguished -- the tenant lease where the tenant has no land of his own and the parcel lease where the tenant is leasing land to supplement his own farm unit. The parcel lease has by far the greatest significance. In 1960, 50 percent of all farms had at least some rented acreage, while farms consisting of totally rented land accounted for only 5 percent of the total. Table 4 shows that the percentage of tenant lease farms as well as the proportion of rented land leased by tenant farmers increases with the size of farm. Two main reasons for this are found. Tenant farmers on the smaller farms find it very difficult to achieve sufficient income to support their families when they are obligated to the landlord for a substantial rental outlay. A large portion of the rented land which is leased as tenant farms belongs to the state, the community, the church, or (one time feudal) large land owners. These institutions rent preponderatingly larger farms.

Again referring to Table 4, we find the proportion of farms and rental land in the parcel lease category decreasing as farm size increases. With the high sale price for land, the parcel lease offers the small farmer his best alternative for expanding the size of his farm to take advantage of new farm technology and to more efficiently utilize his available labor in attempting to achieve an optimum farm organization. In farms of over 30 hectares, the additional rented land is not so crucial to the farm's existence but nevertheless is a welcome complement to personal holdings. In farms up to the 20-<30 hectare class, the parcel lease accounts for most of the rented land while above this class the largest share of the rented land is in tenant lease farms.

Individual farms may adapt to cyclical changes in the family labor force by relinquishing or acquiring land through the parcel lease. But more important, this form of land lease has served to aid in the adaptation of farms to changing economic and technical conditions. This trend is confirmed by Table 5. The percentage change in rented and owned land by farm size group between 1949 and 1960 compared to the change in total land in each size group during the period is shown in Table 5. The proportion of rented land falling in the 10-<100 hectare farm size groups increased relative to total land between 1949 and 1960. Much of the land in the size groups up to 10 hectares moved into the larger size groups during the period, and as can be seen, the greatest portion transferring was rented land. For the most part, farms in this size category which went out of business during the period leased their land rather than selling. The motives for such action as discussed above ranged from a strong attachment to inherited land and security considerations to speculation with respect to land prices. Many of these landowners prefer to lease their land to larger farm owners because they reason that the larger

Table 4. Relationship between Rented Land and Owned Land - 1960

ar = owned farms with additional rented land t = tenant farms without owned land

Farm Size Ha		Farms with rented land as % of total farms in each size group	Distribution of rental land between ar and t in %	Share of rental land as % of total land
0.01 - <2	ar	31	75	18
	t	5	25	
2 - <5	ar	58	83	22
	t	4	17	
5 - <7.5	ar	66	82	22
	t	4	18	
7.5 - <10	ar	66	80	22
	t	5	20	
10 - <15	ar	61	74	20
	t	6	26	
15 - <20	ar	50	64	18
	t	7	36	
20 - <30	ar	40	50	17
	t	9	50	
30 - <50	ar	33	37	18
	t	12	63	
50 - <100	ar	36	38	21
	t	15	62	
100 - over	ar	40	38	25
	t	21	62	
Total	ar	50	63	20
	t	5	37	

Source: E. Lipinsky: *Die Bedeutung der Landpacht in der BRD im Spiegel der Statistik. Berichte über Landwirtschaft*, 1965, *Heft* 2, pp. 307.

operator does not really need their land to make an economically viable unit, and therefore they can more easily get the land back provided their circumstances change.[5]

The distribution of farms according to owned and rented land in the states deviates sometimes considerably from the West German average. For instance Table 6 shows the number of farms having no rented land in 1960 was especially high in Saarland, Bayern, and Schleswig-Holstein while 100 percent tenant farms were widespread in Schleswig-Holstein and Niedersachsen. From Hessen throughout southern Germany and particularly in Baden Württemberg and Bayern we find a very strong value placed on private ownership of property. Further, the high degree of fragmentation causes difficulties in transfer via renting. The farms are too unproductive to rent as whole units, while parcel lease depends on accessibility to particular plots. The small proportion of 100 percent tenant farms in this area is one of the results.

Table 5. Relative Change in Farmland[1], Owned Land, and Rented Land Between 1949 and 1960 By Farm Size Group. 1949 = 100

Farm Size Hectares[2]	Total Farmland	Owned Land	Rented Land
.5-<2	82	94	53
2-<5	73	76	66
5-<10	85	81	100
10-<20	109	101	162
20-<50	105	98	173
50-<100	98	93	142
over 100	95	95	82
Total	96	94	113

[1]Includes agricultural land, forest and wasteland on farms.

[2]Agricultural land

Source: E. Lipinsky, *Die Bedeutung der Landpacht in der BRD im Spiegel der Statistik. Berichte über Landwirtschaft*, 1965, *Heft* 2, pp. 307.

In West Germany cash rent is the most usual form of farm lease. The landowner retains the normal obligations to pay the land taxes, maintain present improvements, bear the cost of new installations, and carry insurance on the improvements. Because the costs of these obligations may vary considerably over the period of a long term lease, a clause is usually included to adjust the rental proceeds for these fluctuations.

[5]E. E. Lipinsky, *Agrarstrukturverbesserung und Bodenmobilität, in "Agrarwirtschaft" Jg* 12, *Heft* 10, 1963, pp. 321.

Table 6 Farms with Rented Land and Rented Land as a Percentage of Total Farmland [1] by State - 1960

State	Farms			Rented Land in Farms		
	With Only Owned Land	With Owned and Rented Land	With Only Rental Land	With Owned & Rented Land	With Only Rental Land	Total
	in % of all farms			in % of total farmland		
Schleswig-Holstein	48	39	13	11	13	24
Niedersachsen	38	50	13	13	13	26
Nordrhein - Westfalen	43	48	9	15	11	26
Hessen	41	57	3	17	4	22
Rheinland - Pfalz	41	57	3	24	4	28
Baden - Württemberg	45	52	3	15	3	18
Bayern	52	46	2	7	2	9
Saarland	72	27	1	18	2	20
West Germany	45	50	5	13	7	20

[1] Includes agricultural land, forest and wasteland on farms.

Source: F. Brandkamp, *Struktur und Preisniveau des landwirtschaftlichen Pachtwesens. Berichte über Landwirtschaft* 1965, *Heft* 1, pp. 55.

According to the 1960 agricultural census, 44 percent of the 1.8 million hectares of land rented under the parcel lease returned less than $37.50 per hectare per year rent, 20 percent earned between $37.50 and $50.00 and 36 percent earned a rent of over $50 per hectare per year. In general, small farms paid a lower rent per hectare for leased land than did large farms (Table 7). Several reasons are apparent. Large farms have advanced further technologically and thus may have an excess capacity in their stock of labor and capital resources to apply to their land base. These farmers tend to retionalize being able to bid the rental price higher for an additional piece of land on the grounds that their only additional costs are the operational expense of working it since they already have the surplus labor and capital they need. But large rental price differentials would not occur between large and small farms from this cause alone because the rental market is not strongly differentiated between large and small farms. Rather this factor is more likely to cause shifts in rented land from small to large farms. Nevertheless, some of the rent differential can be attributed to this factor.

Relatively low soil productivity and greater fragmentation of holdings which are more frequently found in small farm areas also contribute to the rent price difference.[6] Table 8 shows that generally higher rent prices are found in the northern states of Schleswig-Holstein, Niedersachsen, and Nordrhein-Westfalen where both farm structure and soil quality are better. The *Statisches Bundesamt* estimated the average rent per hectare under tenant lease at $48 in 1960 while rent under the parcel lease averaged $44 per hectare. The main factor contributing to this differential is the difference in the term of the contract under the two types of lease. A majority of the tenant lease farms are leased for a period of longer than 12 years, while the oral one year contract predominates in the parcel lease market.[7] The uncertainty and insecurity associated with the short-term parcel lease tends to depress the rental price relative to that for the longer term tenant lease.

Now let us assume that the average German farm falls into the 70th percentile for *Einheitswert* calculations and thus would have a calculated return per hectare of 145 DM. Capitalizing this return at the rate of 5.5 percent, we find a productivity value of 2635 DM per hectare. But the average rental value is about 180 DM per hectare per year which when capitalized at 5.5 percent yields a value of 3273 DM per hectare. Assuming the rental price to more accurately reflect the productivity of the land than the *Einheitswert* is capable of doing, we still find the capitalized rental value to be about one-fourth the average market value of 14,000 DM per hectare.

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[6] *Statistisches Bundesamt, Besitzverhältnisse in den Landund Forstwirtschaftliche Betrieben. Landwirtschaft Zählung*, 1960, Heft 3 Stuttgart und Mainz, 1964.

[7] H. Röhm, *Die Landpacht im südwestdeutschen Raum, in Berichte über Landwirtschaft. Band* 37 (1959) pp. 805ff.

Table 7 Distribution of Rented Land [1] by Farm Size and Rent Price [2] Groups in West Germany - 1960

Farm Size Ha	Annual Rent (dollars per Hectare)						Rented Land in 1000 Ha
	<25	25 - <37.50	37.50 - <50	50 - <62.50	62.50 - <75	75 - over	
	% of Rented Land						
0.01 - <2	35	27	16	11	6	5	9
2 - <5	29	29	19	12	6	6	260
5 - <10	22	27	20	14	7	9	481
10 - <20	17	24	21	16	9	14	611
20 - <50	14	18	20	17	11	20	292
50 - <100	20	13	15	15	12	26	61
100 or over	30	21	13	12	8	16	29
Total	20	24	20	15	9	13	1741

[1] Single fields, not whole farms

[2] Only cash rent

Source: F. Brandkamp, *Struktur und Preisniveau des landwirtschaftlichen Pachtwesens. Berichte uber Landwirtschaft* 1965 *Heft* 1, pp. 55.

Table 8 Distribution of Rented Land [1] by State and Rent Price [2] Groups in West Germany - 1960

State	Annual Rent (Dollars per Ha)					
	<25	25 - <37.50	37.50 - <50	50 - <62.50	62.50 - <75	75 - over
	% of total rented land in each Land					
Schleswig-Holstein	11	13	20	18	11	27
Niedersachsen	9	21	24	20	13	14
Nordrhein-Westfalen	8	14	18	18	13	30
Hessen	30	31	20	13	4	3
Rheinland-Pfalz	40	23	11	9	7	11
Baden-Württemberg	25	37	20	12	5	3
Bayern	25	30	22	12	6	5
Saarland	86	11	2	.5	.2	.2
West Germany	20	24	20	15	9	13

[1] Single fields, not whole farms.

[2] Only cash rent.

Source: F. Brandkamp, *Struktur und Preisniveau des landwirtschaftlichen Pachtwesens. Bericht über Landwirtschaft* 1965, *Heft* 1, pp. 55.

In other words, the annual rate of return on investment in farm real estate is between 1 and 1.5 percent. This means that from a purely economic viewpoint farm real estate is priced about four times higher than it should be for the investment return to be comparable to those in alternative investments. The cost of agricultural fundamentalism in Germany is extremely high.

This has some very important implications for future structural adjustment in German agriculture. First, as long as land market prices are so high relative to their comparable rental values, we should expect little increase in the market turnover of farm real estate. Even though the expansion buyer is willing to pay the market prices, it is difficult to accumulate enough wealth to purchase additional land in any quantity. Thus, expansion through purchase will not be of importance in altering farm structure during the next decade. The lease remains then as the most useful tool available to German farmers in their expansion attempts. Change in the number of tenant leases is doubtful, and even if it did occur, it would not significantly affect farm size structure since this form of lease covers only 5 percent of the total farms and 7.4 percent of the total agricultural land. The parcel lease, however, appears to be rapidly increasing in importance. Further, evolution of the lease laws, continued general economic growth providing employment alternatives for many small farmers, and increasing pressure on the large farms to expand to take advantage of new technology and use excess family labor should contribute to making the parcel lease play an even greater role in the future.

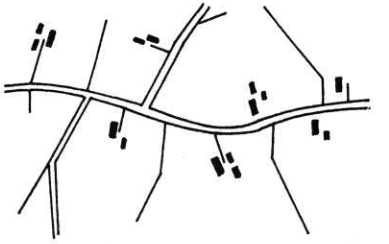
Rural Settlement

Another factor affecting production conditions in West German agriculture is the type of rural settlement. Differences in the types of settlements in various areas of the country can be traced primarily to the fact that colonization spanned many centuries and therefore the method of colonization differed in order to meet the needs of the times. The need for a common defense during periods of hostility created one type of settlement whereas during periods of peace and relative harmony another type prevailed. Also, natural and climatic conditions played their part in determining what type of settlement would best fit the needs of the inhabitants. The latest factor in the evolution of rural settlements is the industrialization of agricultural areas. Thus, a new type of settlement, city-like in appearance and structure has taken its place alongside the older forms.

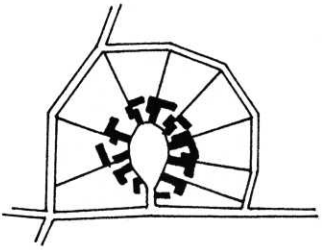
Agricultural settlements can be classified into two main types -- the village and the single farm. The most widespread type of settlement in West Germany is the clustered village of which three stages of development can be distinguished. The small loosely clustered village seldom has more than three or four hundred inhabitants and most nearly approximates the earliest type of German settlement. It has an asymmetric arrangement of farmsteads

Figure 3. German Farm Village Types

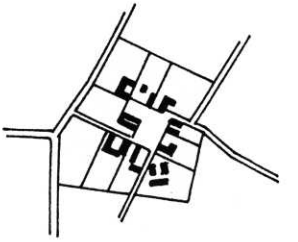
Cluster Village



Single Farmsteads

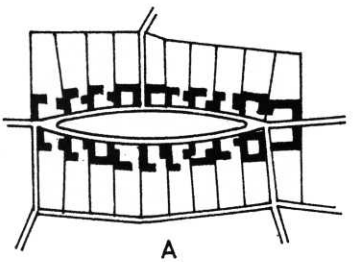


Pie Shaped Village

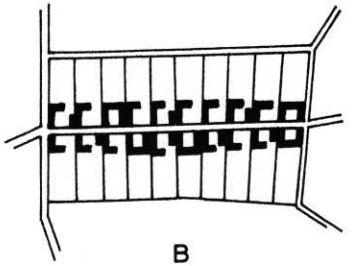


Cluster Village with Farmstead Adjacent to Land

Various Types of Strip Villages



A



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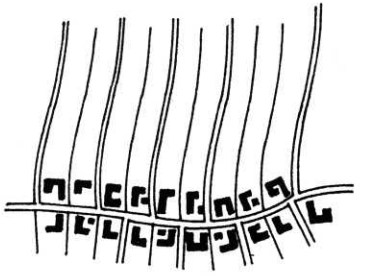
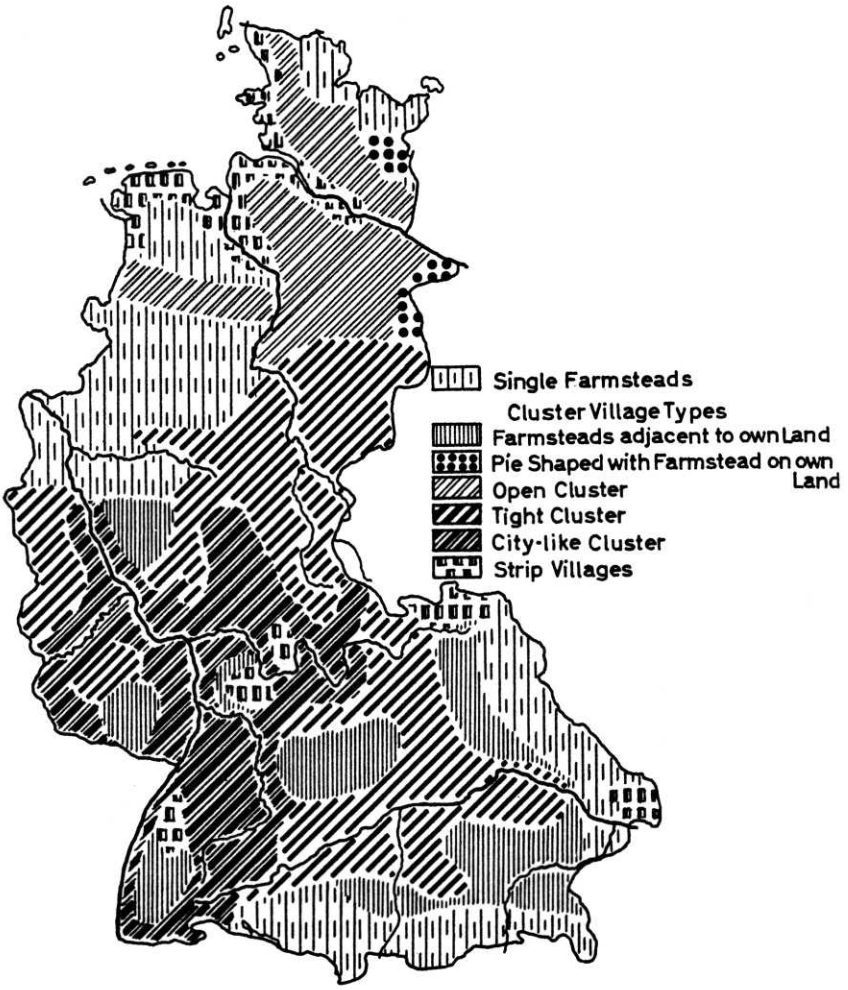


D

By Miller

Figure 8. Corn Production Regions for Grain in West Germany



and is found primarily in the less fertile regions of Niedersachsen and Schleswig-Holstein. (For this and other forms see Figures 3 and 4).

The closed clustered village has a population of up to one thousand with farmsteads in closer proximity to one another. This form predominates in southern Niedersachsen and Nordrhein-Westfalen, in northern Hessen, and in the village areas of Bayern.

The most recent stage of development is the industrial village with a population of three to five thousand. This type is dominant in the village areas of Baden Württemberg, western Bayern, southern Hessen, Saarland, and the major portion of Rheinland-Pfalz.

The main disadvantage in all of these types of villages is that the farms have no direct access to their fields. They differ, however, as to the extent each limits movement on the farmsteads. The loosely clustered village has the most room for freedom of action by individual farmers and in most cases there is sufficient room available for the extension of building capacity. Thus, of all the clustered village types, the loosely clustered village offers farmers the greatest opportunity to adapt to a new technology and plan for efficient production practices.

More serious problems of space limitations occur in the closed clustered village, and finally the industrial village places an impossible burden on farmers trying to adapt their farmsteads for efficient modern production. The industrial village is no longer a suitable location for commercial farms as it is so crowded that any expansion or modernization of the farmstead is out of the question.

As long as the techniques of production continued primarily at the hand labor stage and expansion of production was not a matter of survival, circumstances which threatened the very existence of the farmer seldom developed as the result of restricted space in these villages. Under present production conditions the space restrictions imposed by these villages offer a very real threat to the farmer's survival and resettlement outside of the villages appears to be the only long-run solution. Resettlement, however, is so expensive that to date only a small number of farms have been able to take this step.

A somewhat more desirable settlement than the cluster village is the strip village. The farmsteads in a strip village are situated in such a way that each has access to its own fields. This form affords much greater mobility and room for expansion than the clustered village type.

The most desirable type of settlement with respect to the innovation of modern technology is the single farm. Only a very few small areas in Germany can boast this type of settlement. Single farms are in part conditioned by topography and in part they represent secondary settlements originating between the tenth and fourteenth centuries, and again in the eighteenth century.

It is not possible to numerically verify the exact distribution of the various types of settlements. Figure 4, however, leads us to deduce that about half of the villages in Germany are either closed clustered or industrial villages. All types of clustered villages together comprise at least two thirds of the agricultural land leaving only one third for settlements which are more economically favored.[8]

Structural adjustment in German agriculture becomes very difficult and costly under these settlement conditions. With respect to today's markets, animal production enjoys a more favorable position than crop production. As a result of the disappearance of neighboring farms, possibilities for buying additional production factors are increasing. However, the majority of German farmers can take only partial advantage of their opportunities to expand production and then at a very high cost due to space limitations. Most farmsteads are so congested that remodeling is generally imperfect with respect to optimum labor efficiency and expansion in many cases is impossible. The only solution which seems feasible is that of resettlement or moving the farmstead out of the village onto its own land. But, the marginal costs of livestock herd expansion by this method are extremely high. The structural situation can change only over a long period of time since, as a rule agricultural incomes even with governmental aid are inadequate to meet the needs for this type of investment.

Buildings

The production difficulties arising from the type of settlement are compounded by the type of buildings presently composing the farmstead and the customs and institutional restrictions associated with them. As a result of the German climate, animal production requires adequate housing for protection during the major part of the year. Cost-price relationships in the feed-livestock enterprises make quite evident the need for well insulated buildings, particularly for pork and poultry production, in order to keep the feed conversion ratio as low as possible. Furthermore, most German farmers have a strong preference for very durable buildings. Finally, the laws pertaining to landscape preservation and the regulations of fire insurance companies call for specific and costly building constructions. It is not possible to estimate the average expenditure which results from these regulations since the requirements vary considerably from region to region and to a large extent depend on the method of handling by local authorities. Landscape preservation laws often require specific roof constructions, construction materials, and even colors. Fire insurance company regulations carry even greater weight. Building costs are increased by prescriptions for construction materials, type of electrical installations, and distance between and arrangement of buildings. In general, one can only conclude that the ad-

[8] H. Rämer, *Die Westdeutsche Landwirtschaft*, pp. 21.

ditional costs due to these institutional restrictions are considerable.

The above named factors along with low agricultural incomes have resulted in a slow adjustment of farm buildings to the needs of modern agriculture. According to Bothe, 75 percent of all farm buildings are in need of extensive modifications or total replacement in order to become fully efficient.[9]

A more detailed understanding with respect to building age and the need for new construction can be derived from the results of the 1960 agricultural census in Schleswig-Holstein.[10] Table 9 demonstrates that the age distribution of agricultural buildings is largely dependent on the use of the building. While at least 33 percent of the stalls and sheds for larger animals were built in the last century and only 14-20 percent between 1945 and 1960, no more than 12-14 percent of the housing for poultry and machinery was constructed before 1900 and about 40 percent between 1945 and 1960. The age of a building does not necessarily reveal the condition of its structure or its value for production. However, since technological developments continually change, the functional requirements of these buildings also change and in only a few cases can the older structures be adapted by means of slight renovation and new installations to fit modern technological needs for efficient production.

Land Fragmentation

The types of settlements not only have a direct influence on the labor requirements and the limits of possible expansion of production on the farm, but also have a direct relation to the characteristics of the land holdings. These characteristics include extent of fragmentation, average distance between farmstead and fields, and the shape of the fields. Those areas with single farms as a rule have model land holding characteristics. These characteristics tend to deteriorate in quality as we move to the strip village and on to the clustered village types of settlements. In most strip villages the land holdings are only slightly fragmented and are normally easily accessible even though the length of strips may prove at times to be disadvantageous. Isolated cases of strip village land divisions from which very narrow parcels of land resulted are also found.

The most unfavorable conditions with respect to the characteristics of land holdings are found in the clustered villages. The method of land allocation at the time of original settlement and the inheritance customs and laws are the two principal factors involved in creating this unfavorable situation. Normally at the time of original settlement farmers worked together as a group to clear specific areas of land surrounding the village. Once a piece of land was cleared, it was divided among those who did the work. Over time

[9] H.G. Bothe, *Grundlagen der Agrarstruktur in der BRD, in Berichte über Landwirtschaft Band* 43, 1965.

[10] *Die Gebäude in der Landwirtschaft Schleswig-Holstein, Statistische Monatshefte Schleswig-Holstein, 17 Jahrgang, Heft* 11, 1965.

Table 9 Age of Farm Buildings [1] in Schleswig-Holstein - 1960

Use of Buildings	Number of Buildings	Out of Total were Built . . .			
		Before 1900	1900-1914	1915-1944	1945 and later
	Total	% of all buildings			
Cattle and Horses	11,249	33	24	24	20
Pigs	10,395	39	27	20	14
General Purpose (Cattle, Horses, Pigs, Sheep and Hay and Straw)	9,074	31	23	26	20
Hay and Straw	14,874	31	20	27	22
Poultry	7,304	12	9	39	41
Machinery	21,889	14	15	32	40

[1] In farms greater than 2 hectares agricultural land.

Source: *Die Gebäude in der Landwirtschaft Schleswig-Holstein.* *Statistische Monatshefte Schleswig-Holstein.* 17th Edition, *Heft* 11, 1965, pp. 254.

as more and more of the land surrounding the village was cleared, each farmer acquired a piece of each new clearing. Fragmentation of individual holdings resulted.

The inheritance custom of dividing the estate equally among the heirs perpetuates and enhances fragmentation. This type of inheritance custom is found primarily throughout Baden Württemberg, Saarland, Rheinland Pfalz and in the southern areas of Nordrhein-Westfalen and Hessen and in the northernmost areas of Bayern. Throughout the rest of Germany with some local exceptions, the inheritance custom operates in such a way as to maintain the estate as a unit when it is passed on to the heirs.

Until the twentieth century, the agricultural disadvantages of small and widely scattered, irregular fields were relatively unimportant. Previous to this time, the fields of a whole community had a common crop rotation program necessitated by the fact that livestock grazed on the fallow land so the land with crops had to be protected against the animals. This did not allow intensive individual cultivation practices. With an increase in mechanization and more intensive cultivation, restrictions imposed by fragmentation became more apparent and finally threatened the very existence of numerous farmers. Estimates of labor and capital waste on strongly parceled farms vary between 40 and 120 percent.[11]

The degree of fragmentation ranges widely between areas. The most extreme fragmentation of holdings in all of West Germany in 1960 was found in a region of north Bavaria where 22 percent of all the farms were splintered into more than 50 pieces of land and the average size of each fragment for all farms in the area was only .21 hectares. Table 10 depicts the degree of fragmentation in West Germany by farm size in 1960. The smaller farm size groups reflect conditions in southern Germany while the larger farm size groups reflect northern German conditions with their different inheritance laws and types of settlement. The farm size group with 7.5 to 10 hectares has the most fragmentation of the land holdings.

Marginal Land Use

With increased costs of production and without a comparable increase in farm prices -- the situation expected in Germany under the Common Agricultural Policy -- several areas are subject to becoming submarginal. These include the very sandy soils in northern Germany and the shallow, stony soils in parts of the mountain regions in central and southern Germany. Poor drainage conditions in northern Germany and short growing periods in the mountain regions contribute greatly to making these areas submarginal. Improvements in drainage and reclamation programs would be useful in some cases. In fact, a number of extensive reclamation programs were undertaken since World War II.

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[11] W. Abel, *Agrarpolitik*, pp. 266.

In Niedersachsen, these more than compensated for the agricultural lands lost to urban uses until after 1960. In these areas, considerable land reserves still exist. Niedersachsen had approximately 125,000 hectares of uncultivated moor land in 1963, most of which could be reclaimed. Bayern had 29.000 hectares of moor land but provisions have been made to use large sections of this as natural parks.[12]

Table 10. Percent of Farms by Farm Size Group With Various Numbers of Land Parcels in West Germany in 1960.

Number of Land Parcels Per Farm[1]	Farm Size Group in Hectares						
	.01-<2	2-<5	5-<7.5	7.5-<10	10-<20	20-<50	50-over
5 or less	74	42	31	28	31	40	46
6-10	19	25	26	26	27	29	27
11-20	6	22	23	23	22	21	20
21-30	1	8	11	11	10	5	4
31-50	0	3	7	8	7	3	2
over 50	0	0	2	4	3	2	1

[1]Parcels separated by some distance, not only by roads, ditches, or fences

Source: Peter C. von Harder, *Wirtschaftliche Voraussetzungen und Entwicklungslinien der Mechanisierung in der Landwirtschaft der Bundesrepublik Deutschland seit* 1949, *Berichte über Landtechnik*, Vol. 85, 1965.

Another important factor in causing some areas of West Germany to become submarginal is slope. According to Rühmann, mechanized methods of crop production will be noticeably hindered on fields of 6-10 percent slopes.[13] Compared with level areas, fields with 19 to 21 percent slope require an additional 22 percent labor in grain cultivation and 40 percent greater labor requirement in potato and sugar beet cultivation. Slopes greater than 21 percent result in progressively increasing labor requirements or in other words a lower order of mechanization. For more detail, see Table 11. The economic limit to slope mechanization depends on existing wage levels as well as the alternative possibilities for mechanization of the different crops. The technical limit for the highest stage of mechanization occurs at a 15 percent slope for beet crops, 20 percent slope for potatoes and a 25 percent slope for grain, forage, and hay. In general, the more intense the land utilization, the greater the disadvantage of slope to cultivation. In other words, the greater the slope the more extensive the type of cultivation possible.

[12]H.G. Bothe, *Grundlagen der Agrarstruktur in der BRD, in Berichte über Landwirtschaft Band* 43, 1965, pp. 435.

[13]H. Rühmann, *Landmaschineneinsatz im Hanggelände, Agrarjahr* 1965, *Würtzburg* 1965.

No agricultural land classification by the degrees of slope gradation is available for the total of West Germany. But statistics for the state of Hessen are available.[14] According to these statistics, 19 percent of the agricultural land in Hessen has a slope of between 10 and 20 percent, 5 percent of the land has a slope between 20 and 30 percent and 1 percent has a slope of over 30 percent. We can conclude from this that mechanized methods of cultivation in Hessen are notably if not greatly impaired on at least 25 percent of the agricultural land. On at least 6 percent of the arable surface, the employment of harvest machinery of a high order of mechanization for root crops is practically out of the question, while other types of cultivation can be accomplished only with increased labor costs. One can count on this land being either totally excluded from agricultural use by 1975 or only used in an extensive way such as pasturing.

Table 11. Influence of Slope on the Labor Requirement in Cultivating Various Crops (Labor requirement on level land = 100)

Slope in Percent	Grain	Fodder Beets	Sugar Beets Potatoes	Hay
7-9	101	102	102	101
10-12	102	108	109	105
13-15	106	116	117	114
16-18	112	128	130	126
19-21	122	135	140	142
22-24	138	---	---	160
25-27	156	---	---	181
28-30	---	---	---	192

Source: H. Rühmann, *Die Erschwerungmotorischer Arbeiten am Hang in Bayerisches Landwirtschaftliches Jahrbuch*, SH4, München-Basel-Wien, 40. Jg. 1963.

With the rising cost of labor, land with 10 to 20 percent slope gradation will tend toward more extensive uses such as grain and grass. The more unfavorable the climatic and other natural conditions and the more favorable the general economic conditions outside of agriculture, the greater the possibility for the exclusion of this land from agricultural production.

We have shown above that 6 percent of the agricultural land in Hessen has a slope of over 20 percent. Looking at regional topographical maps, and considering the different portions of agricultural land in these regions we can roughly estimate that the figures which apply to Hessen also apply in

[14] S. Sabarth, *Gegenwärtige und Zukünftige Richtbetriebsgrössen und-Organisationen landwirtschaftlicher Familienbetriebe in Hessen*, AVA in Hessen *Sonderheft 17*, Wiesbaden 1965, pp. 34.

Rheinland-Pfalz, Saarland, Baden Württemberg and Bayern. Nordrhein-Westfalen and Niedersachsen are affected by unfavorable slope conditions primarily in their southern regions. On this basis, we estimate that 3 percent of the agricultural land in Hessen, Rheinland-Pfalz, Baden Württemberg and Bayern will be excluded from agricultural production due to excess slope by 1975 while only 1.5 percent in Nordrhein-Westfalen and only .5 percent in Niedersachsen will be affected.

The government is offering an alternative use for some of the land which will become submarginal because of slope. Under certain conditions, subsidies amounting to 110 to 450 dollars per hectare were made available in 1965 through the Green Plan for reforestation.[15] Official estimates in 1965 showed that approximately 500 thousand hectares of agricultural land are no longer suited for agricultural usage but only 300 thousand are capable of forestation. If this program is to be completed, the pace must be greatly increased because since 1950 only 80 thousand hectares have been planted to forest.[16] As the pressure for mechanization increases on German farms the forestation alternative on this marginal land will become more attractive.

Programs to Correct Agricultural Structure

Efforts to reduce fragmentation through consolidation have been in effect for centuries. Some of these programs were voluntary and some forced by the landed nobility. Consolidations in northern Germany were quite successful as evidenced by the large farms and less fragmentation presently found in that area. Since World War II and in particular since the introduction of the Green Plan in 1956, efforts to improve agricultural structure have greatly increased. In addition to the attention directed toward consolidation, more and more attention is being directed to improvement of farm structure through enlargement of small farms. The goals of the Green Plan are (1) to improve the efficiency of German agriculture, (2) to increase its competitive position as it moves toward the Common Market, and (3) to improve economic and social conditions relating to agriculture to such an extent that persons employed in agriculture may participate equally in the total economic development.[17] The concept of the Green Plan structural reform program includes consolidation of parcels, improvement of routes of access, ditches and drainage, soil improvement, moving of farmsteads from villages onto the outlying fields, and improvement of existing farmsteads in the villages. These measures are accomplished through help in centralized planning, direct subsidies, and interest free or low interest rate long-term credit.

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[15] *Grüner Plan* 1965, pp. 57ff.

[16] *Landtechnik Heft* 20, *München* 1965 *Halbmonatlicher Überblick.*

[17] *Grüner Plan*, 1960 and 1965, pp. 3.

During the past ten years, the number of hectares embraced by the structural program annually has increased from 200 thousand to 300 thousand hectares.[18] Despite all the efforts of the farmer and the government, the present rate of structural improvement in agriculture is not fast enough to insure successful adjustment to present economic conditions and the Common Market.

A 1965 Ministry of Agriculture estimate shows that 46 percent of the agricultural land in Germany is in critical need of some type of structural program immediately.[19] If, as in the past, only 250-300 thousand hectares come under the program annually in the future, then at least 25 to 30 years will be needed to restructure those farms which are presently in critical condition. Obviously, the present rate is too slow.

While fragmentation is a problem throughout Germany, it is less so in the north than in the south. Therefore, the structural program emphasis in Schleswig-Holstein, Niedersachsen and Nordrhein-Westfalen includes drainage reclamation and access route programs, whereas in all of the southern states consolidation is by far the most important program. Table 12 shows the number of land owners and land plots involved in consolidation programs in 1964 by state. The southern states begin with smaller average-sized plots and a greater number of land owners and plots in the program. The last column of the table indicates that the increase in size of plot through consolidation is twice as great in the southern area than in the northern states.

Since consolidation can be justified only if it improves the conditions for production, long-range success can be achieved in many cases only through the enlargement of farms now too small to be efficient. Within the framework of the Green Plan, some 43 thousand farms have been enlarged between 1956 and 1964.[20] Until recently consolidation has been the primary action program along with an accompanying effort to improve farm traffic conditions. Recently more and more voices are heard calling for a program which will result in an improvement of the total economic structure of a region.[21] The high subsidies coming from public funds along with the small number of farms aided will probably result in some curtailment in the future of the more individualistic programs in favor of those which have a wider range and effect.[22] In villages where space is less restricted, programs to build new and recondition old farmsteads are operating. At present it is difficult to say how much self help is being attempted with those resources the individual

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[18] *Grüner Bericht*, 1965.

[19] *Die Flurbereinigung in den Ländern der BRD. Jahresbericht* 1962, BLEF, Bonn, pp. 19.

[20] *Grüner Plan*, 1965, pp. 6.

[21] *Agra-Europe*, 25 January 66, *Länderberichte*, pp. 4.

[22] E. E. Lipinsky, *Agrarstrukturverbesserung und Bodenmobilität, in Agrarwirtschaft*, Jg. 12, *Heft* 10, 1963, pp. 322.

Table 12 Number of Land Owners and Land Plots Involved in the Land Consolidation by States -1964

State	Number of Land Owners		Number of Land Plots		Average Size of Plots in Ha		Consolidation Ratio 1:
	Before Consolidation	After Consolidation	Before Consolidation	After Consolidation	Before Consolidation	After Consolidation	
	(1)	(2)	(3)	(4)	(5)	(6)	(Col. 6/Col. 5)
Schleswig-Holstein	3396	3333	20733	11366	1.36	2.48	1.8
Niedersachsen	4197	3887	22278	12091	0.95	1.75	1.8
Nordrhein-Westfalen	9871	9586	56687	28332	0.62	1.24	1.5
Hessen	14441	13582	114288	40463	0.31	0.88	2.8
Rheinland-Pfalz	25175	22953	196984	57577	0.15	0.50	3.3
Baden-Württemberg	19027	17895	138578	44137	0.22	0.70	3.2
Bayern	19500	17355	213262	63369	0.33	1.12	3.4
Saarland	2628	1795	25246	6539	0.09	0.33	3.7
West Germany	98235	90386	788056	263874	0.32	0.96	3.0

Source: *Die Verbesserung der Agrarstruktur in der Bundesrepublik Deutschland 1964-65*, Published by: *Der Bundesminister für Ernährung, Landwirtschaft und Forsten*, Bonn, 1965, pp. 39.

farmer has at his command. Evidence does indicate, however, that progressive farmers everywhere are doing extensive remodeling of existing buildings. These efforts have been supported with public funds since 1959. By the end of 1964, 9 thousand farms were participating in this program with 50 percent of the total located in Bayern. The average cost per farm ran to 20,500 dollars. State help was primarily in the form of low cost credit, and the granting of aid was closely tied to certain self-help requirements.[23]

The total volume of capital credit made available by the Green Plan at lower interest rates amounted to 475 million dollars at the end of 1964. Since under the Common Agricultural Policy of the EEC the individual countries will become completely deprived of a price and subsidy policy with the goal of improving farm income, it is probable that policies relating to structure will be strengthened as main individual country contributions to the long-range goals of agricultural policy. More efficient production techniques undoubtedly can reduce the cost of production considerably. Specialization is regarded as one of the most efficient ways to reach this goal. The major barriers to this type of adjustment include: (1) the large number of farms with low level production; (2) a substantial surplus of labor in agriculture which can only be reduced significantly by also reducing the number of farms; and (3) the necessity for those who continue farming to purchase the factors of production from those who leave in order to improve income and production potentials. This requires large quantities of capital not available to most farmers. If the government provides funds for these purposes without taking parallel measures to reduce the overall number of farms; production, particularly in certain livestock enterprises, will quickly exceed demand. In 1965, an extensive study of this problem was made by Weinschenck and Meinhold[24] who proposed that agricultural policy should aim at: (1) reduction of overall number of farms and persons employed in agricultural production; (2) provision of efficient farms with enough funds so that they will be able to take full advantage of their production potential; (3) retention of Germany's present share of the agricultural market; (4) provision of better education and extension for the farmer; and (5) provision of equal social security within the country and within the EEC.

In order to estimate the capital needs for such a policy, the authors postulated a model for which they made the following assumptions: (1) Income of future full-time farms should amount to at least 10 thousand DM annually and would require 7-18 hectares of agricultural land under assumption A or

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[23] *Die Verbesserung der Agrarstruktur in der BRD*, 1964-65, BLEF, Bonn, pp. 67.

[24] G. Weinschenk und K. Meinhold. *Vorschläge zür künftigen agrarpolitik in der BRD. Gutachten erstellt im Auftrage de Wirtschaftsrats der CDU*, Stuttgart-Höhenheim 1965.

Table 13 Estimated Capital Needs for an Agricultural Structural Consolidation Program in West Germany in Billion Dollars

Year	Low Prices for Land Transfer ($37.50/Ha rental-$3750/Ha Sale)		High Prices for Land Transfer ($75/Ha rental-$6250/Ha Sale)	
	90% rented 10% bought	10% rented 90% bought	90% rented 10% bought	10% rented 90% bought
	Annual Capital Needs for 10,000 DM Annual Income (Assumption "A")			
1965	1.04	1.60	1.20	2.12
1970	1.02	1.57	1.18	2.06
1975	0.92	1.39	1.06	1.81
	Annual Capital Needs for 15,000 DM Annual Income (Assumption "B")			
1965	1.32	2.10	1.56	2.82
1970	1.30	2.06	1.53	2.74
1975	1.16	1.80	1.35	2.38

Source: G. Weinschenck and K. Meinhold: *Gutachten zür künftigen Agrarstrukturpolitik der Bundesrepublik Deutschland.* Stuttgart-Höhenheim 1965.

15 thousand DM and require 10-27 hectares of agricultural land under Assumption B. (2) Farms which employ the operator full time but do not yield an income of at least 10 thousand DM under Assumption A or 15 thousand DM under Assumption B become transitional farms and must either move up the income scale to become full-time farms or move down the scale and become part-time farms. (3) Future part-time farms will average 1 to 2 hectares of agricultural land, will keep no cattle, and will limit the number of pigs to the number they kept in 1960. (4) The land from transitional farms which comes to the market will be distributed by sale or rent so that the highest possible number of farms will be maintained.

According to the criteria which the authors suggest, there were about 538 thousand part-time farms in 1965 with more than 2 hectares of agricultural land and some 625 thousand full-time and transitional farms. Out of the latter group, according to Assumption A, there were 330 thousand transitional farms and according to Assumption B, 435 thousand. In accordance with Assumption B, 400 thousand full-time farms will be found in 1975, 4.3 million hectares of land will change hands through lease or sale to accomplish this, and at the same time a large number of cattle will have to change hands. Table 13 shows the annual capital requirement to effect this type of program under Assumptions A and B with further assumptions about the land price and the ratio of rented to bought land under the program. The low prices for land transfer assumptions include $37.50 per hectare rental price and $3,750 per hectare sale price. The high price land transfer assumptions include $75.00 per hectare rental cost and $6,250 per hectare sale price.

The estimates for land sale prices are in our opinion too high if the lease prices in each price group are correct. Since it is more than likely that the greatest portion of transferable land will be leased rather than sold, the sale price in the assumption of 90 percent leased, 10 percent sold does not weigh heavily. We also find Assumption B more plausible than Assumption A in that an income of $3,750 in 1975 for full-time farms does not appear to be more than a minimum considering present growth rates. In Table 13, this puts us in the lower half under the 15 thousand DM annual income assumption and in the first columns of the different price assumptions under 90 percent rented, 10 percent bought in both cases. Assuming the actual situation to be bracketed by the low and high price assumptions for the land transfer, we can estimate that the annual capital need for structure adjustment between 1965 and 1975 according to the model should amount to about 1.25 billion dollars. The 1965 Green Plan budget amounted to only .675 billion dollars and about half of this was allotted to structural reform measures of the type which the Weinschenck-Meinhold model discusses. Even with a stronger national structural policy program, it is highly unlikely that the total budget level can be raised to meet this requirement. Thus, the rate of agricultural-structural change assumed in the model is not likely to be found in ac-

tual practice. It follows then that farm incomes will not meet the desired objective, and the number of transitional farms along with the production of part-time farms will be reduced at a slower rate than assumed and total livestock production, particularly pig and poultry, will tend to increase at a faster rate than assumed in the model. If the decrease in the number of farms would take place as assumed but capital were short, not all of the factors of production could be transferred to the farms which stay in business and the German market share would drop. This is particularly true for livestock production. If the German market share drops, the gap would probably be filled by both other EEC countries and third countries depending upon the product.

Summary

One of the main problems facing German agriculture in the next decade is that of adjusting to remain competitive under the economic conditions imposed by the adaptation of the Common Agriculture Policy of the EEC. An important facet in this adjustment is the ability to efficiently utilize available farming methods and modern technology. With respect to the real estate component of agricultural production factors, major deterrents to efficient adjustment include the high market prices and low sales turnover rate of farm land, a relatively thin rental market, a high degree of fragmentation of land holdings, a village farmstead structure which inhibits expansion, and farm buildings of a very durable nature which were built for a past age of farming and are economically costly if not technically impossible to adapt to modern production techniques.

Present levels of farm income do not generate enough capital for farmers to adjust through increasing farm size, land consolidation, and farmstead improvements at the rate necessary to efficiently compete in the Common Market. Government structural programs, although effective, are also inadequate and will remain so even though the amount of assistance will probably increase.

The farm land rental market appears to be the brightest star on the horizon for improving farm structure both in terms of increasing farm size and decreasing fragmentation to the extent that percels adjacent to owned land become available for rent. Movement away from the village farmstead structure is too costly for individual farmers and even with governmental assistance it cannot be accomplished on a large scale.

Thus, the needed wholesale restructuring of the real estate input in German agriculture will not be accomplished in the next decade. If general economic conditions remain favorable, the pace of restructuring during the next 10 years will be at least as fast as during the last 10 and probably somewhat faster.

Chapter 3

Production Effects of Farm Structure

Introduction

In order to develop the supply projections of crop and livestock production found in later chapters, several causal factors must be analyzed. In the last chapters, one of the variables which was shown to be an important limitation to change was farm structure.[1] The primary reasons for farm size being such an important variable include the different amounts and sources of the available labor supply and the ability -- technically and financially -- to mechanize to different levels. In general, the larger the farm the greater is the possibility to use the more sophisticated mechanical technology and, therefore, the crops grown on these farms are those which more readily lend themselves to mechanized production. Conversely, the smaller the farm, the more operator and family labor available at a low opportunity cost for highly intensified production methods using hand labor. Thus, these farms tend to produce labor intensive crops and livestock not so adaptable to mechanization. Therefore, farm size becomes an important limiting factor affecting individual farm crop and livestock patterns. Within any given region, the total number of hectares in that region devoted to a given crop and the size and structure of the livestock population, therefore, are closely related to the distribution of farm sizes in the area.

Change in Farm Structure

Farm numbers by farm size group then appear to be an important factor to analyze with respect to its influence on agricultural production. One approach in this analysis is to predict farm numbers by farm size group and to measure the impact of this shift in farm structure on crop and livestock patterns. Actually the relevant statistic in this case is the number of hectares of the total in the region in each of the farm size groups. These can be obtained directly in the statistics and projected independently of the farm numbers. Both sets of projections will be made, however, because the farm number projections will afford at least a loose independent check of the hectare projections.

Once the hectare projections are completed and the cropping pattern on the different farm size groups established for a base period, the change in

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[1] By farm structure, we mean primarily the size distribution of farms in terms of land area. But, we also include such factors as extent of fragmentation, distance from farmstead to field, quality and sufficiency of access routes within the farm and from farm to market, farmstead layout and building capacity and adequacy. We will use the farm size variable as a proxy for farm structure since data are more readily available and since most of the other structural variables can be expected to correlate quite closely with size.

hectares devoted to a given crop associated with change in farm size structure can be estimated. The assumption implicit in these projections is that the factors influencing farm size change at a constant percentage rate into the future based on their behavior during the known base period. The projection method does not force a linearity assumption but does assume a constant rate of nonlinearity. Influencing factors include such variables as the rate of labor exodus, capital availability for technological innovation, the rate of growth of the general economy, the level of employment in the general economy, the availability of inventive technology, and governmental policy affecting credit and structural programs. With respect to the base period 1960-1965, we are assuming for the projections a slight decline in the rate of increase in GNP, a relatively constant rate of labor exodus, credit available at continued favorable terms, continued employment opportunities in the nonfarm economy, and a strong government structural policy. These assumptions are analyzed in greater detail elsewhere in the study. The procedure used for projection is an adaptation of the Markov chain technique.[2]

Table 14 presents the historical development from 1955 and projections to 1970 and 1975 for farm numbers by farm size group in each of the eight German states and national aggregates for the total country. Table 15 presents the results of the hectare distribution projections by farm size group for the eight state and aggregated totals for West Germany.

With respect to numbers of farms, we find a historical decrease in all states and the projections continue this decline at a somewhat slower rate. Table 16 presents the percentage decrease in farm numbers in each state for the five year intervals between 1955 and 1975. A large variation in the rate between individual states is evident. The more industrialized states of Nordrhein-Westfalen, Hessen and Rheinland-Pfalz have the greatest rate of decrease in farm numbers. Off farm job opportunities, particularly for the young, are more readily available in these areas. In most cases, taking the nonfarm job will mean moving to the city but the farm family is close enough for weekend visits making the break from farming more attractive from the social as well as economic point of view.

The northern states of Schleswig-Holstein and Niedersachsen are experiencing a somewhat slower decline in farm numbers. The greater distance from industrial job opportunities coupled with an already larger farm size partially accounts for the lower rate of decrease.

The southern states of Baden-Württemberg and Bayern also show a relatively low rate of decrease in farm numbers. Bayern has lagged behind the rest of West Germany to some extent in industrial development and therefore has not provided the nearby industrial job alternatives found elsewhere.

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[2]The Markov chain process and its use in projecting farm numbers and farm hectares by farm size group to 1970 and 1975 is explained in Appendix C.

Table 14

Number of Farms by Farm Size Group by State in West Germany
1955-1965 with Projections to 1975

Land / Year	Farm Size Groups in Hectares .5 - <2	2 - <5	5 - <10	10- <20	20- <50	50 - up	Total
Schleswig-Holstein							
1955	12,662	10,652	8,621	14,542	17,063	3,503	67,043
1960	10.823	8,687	7,066	13,512	18,032	3,679	61,799
1965	10,291	7,274	5,700	11,810	18,817	3,754	57,646
1970	9,936	6,307	4,551	9,810	19,468	3,933	54,005
1975	9,700	5,469	3,633	8,149	20,016	3,992	50,959
Niedersachsen							
1955	80,920	58,486	51,191	51,777	31,713	5,215	279,302
1960	65,859	45,752	41,654	53,731	34,943	6,053	247,992
1965	55,245	38,401	33,814	50,365	38,366	6,595	222,786
1970	48,455	34,750	27,448	46,892	41,728	6,958	206,231
1975	42,500	31,447	22,280	43,651	44,828	7,352	192,058
Nordrhein-Westfalen							
1955	78,453	54,332	41,772	35,456	19,280	2,702	231,995
1960	62,402	44,463	36,490	38,027	20,876	2,749	205,007
1965	49,178	36,665	30,266	37,826	22,393	2,814	179,142
1970	39,400	30,804	23,990	36,814	23,787	2,986	157,781
1975	31,566	25,880	19,016	35,736	25,131	3,169	140,498
Hessen							
1955	77,759	56,532	34,029	20,252	4,010	645	193,227
1960	58,192	44,754	28,963	23,430	4,577	600	160,516
1965	40,632	35,452	23,197	23,976	6,160	590	130,007
1970	26,739	28,254	17,517	22,578	10,267	609	105,964
1975	17,596	22,511	13,227	21,037	14,083	671	89,125
Rheinland-Pfalz							
1955	76,458	65,314	39,589	14,448	2,261	295	198,365
1960	62,339	48,580	35,405	19,506	3,159	291	169,280
1965	50,488	37,171	28,803	22,110	5,056	292	143,920
1970	41,559	29,675	22,502	22,337	8,473	309	124,885
1975	34,208	23,691	17,579	21,840	11,906	335	109,559
Baden-Württemberg							
1955	137,526	117,845	75,867	34,102	8,096	850	374,286
1960	116,007	90,373	70,974	39,082	8,393	671	325,500
1965	110,771	77,795	61,842	42,226	9,491	683	302,808
1970	106,281	75,793	50,949	43,838	11,224	957	289,042
1975	103,954	73,842	41,974	43,345	12,823	1,336	277,274
Bayern							
1955	89,973	124,299	131,197	91,991	31,635	2,617	471,712
1960	75,927	100,171	121,098	98,074	31,890	2,398	429,558
1965	62,702	84,006	106,892	102,164	33,861	2,322	391,947
1970	53,155	73,975	90,524	104,158	35,488	2,548	359,848
1975	45,061	65,138	76,663	105,149	37,148	2,795	331,954
Saarland							
1955	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1960	16,425	5,969	2,119	1,675	426	49	26,663
1965	13,624	4,990	1,834	1,574	822	59	22,904
1970	11,458	4,259	1,605	1,465	1,189	88	20,064
1975	9,636	3,635	1,403	1,348	1,515	130	17,667
West Germany							
1955	553,751	487,460	382,266	262,568	144,058	15,827	1,815,930
1960	467,974	388,749	343,769	287,037	122,296	16,490	1,623,514
1965	392,931	321,754	292,348	292,051	134,967	17,109	1,451,160
1970	336,983	283,817	239,086	287,892	151,624	18,388	1,317,790
1975	294,221	251,613	195,775	280,255	167,450	19,780	1,209,094

Table 15
Number of Hectares by Farm Size-Group by State in West Germany
1955-1965 with Projections to 1975 (in 1,000 Hectares)

Land	Farm Size Group in Hectares						
Year	.5- <2	2 - <5	5 - <10	10- <20	20- <50	50 - up	Total
Schleswig-Holstein							
1955	14.5	34.3	63.1	213.9	523.2	305.6	1,154.6
1960	11.9	27.9	52.2	203.6	551.1	317.1	1,163.8
1965	11.0	23.5	41.9	180.0	574.9	323.7	1,155.0
1970	10.4	22.1	34.6	151.3	599.3	329.6	1,147.3
1975	10.0	20.9	28.8	127.0	616.8	335.7	1,139.2
Niedersachsen							
1955	86.8	192.6	370.3	723.3	949.2	421.2	2,743.4
1960	69.5	150.3	305.7	765.1	1,046.5	476.3	2.813.4
1965	58.1	125.2	247.7	731.4	1,145.1	514.1	2,821.6
1970	51.9	115.7	209.0	657.7	1,245.2	542.2	2,821.7
1975	45.9	105.7	176.5	582.2	1,316.0	567.3	2,793.6
Nordrhein-Westfalen							
1955	86.5	176.2	300.0	496.3	563.0	211.7	1,833.7
1960	67.9	144.6	266.3	537.2	606.5	213.3	1,835.8
1965	53.0	119.2	220.8	542.1	645.7	218.1	1,798.9
1970	41.0	97.6	170.7	530.9	698.6	231.1	1,769.9
1975	31.8	79.4	132.9	526.1	726.0	245.3	1,741.5
Hessen							
1955	79.5	183.4	241.6	274.1	106.9	66.8	952.3
1960	61.0	146.0	208.9	320.0	120.7	59.9	916.5
1965	43.4	116.2	166.6	338.9	159.9	58.4	883.4
1970	26.4	84.6	114.3	299.5	272.0	60.1	856.9
1975	16.4	61.3	82.1	256.1	357.7	66.1	839.7
Rheinland-Pfalz							
1955	94.7	252.3	309.0	190.1	61.5	23.3	930.9
1960	68.1	160.2	254.1	261.7	83.1	22.9	850.1
1965	54.3	122.6	207.4	304.7	131.0	23.0	843.0
1970	44.5	103.3	167.4	304.4	196.6	23.0	839.2
1975	36.4	87.0	136.1	291.0	261.9	23.2	835.6
Baden-Württemberg							
1955	148.2	390.4	525.4	461.3	218.9	86.5	1,830.7
1960	123.6	301.2	505.1	529.5	223.2	60.6	1,743.2
1965	116.5	257.6	444.5	579.4	249.1	61.8	1,708.9
1970	111.8	243.8	365.5	595.9	285.1	87.2	1,689.3
1975	108.7	229.7	302.0	589.2	319.3	121.0	1,669.9
Bayern							
1955	101.6	428.2	936.6	1,274.2	870.5	235.3	3,846.4
1960	83.6	346.7	881.3	1,357.9	871.2	206.6	3,747.3
1965	68.8	291.1	782.1	1,423.6	915.6	194.5	3,675.7
1970	58.9	253.6	658.4	1,460.1	978.3	220.8	3,630.1
1975	50.3	220.9	555.9	1,465.4	1,042.3	250.4	3,585.2
Saarland							
1955	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1960	17.0	18.4	15.1	23.3	11.0	4.2	89.0
1965	14.0	15.4	12.8	22.5	22.6	5.0	92.3
1970	10.9	12.1	10.2	19.3	31.9	7.0	91.4
1975	8.4	9.6	8.0	15.9	38.7	9.8	90.4
West Germany							
1955	611.8	1,657.4	2,746.0	3,633.2	3,293.2	1,350.4	13,292.0
1960	502.6	1,295.3	2,488.7	3,998.3	3,513.3	1,360.9	13,159.1
1965	419.1	1,070.8	2,123.8	4,122.6	3,843.9	1,398.6	12,978.8
1970	355.8	932.8	1,730.1	4,019.1	4,307.0	1,501.0	12,845.8
1975	307.9	814.5	1,422.3	3,852.9	4,678.7	1,618.8	12,695.1

While industrial activity is increasing the opportunities are for more skilled jobs. This along with the traditional rural outlook and strong value placed on individual enterprise and property ownership found in this area caused us to project a nearly constant rate of decrease in farm numbers during the next decade.

Table 16. Percentage Decrease in Farm Numbers By State and Five Year Period in West Germany, 1955-1975.

State	Time Period			
	1955-1960	1960-1965	Projected 1965-1970	Projected 1970-1975
Schleswig-Holstein	7.8	6.7	6.3	5.6
Niedersachsen	11.2	10.2	7.4	6.9
Nordrhein-Westfalen	11.6	12.6	11.9	10.9
Hessen	16.9	21.3	18.5	15.9
Rheinland-Pfalz	14.7	14.9	13.2	12.3
Baden-Württemberg	13.0	7.0	4.5	4.1
Bayern	8.9	8.8	8.2	7.8
Saarland	n/a	14.1	12.4	11.9
West Germany Average	10.6	10.6	9.2	8.2

Source: Own calculations from Table 14

In Baden-Württemberg, we also find a strong property ownership value and rural tradition. But, in addition, we find a heavy concentration of atomistic industry located throughout the state affording off-farm job opportunities within easy commuting distance of the farm home. Thus, we project a very low rate of farm disappearance in the next decade but a large shift to part-time farms which will slow the rate of decrease in number of farms in the below 10 hectare size groups.

Turning to the shifts of farms between size groups, we find the number of farms increasing in all states in the 20 hectares and over categories and decreasing in the .5-<10 hectare category. In Hessen, Rheinland-Pfalz, Baden-Württemberg, and Bayern the 50 hectare and over size group lost farms during at least part of the base period. During that time, governmental policy was directed toward providing farms for as many farmers as possible partly due to the large influx of East German refugee farmers. Thus, many large estates which were state or local community owned as well as some church owned estates were divided into smaller farms. The policy is no longer in effect so the 50 hectare and over category is growing again.

The 10-<20 hectare size group is worthy of special note because it is the transitional class. Schleswig-Holstein has the largest average size farms and we find the 10-<20 size group losing farms throughout the time period. In all of the states except Bayern, we find a turning point in the size group from an increasing to a decreasing number of farms during the time

span. The number of farms in this size group in Bayern increases thoughout the projection period, but will probably also reach a turning point sometime between 1975 and 1980. This means that the average size farm in all states is increasing and that the economic farm unit size lies somewhere above 20 hectares with today's technology.

The growth of the average size farm in each state is shown in Table 17. With the exception of Bayern, farm size is largest in the north and smallest in the south. In Bayern the average size is a bit deceiving. The heavy concentration of farms is more or less equally distributed in the 2-<20 hectare groups with few farms relative to the total in the .5-<2 size group. Thus, while Bayern has no greater proportion of farms in the 20 hectare or over groups than other states, it has proportionately fewer very small farms with the net effect being a larger average farm size.

Another interesting phenomenon evident in Table 14 is the increasingly distinct emergence of a bimodal distribution across the size groups in every state except Bayern. The first mode is normally found in the .5-<2 hectare group and the second with some deviation is found in the 10-<20 hectare group. This has been caused by past growth in 10 hectare and over groups,

Table 17. Average Farm Size By State 1955-1975 In Hectares.

State	Year				
				Projection	
	1955	1960	1965	1970	1975
Schleswig-Holstein	17.2	18.8	20.0	21.2	22.3
Niedersachsen	9.8	11.3	12.7	13.7	14.5
Nordrhein-Westfalen	7.9	9.0	10.0	11.2	12.4
Hessen	4.9	5.7	6.8	8.1	9.4
Rheinland-Pfalz	4.7	5.0	5.9	6.7	7.6
Baden-Württemberg	4.9	5.4	5.6	5.8	6.0
Bayern	8.2	8.7	9.4	10.1	10.8
Saarland	n/a	3.3	4.0	4.6	5.1
West Germany Average	7.3	8.1	8.9	9.7	10.5

Source: Own calculations from Tables 14 and 15.

and the fast decline in the 2-<10 hectare groups relative to the .5-<2 hectare group. Beyond the projection period, we expect the second mode to shift to the 20-<50 hectare group in all states as it has already in Schleswig-Holstein and Niedersachsen. The .5-<2 hectare group, while relatively large in number of farms, accounted for only 3.2 percent of the total West German agricultural land in 1965. And, even though the 20 hectare and over size groups only accounted for 10.5 percent of the farms in 1965, 40.3 percent of the land fell in these groups.[3]

The hectare distribution shifts among farm size groups follow the farm

[3]Tables on the percentage distribution of farms and hectares by farm size group by state for 1955-1965 and projections for 1970 and 1975 are found in the statistical appendix.

number shifts with some variations. Like farm numbers, the number of hectares are increasing in the 20 hectare and over group and decreasing in the .5-<10 hectare groups in all states. Again, the 10-<20 hectare size group is the transitional category. In Bayern this size group is gaining hectares at a declining rate throughout both the historical and projection periods. In Niedersachsen this size group increased hectares between 1955 and 1960 and then began to decline between 1960 and 1965. The turning point for Nordrhein-Westfalen, Hessen and Rheinland-Pfalz is projected between 1965 and 1970 and for Baden-Wurttemberg between 1970 and 1975. In Schleswig-Holstein and Saarland, this size group has lost hectares during the total time period shown in Table 15.

In general then, the trend is toward the 20 hectare and above farm size groups becoming larger while a declining number of farms and farm land remain in the farm size groups up to 20 hectares. Further evidence of this fact is shown when we look at the average farm size. Overall average farm size is increasing while the average size of farms in the 10 hectare and over size groups is declining. This is due to a large number of farms moving into the upper two categories and being of a size just large enough to be counted in that category, thus, moving the average down. The 10-<20 hectare class is declining in average size probably due to the fact that the larger within category farms are in a better capital and labor position to move out of the category while the larger farms in the 5-<10 hectare group are not as able to move to the next higher category.[4]

Crop and Livestock Patterns by Farm Size Group and by State

Referring back to Table 17, we see that farm structure as measured by size of farm changes very slowly. The West German average size farm has increased less than one hectare per each five year period since 1955. The farm size change has been slightly more in the northern states and somewhat less than one hectare per five year period in the south.

To the extent that farm structure is a limiting factor determining the extent of enterprise flexibility, and the innovation of technology, we should expect to find different crop and livestock patterns in the various farm size groups.

The 1960 agricultural census presents data on the crop and livestock patterns by farm size group for each of the states. Table 18 presents the cropping pattern in 1960 for each state in terms of the percent of land devoted to each crop in each farm size group. We can think in terms of Table 18 presenting the crop distribution on any hectare of land in a particular farm size group. For example, a hectare of land falling in the .5-<2 hectare size group in Schleswig-Holstein would have 1.99 percent of its surface devoted to wheat. If that same hectare moved into a farm of 50 hectares or over, it

[4]A table of average farm size by farm size group by state 1955-1965 with projections for 1970 and 1975 is found in the statistical appendix.

would have 12.22 percent of its surface devoted to wheat. Thus, we find the amount of different crops grown on a typical hectare is associated with farm size. Even with just a cursory look, we concede from Table 18 that all farm groups in all states raise some amount of all listed crops. In other words, no full specialization in crop production is found either by farm size group or by area. We do, however, find differences in the proportion of total area devoted to certain crops by farm size group and by state.

In a look at the tendency for specialization in certain crops by area, we find the southern part of the country more heavily engaged in the cultivation of wheat and summer barley primarily for brewing purposes. The north concentrates more heavily on rye, winter barley and mixed grain. Oats production is concentrated more in the middle with the extreme north and south devoting less land area to this particular crop. All other crop categories listed including grassland have slight state to state variation but all areas follow broadly similar cropping patterns with respect to these crops. So we find that the big differences with respect to area are among the grains. Since all grain crops require similar types of technology, these between-area differences must be rationalized on reasons other than farm structure or differential technology rates. These other causes may include climate, soil quality, location of supporting industries such as the brewing industry concentration in southern Germany leading to a higher proportion of summer barley grown in that region for malting, availability of import substitutes, and price.

In terms of the different cropping patterns by farm size group, we find general similarities among the areas. Wheat, barley and sugar beets increase with farm size while rye, potatoes and fodder beets decrease. No discernible trends are evident with respect to farm size for oats, mixed grain, other feed crops, other crops or grassland. Oats do, however, tend to be concentrated in the 5-<20 hectare size groups while mixed grain is concentrated in the 5-<50 hectare groups. We find a rather marked jump in proportion of surface devoted to wheat, barley and sugar beets in moving from the 20-<50 hectare size group to the 50 and over size group. It is probably only in the farms with more than 50 hectares that the full mechanization potential can be reached.

We can calculate a similar measure for the livestock pattern by farm size group. Table 19 shows the livestock concentration per 100 hectares by farm size group for different types of animals. The concentration pattern across the states appears very similar. The main differences between the different states appear in pigs and dairy cows. The north has substantially more pigs per hundred hectares than the south and the southern two states of Baden-Württemberg and Bayern have the heaviest concentration of milk cows per hundred hectares. Nordrhein-Westfalen also has a heavy milk cow concentration due to the proximity of the large Ruhr industrial area.

Table 18. Crop Pattern in Percent of Land Devoted to Each Crop in 1960 by Farm Size Group by State in West Germany

Land Crop	Farm Size Group in Hectares						Hectare Weighted Average all Size-Groups
	.5-<2	2- <5	5-<10	10-<20	20-<50	50- over	
Schleswig-Holstein							
Wheat	1.99	2.43	3.48	5.15	7.15	12.22	7.92
Rye	6.03	6.42	8.59	10.70	10.90	8.71	10.04
Winter Barley	.19	.47	.88	1.70	2.70	4.13	2.79
Summer Barley	1.03	1.27	1.51	2.52	3.71	5.56	3.85
Oats	2.18	2.85	4.40	5.22	5.41	6.01	5.44
Mixed Grain	5.45	5.71	7.25	7.91	6.74	3.70	6.10
Potatoes	6.41	4.44	3.50	3.58	3.63	3.93	3.72
Fodder Beets	3.40	3.38	3.32	3.39	2.67	1.80	2.60
Sugar Beets	.06	.05	.14	.46	.89	2.39	1.17
Other Feed Crops 1/	9.87	11.11	12.62	13.89	14.54	12.72	13.76
Other Crops 2/	13.45	5.42	2.23	1.02	1.68	6.24	2.96
Grassland	49.94	56.45	52.08	44.46	39.98	32.59	39.65
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Niedersachsen							
Wheat	1.80	2.72	3.25	3.32	6.11	11.98	5.85
Rye	16.25	15.53	17.36	16.56	14.47	11.91	14.97
Winter Barley	.74	.99	1.27	2.04	2.87	5.48	2.81
Summer Barley	.42	.39	.48	.76	1.71	3.73	1.59
Oats	3.44	5.45	6.51	5.88	5.01	5.33	5.49
Mixed Grain	3.31	2.97	3.80	4.50	4.63	4.09	4.32
Potatoes	14.10	10.09	5.56	8.28	7.28	7.31	7.55
Fodder Beets	3.25	3.87	3.56	2.96	2.12	1.23	2.45
Sugar Beets	.60	.85	1.62	2.74	4.00	8.09	3.93
Other Feed Crops 1/	2.46	2.90	2.98	2.74	2.83	3.82	2.99
Other Crops 2/	2.55	1.20	.57	.33	.54	2.49	.87
Grassland	51.08	53.04	53.04	49.89	48.43	34.54	47.18
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nordrhein-Westfalen							
Wheat	2.83	4.05	6.74	9.13	10.33	13.44	9.37
Rye	10.39	13.57	14.85	14.54	14.23	11.04	13.92
Winter Barley	.63	1.02	1.43	2.77	4.82	10.45	4.19
Summer Barley	.36	.40	.55	.99	2.88	7.11	2.37
Oats	2.89	5.61	7.31	8.09	8.38	10.15	8.16
Mixed Grain	1.95	3.35	4.22	5.18	6.01	4.14	5.04
Potatoes	10.18	8.47	7.73	6.66	5.28	2.86	6.01
Fodder Beets	3.93	5.23	5.58	4.82	2.21	6.25	4.28
Sugar Beets	.16	1.89	1.29	4.19	3.71	7.28	3.62
Other Feed Crops 1/	5.96	6.02	5.77	5.27	4.53	3.82	4.97
Other Crops 2/	3.92	2.99	1.09	.41	.64	2.07	1.05
Grassland	56.80	47.40	43.44	37.95	36.98	21.39	37.02
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 18 continued
Crop Pattern in Percent of Land Devoted to Each Crop in 1960
by Farm Size Group by State in West Germany

Land Crop	Farm Size Group in Hectares						Hectare Weighted Average all Size Groups
	.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	
Hessen							
Wheat	5.45	8.18	11.88	14.99	12.56	19.64	13.01
Rye	14.66	15.65	13.18	11.75	9.47	7.94	12.07
Winter Barley	.43	.52	1.23	2.51	3.30	6.10	2.26
Summer Barley	1.10	1.79	3.10	3.66	2.60	6.37	3.21
Oats	7.65	10.47	11.30	9.66	6.05	5.23	9.23
Mixed Grain	.79	.97	1.60	2.08	1.87	2.22	1.75
Potatoes	12.76	10.24	8.89	7.98	4.77	4.95	7.82
Fodder Beets	4.82	6.47	6.62	5.88	3.25	1.88	5.41
Sugar Beets	.08	.20	.96	2.64	2.89	6.64	2.15
Other Feed Crops 1/	5.74	7.00	7.51	7.83	5.64	7.04	7.17
Other Crops 2/	5.36	1.48	.56	.45	.69	3.91	.93
Grassland	41.16	37.03	33.17	30.57	46.91	28.08	34.99
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Rheinland-Pfalz							
Wheat	5.68	8.90	12.45	14.51	15.17	17.25	12.81
Rye	10.60	10.73	9.52	8.66	8.67	6.98	9.31
Winter Barley	.34	.55	.88	1.35	2.04	3.01	1.15
Summer Barley	2.38	3.48	5.66	9.65	11.06	9.52	7.24
Oats	5.91	9.82	11.45	9.84	8.19	5.29	10.00
Mixed Grain	1.11	1.68	2.58	2.93	3.07	1.58	2.53
Potatoes	11.17	9.79	8.88	8.26	7.04	5.46	8.58
Fodder Beets	3.97	6.02	6.32	5.47	3.75	2.09	5.55
Sugar Beets	.23	.89	2.11	3.13	4.03	5.22	2.49
Other Feed Crops 1/	6.24	8.18	9.42	9.85	10.03	8.19	9.32
Other Crops 2/	8.15	2.81	1.17	.78	1.20	3.75	1.51
Grassland	44.22	37.15	29.56	25.57	25.75	31.66	29.51
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Baden-Württemberg							
Wheat	9.35	12.05	13.51	13.78	12.75	16.12	13.28
Rye	1.99	2.07	1.69	1.67	1.84	1.73	1.78
Winter Barley	.57	.44	.42	.48	.49	1.88	.51
Summer Barley	5.50	6.08	7.53	8.61	8.92	9.73	7.88
Oats	1.67	3.00	4.14	4.56	4.31	4.58	4.09
Mixed Grain	2.06	3.14	3.69	3.88	3.54	1.67	3.55
Potatoes	8.05	6.96	6.53	5.98	4.84	3.50	6.10
Fodder Beets	2.14	3.80	3.82	3.33	2.55	1.35	3.37
Sugar Beets	.13	.33	.99	1.44	1.02	4.20	1.13
Other Feed Crops 1/	11.83	12.66	13.52	13.91	12.78	10.19	13.26
Other Crops 2/	3.79	1.88	1.00	.68	.82	5.22	1.21
Grassland	52.92	47.59	43.16	41.68	46.14	39.83	43.84
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 18 continued
Crop Pattern in Percent of Land Devoted to Each Crop in 1960
by Farm Size Group by State in West Germany

Land Crop	Farm Size Group in Hectares						Hectare Weighted Average all Size Groups
	.5-<2	2-<5	5-<10	10-<20	20-<50	50- over	
Bayern							
Wheat	4.75	7.94	10.51	11.43	13.58	15.16	11.57
Rye	7.47	9.61	7.90	6.84	5.10	2.83	6.72
Winter Barley	.26	.25	.26	.33	.56	1.63	.43
Summer Barley	5.15	6.41	8.60	9.67	10.52	11.55	9.40
Oats	2.53	4.65	5.18	5.40	5.11	2.88	5.05
Mixed Grain	1.31	1.96	2.27	1.98	1.48	1.29	1.89
Potatoes	12.53	9.84	8.73	7.65	6.73	8.25	7.95
Fodder Beets	2.38	4.20	4.10	3.41	2.68	1.34	3.36
Sugar Beets	.91	.19	.75	1.29	1.59	3.85	1.27
Other Feed Crops 1/	5.90	8.31	9.30	9.59	9.55	7.64	9.26
Other Crops 2/	3.21	1.20	.61	.46	.62	2.42	1.00
Grassland	53.60	45.44	41.79	41.95	42.48	41.16	42.37
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Saarland							
Wheat	5.86	8.20	9.97	13.24	14.01	13.24	11.26
Rye	4.81	6.10	7.24	7.24	7.71	6.29	6.92
Winter Barley	.50	.42	.44	.54	.64	1.87	.58
Summer Barley	1.22	1.96	3.13	4.08	5.35	5.62	3.57
Oats	4.42	7.70	11.13	12.01	9.77	6.68	10.10
Mixed Grain	1.27	1.44	2.39	3.46	4.25	3.21	2.79
Potatoes	8.68	7.75	7.34	6.46	4.95	3.02	6.61
Fodder Beets	3.54	5.22	5.82	5.92	4.51	1.96	5.23
Sugar Beets	.06	.45	.40	.26	.12	.29	.63
Other Feed Crops 1/	9.34	12.43	12.38	11.05	9.05	9.31	11.22
Other Crops 2/	17.68	9.35	5.40	1.88	2.89	4.69	4.67
Grassland	42.62	38.88	34.36	33.86	36.75	43.82	36.42
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

1/ Including ripe legumes, other row crops and fodder crops and hay not specifically listed elsewhere.

2/ Including garden crops, hops, tobacco, rape, exotic crops, green manure, and summer fallow.

Table 19 Livestock Pattern by Farm Size Group by State in West Germany 1960 - Animals/100 Hectares Agricultural Land

State / Livestock	Farm Size Group in Hectares						
	.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	Average
Schleswig-Holstein							
Calves to 3 mo.	2.6	17.9	19.6	18.8	15.4	8.6	14.2
Calves 3 mo.-2 yrs.	4.1	35.6	45.4	51.9	53.8	39.6	46.5
Milk cows (incl. draft)	40.8	55.3	51.6	48.6	39.7	30.5	39.7
Pigs (incl. piglets)	332.0	147.0	114.0	114.0	102.0	81.0	102.0
Chickens over 6 mo.	1554.0	623.0	333.0	227.0	143.0	85.0	176.0
Niedersachsen							
Calves to 3 mo..	8.2	10.1	13.2	14.2	12.4	7.7	11.8
Calves 3 mo.-2 yrs.	1.8	21.0	29.5	37.4	42.9	30.3	35.0
Milk cows (incl. draft)	39.0	57.3	49.1	40.3	31.8	23.9	36.2
Pigs (incl. piglets)	277.0	192.0	178.0	151.0	112.0	69.0	131.0
Chickens over 6 mo.	134.0	645.0	447.0	321.0	207.0	121.0	301.0
Nordrhein-Westfalen							
Calves to 3 mo.	12.0	10.5	13.8	13.8	12.2	7.5	11.8
Calves 3 mo.-2 yrs.	4.2	27.4	34.1	38.2	39.3	28.5	34.7
Milk cows (incl. drart)	43.7	59.2	56.1	47.5	38.2	26.6	44.0
Pigs (incl. piglets)	178.0	372.0	140.0	124.0	111.0	71.0	119.0
Chickens over 6 mo.	381.0	668.0	479.0	331.0	265.0	125.0	372.0
Hessen							
Calves to 3 mo.	.4	8.6	11.1	11.7	10.3	6.3	9.8
Calves 3 mo.-2 yrs.	1.7	30.5	38.1	37.9	33.7	21.4	32.7
Milk cows (incl. draft)	38.5	62.0	49.9	41.7	33.8	25.2	44.5
Pigs (incl. piglets)	140.0	100.0	109.0	115.0	102.0	71.0	108.0
Chickens over 6 mo.	816.0	394.0	268.0	203.0	164.0	101.0	277.0
Rheinland-Pfalz							
Calves to 3 mo.	.8	9.3	11.8	10.7	8.5	5.3	9.6
Calves 3 mo.-2 yrs.	3.0	31.9	39.0	36.4	29.5	19.6	32.5
Milk cows (incl. draft)	30.9	51.9	44.0	35.2	26.8	20.7	39.4
Pigs (incl. piglets)	75.0	64.0	74.0	72.0	67.0	56.0	70.0
Chickens over 6 mo.	682.0	342.0	237.0	185.0	154.0	118.0	265.0
Baden-Württemberg							
Calves to 3 mo.	.4	7.6	10.8	11.6	10.6	5.4	9.5
Calves 3 mo.-2 yrs.	1.7	32.4	42.5	44.7	40.1	22.2	37.5
Milk cows (incl. draft)	32.3	64.3	51.4	52.7	43.4	22.7	48.9
Pigs (incl. piglets)	79.0	70.0	86.0	93.0	87.0	68.0	85.0
Chickens over 6 mo.	783.0	363.0	258.0	196.0	151.0	120.0	276.0
Bayern							
Calves to 3 mo.	1.2	9.3	12.5	12.9	11.9	6.4	11.6
Calves 3 mo.-2 yrs.	3.6	29.0	39.4	41.7	37.9	23.7	37.3
Milk cows (incl. draft)	49.4	69.9	59.5	48.3	39.6	25.8	49.7
Pigs (incl. piglets)	108.0	84.0	92.0	87.0	77.0	68.0	85.0
Chickens over 6 mo.	928.0	454.0	327.0	237.0	182.0	114.0	274.0
Saarland							
Calves to 3 mo.	.4	5.1	7.8	9.5	8.2	5.4	6.2
Calves 3 mo.-2 yrs.	1.7	18.9	25.3	30.3	28.6	19.0	20.9
Milk cows (incl. draft)	31.3	48.9	43.9	42.1	35.5	21.0	39.9
Pigs (incl. piglets)	61.0	52.0	64.0	73.0	69.0	76.0	64.0
Chickens over 6 mo.	1029.0	396.0	333.0	170.0	147.0	198.0	407.0

The differences in farm size group concentration follow a similar pattern across state lines. When we look at the three cattle categories, we find the milk cows tend to be concentrated in the smaller farms while the 3 month to 2 year calves which are the class being fed out for beef are concentrated in the larger farms. Calves to three months are somewhat more uniformly spread out across the size groups except for the .5-<2 hectare group. Farms in this size group seldom feed calves primarily due to space limitation and thus sell to larger size farms when the calves are eight days old. So we see a pattern emerging where milk cows are concentrated in the smaller farms, beef feeding in the larger farms and veal production more spread out although there is a tendency for concentration in the 2-<20 hectare groups.

Relative to the other size groups, we see the .5-<2 size group has a very heavy concentration of pigs and chickens. A very small proportion of the production from these farms ever reaches market since they produce mainly for home consumption. The exception in this case would be eggs which are sold from these farms on a door to door basis often by the housewife for pin money. When we move to the 2 hectare and over farms, we find a steady decline in both pigs and chickens per hundred hectares as farm size increases.

The distribution of livestock, particularly hogs, among size groups can be traced in the developments of the last 100 years. Small farms were forced to expand their productive capacity in the face of land shortages. Livestock intensification was possible due to a rapidly increasing demand.

Effect of Changing Farm Structure on Production

We must remember that both the crop and livestock patterns depicted in Tables 18 and 19 are for the single year 1960. In order to relate farm structural change to crop and livestock pattern development, we have taken the cropping and livestock pattern by farm size group from the 1960 census report -- the latest year for which this type of data is available -- as presented in Tables 18 and 19 and applied these patterns to the farm hectare structure by farm size group as presented in Table 15. By applying the 1960 crop and livestock pattern to the 1970 and 1975 projections of farm hectares by farm size group, we find the change in the number of hectares devoted to each crop in 1970 and 1975 and the change in the number of different types of livestock associated with change in farm size structure. Tables 20 and 21 show the results for each state and the aggregates for West Germany for crops and livestock, respectively, in terms of percentage change from 1960.

Change in size structure alone would not be expected to change crop and livestock patterns, but the conditions and scope of economic choice which are directly related to the size variable do provide the incentive for changes. In effect, what we are saying is, if the production conditions, cost-price structure, and degree of technological innovation were frozen in 1960 for each size group of farms and applied to the change in farm structure, which

we have projected for 1970 and 1975, we will measure the change in the crop and livestock patterns due to *differences* in the conditions and technological level between farm size groups as they existed in 1960.

Table 20. Percentage Change From 1960 in Hectares Devoted to Various Crops Associated With Change in Farm Size Structure -- 1970-1975 by State

Crop	Percentage Change from 1960							
	Schleswig-Holstein		Niedersachsen		Nordrhein-Westfalen		Hessen	
	1970	1975	1970	1975	1970	1975	1970	1975
Wheat	+1.6	+2.2	+7.5	+9.6	+1.3	+1.8	-1.9	-2.7
Rye	-1.1	-1.9	-1.5	-3.3	-3.8	-5.6	-15.5	-22.9
Winter Barley	+2.3	+3.1	+6.9	+8.6	+5.7	+8.3	+15.0	+22.9
Summer Barley	+1.8	+2.4	+9.9	+13.0	+7.6	+11.2	-4.5	-6.4
Oats	- .6	- .9	-1.1	-2.7	- .1	-1.5	-17.4	-27.1
Mixed Grain	-3.0	-4.6	+1.5	+ .8	- .2	- .6	+ .1	+ .2
Other Feed Crops	-1.1	-1.7	+1.1	+ .4	-6.3	-9.1	-10.9	-16.4
Potatoes	-1.4	-2.0	- .5	-1.8	-8.7	-12.9	-21.8	-33.9
Fodder Beets	-3.9	-5.4	-5.3	-8.9	-8.4	-11.7	-19.6	-31.4
Sugar Beets	+3.5	+4.7	+7.8	+9.7	+3.4	+4.9	+15.2	+22.7
Other Crops	+ .4	+ .9	+3.7	+5.0	-14.4	-20.2	-26.1	-32.7
Grassland	-2.9	-4.2	-1.0	-2.5	-6.7	-9.9	-1.1	+ .5

	Rheinland Pfalz		Baden-Württemberg		Bayern		Saarland		West Germany	
	1970	1975	1970	1975	1970	1975	1970	1975	1970	1975
Wheat	+6.0	+8.1	-2.5	-3.3	- .8	- .8	+15.3	+18.6	+ .9	+1.3
Rye	-4.3	-5.8	-3.5	-4.7	-6.6	-10.0	+8.1	+8.4	-4.2	-6.6
Winter Barley	+18.7	+27.0	+2.6	+7.2	+1.7	+4.8	+9.6	+23.1	+6.5	+9.4
Summer Barley	+15.9	+21.8	- .6	- .7	-1.0	-1.2	+27.0	+35.1	+1.8	+2.6
Oats	-4.3	-6.5	-1.2	-1.8	-2.8	-4.3	+5.9	+4.3	-3.2	-5.1
Mixed Grain	+6.2	+8.4	-3.4	-5.9	-5.1	-7.8	+24.4	+30.7	- .9	-2.0
Other Feed Crops	+1.7	+2.3	-3.4	-5.3	-2.6	-3.8	-2.8	-6.4	-2.7	-4.1
Potatoes	-6.2	-9.0	-6.0	-9.1	-5.4	-7.7	-9.1	-16.7	-5.0	-7.9
Fodder Beets	-7.5	-11.6	-6.7	-10.7	-6.0	-9.2	-1.6	-6.0	-7.7	-11.8
Sugar Beets	+17.8	+24.9	+6.0	+11.3	+3.2	+5.9	-9.5	-15.0	+6.8	+9.7
Other Crops	-20.2	-27.4	-2.4	+1.8	-6.6	-7.3	-24.7	-38.5	-6.5	-7.4
Grassland	-7.0	-9.4	-3.6	-4.9	-3.5	-4.9	+2.4	+1.8	-3.2	-4.7

As farm size increases, the capability to use existing technology also increases. Further, the input of labor becomes a more critical cost factor and pressure for mechanization becomes greater both to substitute for higher cost hired labor and to raise the productivity of the remaining labor. Technology has advanced farther in the ability to mechanize raising of some crops than for others. Generally, the potential to mechanize grains and sugar beets is greater than for potatoes and fodder beets. Therefore, we would expect, and in fact find, a shift in the cropping pattern toward the former and away from the latter.

Potato hectares in Niedersachsen, however, decreased at a slower rate than might have been expected. This is explained in part by the fact that a large area of Niedersachsen concentrates on raising potatoes for seed pur-

Table 21. Percentage Change from 1960 in Number of Animals Due To Change in Farm Size Structure 1970 and 1975 by State.

Animal	Percent Change from 1960					
	Schleswig-Holstein		Niedersachsen		Nordrhein-Westfalen	
	1970	1975	1970	1975	1970	1975
Calves Under 3 months	-4.5	-6.4	- .7	-2.4	-21.4	-24.2
Calves 3 Months To 2 Years	+1.3	+2.0	+2.6	+2.2	-1.2	-2.1
Milk Cows Including Draft	-3.4	-5.0	-4.0	-7.9	-7.5	-11.0
Pigs Including Piglets	-2.9	-4.2	-5.2	-8.7	-6.8	-10.1
Chickens Over Six Months	-8.3	-11.7	-9.6	-14.9	-15.1	-22.4
Animal	Hessen		Rheinland-Pfalz		Baden-Würtemberg	
	1970	1975	1970	1975	1970	1975
Calves Under 3 Months	-3.1	-4.9	-1.6	-3.0	-2.4	-4.4
Calves 3 Months To 2 Years	-2.8	-5.4	-1.4	-2.6	-2.8	-5.0
Milk Cows Including Draft	-15.9	-23.6	-9.6	-14.0	-7.3	-11.3
Pigs Including Piglets	-9.1	-12.9	-2.0	-3.0	-2.5	-4.0
Chickens Over 6 Months	-29.0	-43.6	-15.8	-22.7	-9.2	-13.3
Animal	Bayern		Saarland		West Germany	
	1970	1975	1970	1975	1970	1975
Calves Under 3 Months	-2.4	-3.8	+13.6	+14.9	-4.5	-6.3
Calves 3 Months To 2 Years	-2.2	-3.4	+14.9	+16.9	- .5	-1.6
Milk Cows Including Draft	-6.6	-9.9	-2.3	-6.6	-6.8	-10.6
Pigs Including Piglets	-4.3	-6.3	+5.6	+5.9	-4.8	-7.3
Chickens Over 6 Months	-9.9	-14.8	-26.0	-42.5	-12.2	-18.1

poses which are marketed throughout Germany as a lucrative cash crop as well as high quality potatoes for human consumption. The raising and handling of these seed and food potatoes has required a large investment in sprinkler irrigation systems and climate controlled warehouses. The larger farms are better able to make the initial capital investment while the smaller farms must do so through cooperative arrangements. Thus, we find only a slight decrease in the importance of potatoes in the cropping pattern as farm size increases in this particular state.

We also find a large increase in sugar beet hectares in Hessen and Rheinland-Pfalz. This is partly due to the fact that the small farms are able to obtain a higher return for truck crops and wine than they can with unmechanized growing of sugar beets. As farm size increases, sugar beets can be mechanized and become a profitable alternative. Also a wider market has developed in recent years with the installation of more refineries in these areas. Generally across the board we find a decrease in the rye and oats crops and an increase in wheat and barley. In almost all cases we find a slight decrease in summer barley and a substantial increase in winter barley production. Again, as farm size increases the farms tend to move away from the raising of summer barley for malting purposes because of the associated special handling problems and toward winter barley for feed.

The proportion of grassland to total area decreases as farm size increases. One explanation lies in the fact that small farms maintain relatively more cows per land area than do large farms. These small farms raise grass to support their cows on land which without the cow enterprise or in a broader market economy framework would have a higher and better use in some other crop. Larger farms tend to optimize the use of the land *per se* rather than strictly as support for another enterprise. A partially offsetting tendency on larger farms is for certain marginal land which cannot be mechanized to revert to pasture and grazing land.

The results of the analysis for the livestock enterprises show a decrease in all types of livestock associated with size change over the projected period in all the states with few exceptions. Here again several explanations present themselves. Increased specialization and the high cost of labor affect large farms to a greater extent than small farms. Also, the large farm has a greater land base for income and does not need the labor intensity associated with livestock production to nearly the degree that the small farm does in order to attain a specified income goal. Thus, we find a larger concentration of livestock numbers per unit of land in the small farms than we do in the large. Therefore, as farm size increases the tendency for livestock numbers to decrease is evident.

The most important exception to this decrease in livestock as farm size increases appears for three month to two year calves in Schleswig-Holstein, Niedersachsen and Saarland. Farm size is somewhat larger in the northern

area of Germany and thus we should expect to find a slightly greater tendency toward specialization as well as a more sensitive enterprise adjustment to price. As the beef price increases due to the greater demand for red meats in general and for beef specifically because of rising consumer incomes, we would expect an increase in livestock feeding in those areas where it is structurally possible and profitable to do so. Again, we must be reminded that the analysis in this chapter is that of the effect of change in farm structure on production. We have accounted for only one of the causes of shifting crop and livestock patterns -- differences in production conditions and technological innovation levels in a static sense by farms in different farm size groups. Not yet considered are the differences in the rates of technological advance in a dynamic sense for application to specific types of crops and livestock, changes in relative prices of the various crops, and changes in the relative enterprise costs including those introduced from sources external to agriculture, particularly the opportunity cost of labor. Nevertheless, the results of the farm structural analysis presented above will figure quite heavily as evidence in the final projections of crop and livestock production.

As we shall see in the projection chapters, changes in crop surface were sometimes much greater than those attributable to farm size change. The important thing, however, is that the projected trends in crop surface were in the same direction as predicted by our farm structure analysis. This we might expect. If the past is any indication of the future, we would expect that the differential rates of technological innovation between the different types of crops found in the past might continue. We also expect to find, in general, that present and future research and development will be concentrated in those crops which are presently proving to be more profitable. Thus, the trends that we found in our static farm structure analysis should be amplified when we consider dynamic technological advance.

The correlation between the livestock pattern change in our farm structure analysis and in the projections in Chapter 7 is a slightly different story. The farm structure analysis shows a decrease in all types of livestock. In the aggregate the farm structure analysis shows milk cows and chickens over six months decreasing more than any other type of livestock shown. We would, in fact, expect to find chickens on farms decreasing as the large broiler and egg factories take over. Therefore, the decrease in chickens is entirely consistent with other developments in the poultry industry and is a valuable piece of confirming evidence for projections which estimate a large shift toward industrialized types of poultry and egg production.

If we view the decreases in the different types of cattle along with the assumption that milk cow numbers will increase slightly over the projected period, for reasons which more than compensate for the shift associated with

farm structure change, we have some basis for indicating that calves under three months of age will increase somewhat and calves three months to two years will increase by a substantial amount. In other words, we take the -10.6 percent for 1975 as the projected decrease in milk cows in the farm structure analysis aggregate for West Germany in Table 21 and set that equal to a 4 percent increase. Then the -6.3 percent decrease in calves under three months becomes a small positive number and the -1.6 percent for calves three months to two years becomes a substantially larger positive number. This then indicates that if milk cows remain constant, calves for veal production will increase relatively less than calves for beef production. Other evidence confirms this analysis and we do in fact show these types of trends in our actual projections.

Our farm structure analysis indicates a decline in pig numbers. We will show, however, in Chapter 7 that other factors tend to overwhelm the effect of farm size on pig numbers and we will in fact project an increase. Nevertheless, this analysis is taken into consideration and the projection will be lower than it otherwise might have been had farm structure change not been considered.

Chapter 4
Agricultural Labor

Introduction

The West German agricultural labor force has undergone drastic changes since the closing days of World War II. A remarkable degree of labor mobility is distinguishable considering the predominance of a peasant type of agriculture. It has resulted as an aftermath of World War II and more recently due to intensive capital substitution for labor in the agricultural sector and a high general economic growth rate with full employment levels. The combination of these factors plays an important role in determining the future agricultural labor and income situation.

When we break the labor input into various component stratifications, we find the influence of the different components weighing differently on the total labor picture. Therefore, we will examine some of the variables affecting the labor situation in the past and assess their impacts for the future. Included in the discussion will be age and sex structures, family and hired labor, permanent and nonpermanent labor, farm and nonfarm wages as well as structural and institutional factors affecting mobility and agricultural production adjustment from the labor side.

General Post World War II Development

During and immediately after the closing days of World War II, with an almost totally devastated economy, a complete disruption of the communication and transportation system, and an already large stream of refugees flowing into the West German area from the east, the necessities of life including food and shelter were in extremely short supply. Many people from the east and from urban centers found temporary refuge on the land because only here were they able to fulfill their basic needs. By 1951, reconstruction had progressed to the point where the general economy had once again absorbed most of the urban people who had migrated to the rural areas at the end of the war and the agricultural labor pattern was returned essentially to what it had been prior to the war. In 1950/51, the permanent labor force consisted of 4,380 thousand family and 766 thousand hired workers for a total of 5,146 thousand people in the permanent agricultural labor force. The nonpermanent labor force included 1,180 thousand family and 450 thousand hired workers for a total of 1,630 thousand workers. Thus, a grand total of 6,776 thousand persons were directly engaged in agriculture in 1950/51. As Table 22 shows, the trend behavior of these different classes of farm labor was quite different over the period 1950/51 to 1963/64. By 1963/64 permanent family labor stood at 2,777 thousand persons having experienced a rather uniform decline throughout the period amounting to a total decrease of 36.6 percent. Permanent hired labor followed a similar but faster rate of decline with a 1963/64 level of 257 thousand workers or a decrease of 66.4 percent. Nonper-

manent family labor increased between 1950/51 and 1956/57 to a peak of 1,522 thousand workers, then declined to a low of 1,209 thousand in 1962/63 and finally increased again to 1,302 thousand workers by 1963/64. This represents an increase of 10.3 percent between 1950/51 and 1963/64. Nonpermanent wage labor increased from the 1950/51 level to a peak of 540 thousand in 1957/58 and then declined to a level of 185 thousand in 1963/64. This was a decrease of 58.9 percent for the period. The total number of people engaged in agriculture decreased from 6,776 thousand in 1950/51 to 4,521 thousand in 1963/64 or by 33.3 percent.

In terms of the rate of decline in the trend, the hired labor exodus from agriculture was the most pronounced. The increase in the nonpermanent hired labor force during most of the 1950's indicates a shift from permanent

Table 22. Agricultural Labor on West German Farms With More Than 0.5 Hectares Agricultural Land in 1,000 persons 1/(1925-1965).

Year	Permanent			Nonpermanent		
	Family Labor	Wage Labor	Total	Family Labor	Wage Labor	Total
1925	4755	934	5689	----	---	----
1939	4433	753	5186	1130	360	1490
1950/51	4380	766	5146	1180	450	1630
1951/52	4230	701	4931	1210	460	1670
1952/53	4090	653	4743	1240	470	1710
1953/54	3935	613	4548	1275	485	1760
1954/55	3760	579	4339	1360	500	1860
1955/56	3580	552	4132	1450	520	1970
1956/57	3423	527	3950	1522	531	2052
1957/58	3308	512	3820	1484	540	2023
1958/59	3201	440	3641	1419	454	1873
1959/60	3083	358	3441	1330	359	1689
1960/61	3006	327	3333	1263	286	1549
1961/62	2930	295	3225	1261	277	1538
1962/63	2866	274	3140	1209	262	1471
1963/64 2/	2777	257	3034	1302	185	1487
1964/65 3/	2370	239	2609	961	190	1151

[1]Without West Berlin. After 1960/61 including Saarland.

[2]Including West Berlin.

[3]The data for 1964/65 excludes all labor on those farms in the size group 0.5 to 2 hectares with sales below 1,000 DM annually. They can thus hardly be compared with previous data.

Source: *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten* 1964, Table 65, p. 45.

Wirtschaft und Statistik, Heft 3, March 1966, p. 150ff.

to nonpermanent hired labor. This was essentially a transitional period for some hired labor between agriculture and urban employment. By 1958/59, the transitional period was no longer necessary due to a fully employed general economy and nonpermanent hired labor joined the permanent hired labor trend

downward

The family labor force decline was less pronounced than that of the hired labor force in percentage terms but was much more important in absolute numbers. Between 1950/51 and 1963/64, 26.6 percent of the family labor force left agriculture. In absolute numbers, this reduction amounted to 1,481 thousand family laborers compared to a reduction of 774 thousand hired workers.

Going against the general trend, the nonpermanent family labor force actually increased slightly during the period. Once in, leaving agriculture often is a matter of degree rather than a sudden and complete break. The increase in importance of part-time farming is largely facilitated by increased use of the automobile allowing the industrial worker to commute from his farm home and shorter working hours in industry which help to overcome the long distances between home and factory and also allow time to devote to the home farm.

The process of substituting capital for labor in the form of machinery, labor saving buildings, and investments in land consolidation will continue. Mechanization of West German agriculture is slowly moving out of a period of very costly trial and error. Established and proven types of mechanization, particularly in field work, are spreading with the usual labor releasing consequence. Finally, we can assume that farmers will have access to credit at very favorable terms as part of the public support for agriculture in order to make the capital investments necessary to economic farm organization and adjustment. Therefore, the number of workers in the agricultural labor force will continue to decline.

Sex Structure of Agricultural Labor

It is surprising to observe that the sex structure of the agricultural labor force remained nearly constant during the last fifteen years despite the drastic reduction in numbers. The expected change from female to male labor has not yet occurred nor is there a strong indication of change in the more recent data. According to Table 23, the male labor portion of permanent family labor has actually been slightly reduced while in the nonpermanent family and hired labor forces the male share has increased. Roughly one-third of all farm work is performed by women. Van Deenen's survey of peasant farms carried out in 1959/60 showed that farm wives work an average of four and one-half hours per day outside the household proper doing farm chores. Twenty-one percent of the work with cattle and dairying, 76 percent of the work with pigs and almost all of the work with poultry on the survey farms was performed by female labor.[1]

[1] B. van Deenen, *Der Statistische und Soziologische Befund der landwirtschaftlichen Arbeitsverfassung und Arbeitskräfte nach* 1945 in *Wandl. der landw. Arbeitsverf.*, Berlin, 1961

On the small part-time farms, we can account for the decline in the male share in permanent family labor and its increase in nonpermanent family labor, by the movement of formerly full-time farmers to part-time farming and urban jobs. In this case, female family members take over some of the farm duties from males. On the large farms, this same phenomenon is likely caused by rising wage costs necessitating the release or nonreplacement of hired labor. Thus, in this case the female family members are taking the place of former hired labor.

The social motive for female labor to work less on the farm and to restrict activities to the household is likely to gain strength with growing per capita incomes and increased communication between rural and urban areas.

Table 23. Sex Structure of Agricultural Labor[1] in West Germany by Farm Size Group 1957/1958 and 1963/1964.

Year	Farm Size Group in Hectares						
	0.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	Total[2] Number Persons
	1. Males as percent of permanent family labor						
1957/58	27	35	46	50	50	51	3308
1963/64	12	26	42	48	49	49	2777
	2. Males as percent of part-time family labor						
1957/58	57	63	54	46	42	50	1484
1963/64	78	71	68	54	48	50	1302
	3. Males as percent of permanent wage labor						
1957/58	59	55	54	63	67	72	512
1963/64	61	60	54	59	71	75	257
	4. Males as percent of nonpermanent wage labor						
1957/58	47	43	38	35	36	34	540
1963/64	56	60	55	49	55	50	185

[1] 1957/58 including the township of Hamburg, Bremen and West Berlin. 1963/64 including Saarland, Berlin.

[2] In 1,000's

Source: *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten der Bundesrepublik Deutschland*, Table 61, p. 42. 1964.

It can be assumed that by 1975 -- particularly with a new generation of farm girls and young farm wives -- the female household members will be less and less inclined to work long regular hours outside the household proper. This will tend to both slow the rate of hired labor outflow and speed the rate of mechanization to compensate for the loss of female labor. The relative weight of each in the substitution process will depend on the hired labor wage rate relative to the cost of mechanization.

Age Structure of Agricultural Labor

More significant than the changes in sex structure are the changes in

age structure. A characteristic feature of peasant farming has always been that the labor force include a high portion of young and old persons relative to middle-aged male workers. This tendency has become more pronounced with respect to the old and less pronounced with respect to the young. The evidence in Table 24 indicates that the young, and to a lesser extent the middle-aged, are leaving agriculture at a more rapid rate than the old. Most conspicuous has been the aging of the wage labor force. In 1956, half of the female wage laborers were between 14 and 25 years of age. Four years later in 1960, this figure was down to 40 percent. Male wage labor in the same age group dropped from 39 to 31 percent during the same period. The shift is partly the result of older wage laborers not being replaced when they move out of agriculture through death or retirement. Many farm operators feel a social or moral obligation to their aging hired labor in that they will not turn them out even though they are really no longer needed. Rather, the operator keeps them on until death or retirement and then simply does not replace them.

The family labor force shows a development similar to that of the hired labor force although at a generally slower rate. Quite significant however, is the fact that the proportion of male and female 14 to 18 year olds decreased by half between 1956 and 1960. The exodus of the young is shown even more dramatically in terms of actual numbers. In 1950, 410 thousand family members under 20 years of age were registered as working in agriculture. By 1957, this number had dropped to 320 thousand and by 1961 to 140 thousand. The number of persons in this category decreased by 66 percent in the 11 year period and by over half in the last four years of that period.[2] Urban employment alternatives for potential new entrants into agriculture are exerting a strong pull on both males and females in the under 20 year age group.

The age structure for farm operators shows a mildly reversed trend which is partly due to an unusual circumstance during the period. In 1957, the Agricultural Old Age Pension Act was passed. The qualifying provisions of the law induced a substantial number of aged farmers to transfer their holdings to their successors earlier than they had normally intended in order to begin receiving benefits. Some of these aged farm operators remained on the farm as family farm labor thus strengthening the aging trend in that class.

The future pattern of the changing age structure can be estimated under a set of rather rigid assumptions. A major portion of agricultural labor is over 45 years of age. (Table 24) At present a relatively small number of persons are entering agriculture while a relatively large number of old farmers are leaving through death and retirement. Assuming no in or out movement in the middle-aged group and an economic growth rate which will sustain present new entrant levels, we can calculate a rate of labor outflow by determin-

[2] *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten* 1962. p. 153.

Table 24. Age Distribution of Farmers and Farm Labor[1] in West Germany 1956 and 1960

Year	.....Percent of All Males Working in Agriculture were in the Following Age Groups						.....Percent of all Females Working in Agriculture were in the Following Age Groups					
	14-<18	18-<25	25-<45	45-<65	65-over	Total	14-<18	18-<25	25-<45	45-<65	65-over	Total
	1. Farmers (full-time and part-time)											
1956	0.7		23.8	58.8	16.7	100	0.7		15.9	59.0	24.4	100
1960	0.9		28.0	57.5	13.6	100	0.1	0.8	15.3	59.8	24.0	100
	2. Family Labor (full-time and part-time)											
1956	16.8	30.0	35.3	9.1	8.8	100	6.7	11.5	34.7	38.0	9.1	100
1960	8.8	31.1	35.5	10.0	14.6	100	3.2	10.5	29.7	42.4	14.2	100
	3. Permanent Wage Labor											
1956	39.0		30.6	30.4		100	50.3		29.6	20.1		100
1960	7.0	24.5	34.5	31.4	2.6	100	11.6	28.3	31.9	26.2	2.0	100

[1] On farms with more than 0.5 Hectares agricultural land.

Source: *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten*, 1964, Table No. 56 and 57, page 40.

ing the difference between numbers of new entrants and numbers of old age retirements and deaths.

Kratzsch and Schmidt using 1961 microcensus data calculated the total number of old persons leaving agriculture to be 95 thousand per year while the total new entrants amounted to 40 thousand persons per year. The difference accounts for a net annual loss of 55 thousand persons. By straight extrapolation of these numbers, we can calculate a loss of 550 thousand persons due to aging alone between 1965 and 1975.[3]

The reliability of this exact figure may be questioned and it certainly will be influenced by changes in assumptions concerning general economic growth rates, by people leaving agriculture after having entered and worked there for only a few years, and by old persons retiring from an urban job and returning to their land. But it does bring out the fact that the aging process of farm labor is continuing and will have substantial impact in decreasing the size of the farm labor force in the future.

Farm Size and the Labor Force

The move away from the land has shown different rates according to farm size. As could be expected the greatest reduction in the farm labor force occurred in the small farm size groups, primarily because the number of farms in these groups also declined. The labor force in the large farm size groups also declined even though the number of farms in these groups increased. Between 1956/57 and 1964/65, farms with more than 20 hectares lost about 22 percent of their labor force measured in full man work equivalents or labor units[4] while those between 2 and 10 hectares lost 42 percent. The labor input

[3] See K. Kratzsch, *Verminderung des Arbeitskräftebestandes in der Westdeutschen Landwirtschaft in Wirtwiss, Mitt.*, Köln 16. 1963:1 also W. Schmidt, *Wandlungen im Arbeitskräftebestand der landwirtschaftlichen Betriebe von* 1949 *bis* 1960 in *Wirtschaft und Statistik* N.F. 13.1961:5.

[4] A full man work equivalent or labor unit, as we will call it from this point on, is an attempt to convert actual labor time contributed by groups of widely diverse quality as well as part-time contributors into full-time man-year equivalents. The size of the labor force in peasant farms is not clearly evident and comparisons with large scale farm labor inputs is likely to be very difficult. The comparison problems stem from the fact that: (1) A relatively high proportion of the agricultural labor force consists of persons who might be considered as a residue of the move away from the land. That is they are hardly employable elsewhere due to age, health, education or other reasons. (2) A large portion of the farm work is done by female family labor. (3) A significant part of the farm work is done by youngsters less than 16 years of age and by persons over 65 years of age. (4) A portion of farm work is done by casual seasonal labor. It is possible to estimate the number of hours worked by these groups, and the German statistics in this area are reasonably good. The labor unit method takes account of some of the quality differences by defining a labor unit as a full-time work year for an able bodied laborer and converting part-time labor to this basis as well as adjusting labor time by youngsters under 16 by a factor of .5 and by persons over 65 by a factor of .3. Nevertheless, the labor input calculated by this method is probably still somewhat inflated relative to the labor input in countries with a more industrialized type of farming.

in farms of 10 to 20 hectares decreased only 10 percent mainly because this category received the largest increase in number of farms during the period. This size category has reached its peak and now it has also begun to lose farms. So the decrease in labor force within that group will also be more rapid in the future.

The rate of decrease in number of farms was by no means as rapid as the decrease in farm labor. Through the substitution of capital for labor a substantial reduction in the number of workers per farm occurred. Table 25 shows the change in the number of labor units applied per hundred hectares of agricultural land by farm size group. As farm size increases less labor is applied per unit of land. Higher levels of mechanization are possible on the larger farms and thus more labor is substituted for by capital. Also, the labor requirement in all size groups is decreasing through time which means that technological advance and capital-labor substitution is taking place in all farm size groups. In 1964, farms under 20 hectares averaged less than one permanent laborer and the average labor input was under 2 labor units.

Table 25. Agricultural labor Units[1] per 100 Hectares by Farm Size Group in West Germany 1956/57 - 1964/65.

Year	Farm Size in Hectares						
	0.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	Total
1956/57	73.1	40.0	27.1	17.5	12.2	11.3	22.6
1957/58	71.6	39.1	26.7	17.2	12.0	11.0	22.0
1958/59	69.0	37.4	25.2	16.7	11.2	10.2	20.8
1959/60	66.1	35.9	24.1	15.7	10.5	9.7	19.4
1960/61	64.7	34.2	22.9	15.1	10.0	8.9	18.3
1961/62	63.8	33.0	22.2	14.8	9.8	8.7	17.7
1962/63	62.8	31.4	22.0	14.6	9.6	8.7	17.2
1963/64	62.8	32.8	21.8	14.6	9.1	7.5	16.8
1964/65 [2,3]	87.2	32.2	21.3	14.2	8.8	7.0	15.2

[1] For explanation of labor unit see footnote, p. 65.

[2] For 1964/65 in the .5-<2 hectare farm size group, only farms with sales of 1000 DM or more per year are included. This is the reason for the large jump in labor use between 1963/64 and 1964/65.

[3] Preliminary Source: *Statistisches Jahrbuch über Ernährung*, 1964, p. 41.

(Table 26) Farms between 20 and 50 hectares averaged less than 2 permanent laborers and about 2.5 labor units. Thus, the one man farm was the most widespread type by 1964 and only a few farms exceeded the 2 man size.

A large share of the labor force presently employed in farms smaller than 50 hectares, and in particular in farms smaller than 20 hectares, would not be necessary within a framework of a better combination of agricultural resources. That is, if land consolidation and farm size increases would proceed to the extent that they would not hinder a farm organization which could make optimal use of modern technology and methods of production, the labor

requirement would be drastically reduced. Many farms between 10 and 50 hectares are presently overstocked with tractors and machinery relative to their land. Other farms cannot use the highest levels of technology due to the farm structure within which they are forced to operate. Thus, a more efficient farm organization, particularly through structural change, could easily free a large number of workers without endangering present production levels. Ample information is available to fortify this hypothesis. Van Deenen, in a survey in 1960 found an average labor input of 869 hours per hectare in farms smaller than 10 hectares while the comparable figure for farms larger than 50 hectares was only 234. Both size groups yielded roughly the same gross output per hectare. Even greater differences appeared in the labor required for livestock. On farms with up to two livestock units,[5] 300 hours labor per livestock unit were required while on farms with over 26 livestock units only 60 hours labor per livestock unit were needed.[6]

Work by Dovring also supports the hypothesis.[7] He compared the actual

Table 26. Labor per Farm by Farm Size Group in West Germany -- 1964.

Farm Size Group Hectares	Permanent Workers Per Farm	Total Labor Input in Labor Units Per Farm
0.5-<2[1]	0.4	1.1
2-<5	0.4	1.1
5-<7.5	0.7	1.4
7.5-<10	1.0	1.7
10-<20	1.3	2.0
20-<30	1.6	2.3
30-<50	2.0	2.8
50-over	4.5	5.7

[1]Only those farms in this size group with sales of more than 1000 DM annually.

Source: *Wirtschaft und Statistik*, *Heft* 3, March 1966, P. 170.

and the necessary employment in agriculture using labor norms associated with both year and the farm size. Table 27 summarizes his conclusions. In 1960, only 1,475 thousand of the available 2,377 thousand labor units would have been required to perform the necessary tasks. The discrepancy between actual and required labor input was particularly pronounced on small farms. In farms larger than 50 hectares, no excess labor was left by 1960 according to

[5]A livestock unit is based on the feed requirement of a cow. All other animals are given a factor determined from their feed requirement relative to that of a cow. A livestock unit conversion table is found in Appendix C.

[6]B. van Deenen, E. Mrohs, S. Tiede, E. Vilman, *Materialien zür Arbeitswirtschaft Forschungsstelle für Agrarpolitik und Agrarsoziologie*, *Heft* 153 1964.

[7]F. Dovring, *Forecasting the Move Away from the Land*. OECD Observer, 22 January 1964, Paris.

Dovring. The fact that these farms absorbed the loss of 2.9 labor units per hundred hectares (Table 25) between 1960 and 1965 indicates that Dovring's estimates are on the conservative side. Nevertheless, the potential for maintaining a high rate of labor outmovement is present and will probably be realized throughout the next decade.

Table 27. Labor, Available and Required, by Farm Size Group In West Germany 1960. 1/ (thousands of man units)

Farm Size Group Hectares	Labor Available	Labor Needed
0.5-<2	317	80
2-<5	423	170
5-<10	555	300
10-<20	607	450
20-<50	353	350
50-over	123	125
Total	2377	1475

1/ Labor available from "Wirtschaft und Statistik" 1963:2, pp. 87 sqq. 70 (in the annex section called "statistisches Monatszahlen") Labor needed computed from data derived from the 1960 Census of Agriculture as published in "Statistisches Jahrbuch" 1962. At first labor norms were applied which were adequate around 1950 but are now outdated. The results were much too high and were then revised by using alternative assumptions about the degree of reduction in labor requirements in crop and livestock production by means of equations to show which combination of such assumptions would best fit the situation on larger farms, those where hired labor still plays a sizeable role.

Source: Dovring, F.: *Problems of Manpower in Agriculture*, OECD 67, Paris 1965

Based on the assumption that 1.2 labor units are associated with each farm which disappears from agriculture, approximately 60 percent of the loss in agricultural labor between 1950 and 1960 is directly related to the decrease in farm numbers. The other 40 percent can be attributed to a decrease in number of workers per farm. At present, most farms are down to one or two permanent laborers making it physically impossible in many cases to reduce the per farm labor force any further. Consequently, the future reduction in the labor force will depend even more heavily on the reduction in farm numbers

Assuming a reduction in farm numbers of 242 thousand[8] between 1965 and 1975, that 1.2 labor units disappear with each farm, and that farm numbers reduction accounts for 75 percent of the labor force decrease, we can project a decrease of 387 thousand labor units between 1965 and 1975. Thus, in 1975, 1,426 thousand labor units would remain, compared to 1,813 thousand in 1965.

Farm Income and the Labor Force

The exodus from farming since the early 1950's has been due to two main forces. Urban employment opportunities have been available with income lev-

[8] As projected in Chapter 3

Table 28 Wages and Incomes in the Industrial and Agricultural Sectors of West Germany, 1953-1965

A. Wages, DM per hour

	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Agriculture[1]	1.06	1.19	1.24	1.33	1.60	1.73	1.78	1.93	2.15	.241	2.66	2.83	2.90
Industry[1]	1.79	1.84	1.96	2.17	2.36	2.51	2.64	2.88	3.17	3.53	3.79	4.15	3.95
Agriculture Wage / Industry wage	59	65	63	61	68	69	67	67	68	68	70	68	73

B. Income in agriculture in percent of the income under comparable non-agriculture conditions[2]

1954/55	1955/56	1956/57	1957/58	1958/59	1959/60	1960/61	1961/62	1962/63	1963/64	1964/65
66	66	64	74	76	73	74	62	71	79	77

[1]Gross wages, males over 18 on farms larger than 0.5 hectares, excluding dairy herdsmen. All industries male workers, gross wages.

[2]According to the estimates made in the Green Report. Income is defined as follows: Gross return minus production costs, depreciation, and interest for farm capital at 3 1/3 percent. A detailed discussion of the numerous difficulties of such a comparison is to be found in the annual editions of the Green Report.

Source: *Statistisches Jahrbuch über Ernährung Landwirtschaft und Forsten* 1964. *Statistisches Jahrbuch der Bundesrepublik Deutschland*, XXI, Table A2.

els as well as working and living conditions considerably more attractive than those in agriculture. The innovation of modern technology and methods has caused a surplus of labor on individual farms which in turn has produced low operator and family incomes. Rising wage demands have forced farm operators to decrease the hired labor force through release of workers and/or not replacing those who retire. Thus, both the externally generated pull and the internally generated push have operated to reduce the agricultural labor force by 1/3 between 1950/51 and 1963/64. But the friction inherent in the system has also operated. The outmovement of agricultural labor has not proceeded at a rapid enough rate to close the existing urban-rural wage and income gap. Table 28 shows the magnitude of the gap over the past several years.

Agricultural wages averaged about two thirds the level of industrial wages during the past 10 years with some tendency to closing the gap. Agricultural incomes have averaged slightly more than two thirds the nonagricultural income and also have been improving slightly in a relative sense over time. The methodological problems in comparing rural and urban incomes are numerous and cannot be dealt with here. It is sufficient to observe that strong economic incentives to leave agriculture have been present in the past with the income disparity being greater than the average on small farms and less on large farms.

The economic motive is likely to remain provided the West German economic growth rate continues at anywhere near its present level. In the event that the decrease in agricultural product prices under the Common Agriculture Policy is not fully compensated by other means this incentive will be even stronger than during the past decade. Under the CAP, grain prices will drop approximately 10 percent while milk prices will increase from 0 to 3 percent and livestock prices will increase by approximately 5 percent in net with beef and veal prices increasing and pork and poultry prices decreasing. This coupled with generally rising nonfarm incomes and rising farm costs will mean a decrease in the form-nonfarm income ratio.

At the present time, the West German Farmers Union is still in a rather strong political position with respect to the West German government. But under the Common Agricultural Policy the decision making machinery is within the EEC administration -- a step beyond the direct influence of the Farmers Union. So with respect to price policy the best the Farmers Union can hope for is to exert its influence on the West German government to work for its interest in Brussels in policy bargaining sessions with the other EEC member countries. The Farmers' Union influence will be neither so easy nor felt so strongly in this new political structure.

Since price policy is out of the hands of the individual countries under the CAP, less direct means of income support must be employed. These may

Table 29. Relationship Between Production, Labor and Capital in West German Agriculture 1950-1965 1/

Year	Total Agricultural Production in Million Tons Grain Units 2/	Total Agricultural Labor Force in Million Labor Units	Total Expenditure for Means of Production in 100 Million DM 3/
1950/51	32.2	3.885	6.0
1951/52	34.5	3.737	6.7
1952/53	34.2	3.611	7.0
1953/54	36.2	3.483	7.3
1954/55	36.8	3.324	8.4
1955/56	36.5	3.172	8.7
1956/57	36.8	2.997	9.3
1957/58	38.2	2.914	10.1
1958/59	40.1	2.748	10.6
1959/60	39.3	2.561	11.7
1960/61	44.6	2.400	11.8
1961/62	41.4	2.318	12.6
1962/63	43.5	2.251	12.3
1963/64	46.2	2.195	12.1

[1]Since 1960/61 including Saarland and since 1962/63 including Berlin.

[2]Without feed imports. The measurement of total agricultural production in terms of grain units is conceptually similar to that with constant prices. A grain unit conversion table is found in Appendix B.

[3]At constant prices 1958/59 = 100.

Source: *Statistisches Jahrbuch über Ernährung Landwirtschaft und Forsten* 1964, Tables 202, 66, 218, 377.

take the form of structural reform programs and different types of subsidies to this end as well as programs to ease movement out of agriculture, such as retraining and resettlement programs. In the last chapter, we saw the projected cost of accomplishing structural reform in West German agriculture. Since expenditures of this magnitude are doubtful it is probable that German farm income will drop relative to nonfarm incomes at the onset of the CAP -- creating additional outmovement incentives.

Impact of Labor Force Decline on Production

The reduction of the labor force measured in labor units by 43 percent between 1950/51 and 1963/64 was accompanied by a 44 percent increase in production. (Table 29) The most pressing reason for this phenomenon was the fact that the annual capital expenditure for means of production doubled during the period. Part of this additional expenditure was for tractors and machinery, but an even greater proportion was spent for mineral fertilizer, improved seed varieties and chemicals. Thus, capital flowing into agricultural

production was partially the "yield increasing" variety and partially the "labor saving" or labor substituting type.

The labor outflow was probably large relative to the loss in work performed. Much of the outgoing labor was underemployed in agriculture and was easily replaced by a recombination of resources within the farm. Reduction in farm numbers allowed a more efficient use of available capital and labor on those farms which absorbed the land. In other words, a more efficient combination of resources on farms was effected. And finally, heavy public support for land consolidation and farm credit supported the general trend for increased production.

Table 30 shows that the differential rates of labor force decrease in different farm size groups between 1957/59 and 1963/65 are not reflected in the relative increases in production. In farms smaller than 10 hectares a 20 percent decrease in labor corresponds to a 45 percent increase in production while on farms larger than 50 hectares a labor decline of 32 percent is correlated with a production increase of 41 percent. These figures indicate that the large farms could more efficiently absorb the labor loss. That is, even though the small farms had a larger investment increase in labor saving equipment measured in DM per hectare, the large farms had a more favorable substitution rate of capital for labor and thus used their new capital more efficiently. The rate of technological change was particularly rapid in the livestock enterprises, and the small farms as a rule did not have the capacity in these enterprises to be able to innovate much of this technology. Thus, it appears again that farm structure may be the key to the rate at which labor will flow from agriculture. As farm size increases, farms are in a better position to efficiently innovate new technology and can better absorb a high rate of decrease in labor per farm apart from the decrease which comes through disappearance of farm units.

Table 30. Relative Decrease of the Labor Force and Increase of Production in Different Farm Size Groups in West Germany, 1956/58-1963/65.

	Farm Size Groups in Hectares			
	<10	10-<20	20-<50	50-over
Labor Units per 100 Hectares[1]	80	74	72	68
Gross Production per 100 Hectares[1]	145	150	145	141

[1]Average of labor units and of gross production per 100 hectares in 1963/65 as percent of 1956/58.

Derived from data in the Green Report, 1956 to 1965.

Summary

The agricultural labor force in West Germany decreased by one third in the 1950/51-1963/64 period. The only sub-class of labor which increased a-

gainst the general trend was the part-time farmer. The decrease in farm numbers coupled with the increased mechanization on existing farms set the stage for the release of labor from agriculture. The high rate of economic activity and extremely low unemployment rate in the general economy assured a relatively easy absorption of the migrating agricultural labor into urban jobs.

To the extent that these conditions remain, the labor exodus from agriculture will continue. Strengthening the existing trends will be the growing unwillingness of the younger daughters and wives of farmers to work outside the household proper in general farm labor tasks. Also the average age of farmers is increasing. Fewer potential entrants are in fact choosing agricultural occupations. Consequently older farmers moving out of agriculture through retirement and death are not being fully replaced. The CAP may provide additional outmovement incentive through a net decrease in the prices received by German farmers for their products. At present rates the exodus is still not fast enough to materially improve the level of farm incomes relative to those in the general economy.

Finally, technology has progressed so rapidly that the labor outmovement could be even faster without detrimentally affecting production levels and rates of increase. Thus, we can expect a substantial decrease in the agriculture labor force in the next decade. The forces within agriculture point toward a quickening of the rate compared with the past decade. But the key to the speed of exodus will unquestionably lie with developments in the general economy.

The decrease in the agricultural labor force probably has little effect on the level of production when viewed in isolation. But whether as in some cases labor exodus is the cause or as in other cases the effect, it occurs simultaneously with changes in farm structure and the level and mix of the capital input. To the extent that the shift in capital inputs is toward net output increasing forms, aggregate production increases. The mix of agricultural production is affected in that resources tend to be shifted into those crop and livestock enterprises which are most capable of mechanization. We discuss the effects of capital-labor substitution in greater detail in the following chapter.

Chapter 5

Capital and Technology

Introduction[1]

Of all the changes in agricultural production conditions occurring since World War II, the interacting influences of increasing wage and income demands on the one hand and the invention of new machines, techniques, and methods on the other, have been the strongest. Figure 5 presents dramatic evidence of what has happened to relationships of different input costs and production prices in agriculture. Generally, farm prices and nonlabor input prices have risen quite gradually and in reasonably close relationship to each other during the 1950/51-1964/65 period. Fertilizer prices increased as demand pressure increased in the early 1950's and then dropped substantially by the mid 1950's as production capacity caught up with demand. From the mid 1950's to the present, fertilizer prices have followed the general input price pattern.

But while other input prices and product prices were increasing 30 to 50 index points, labor wages increased 200 points with no sign of a slowing in its rate of ascent. Thus, labor cost has increased about five times as fast as other input and product prices on West German farms. Farmers have several ways in which they may adjust to wage and income pressures. First, they may move out of agriculture as indeed many of them did during the past 15 years. Second, they may substitute capital for labor thereby cutting their labor requirements or expanding production with the present labor supply. Finally, they may reorganize the farm unit through specialization in one or more farm enterprises while de-emphasizing or eliminating others. Either of the latter two may and most probably will include structural changes in the farm unit. The extent and type of the potential capital input largely depends on the structural variables such as size, extent of fragmentation, and building capacity and adequacy.

The rapidity of technological innovation and acceptance of new production methods is regionally differentiated -- higher in the north and lower in the south. Along with farm structure, educational levels of farmers have a direct impact.[2] In 1960, 32 percent of the male farmers in Schleswig-Holstein had theoretical as well as vocational agricultural training. In all except one region of Bayern the comparable figure was 4.6 percent. In Niedersachsen and Nordrhein-Westfalen the percentage of male farmers with theoretical training was between 10 to 30 percent while in Rheinland-Pfalz,

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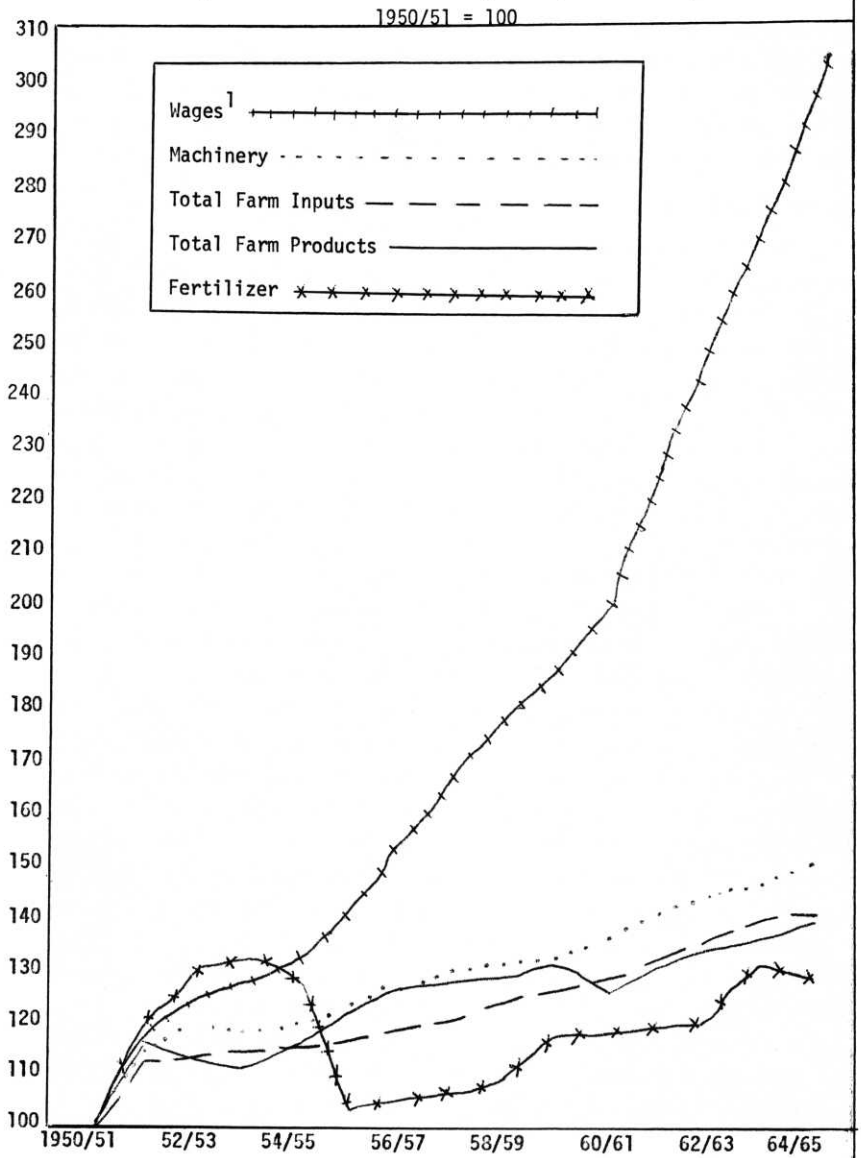
[1] Data in this chapter unless otherwise noted are drawn primarily from P. C. von Harder, *Wirtschaftliche Voraussetzungen und Entwicklungslinien der Mechanisierung in der Landwirtschaft der Bundesrepublik Deutschland seit* 1949, *Berichte über Landwirtschaft, Heft* 85, Frankfurt, 1965.

[2] H. Wagner, *Die Verbreitung Resonanz u. Wirksamkeit von Informations - u. Beratungsmitteln bei den Landwirten Nordrhein-Westfalens. Diss.* Bonn 1964, p. 107.

Figure 5

Relative Price Changes for Various Inputs and Total Output In Agriculture of West Germany 1950/1951 - 1964/1965.



[1]Cash Salary plus value of room and board

Source: *Statistisches Jahrbuch über Ernährung Landwirtschaft und Forsten.* 1958-1965.

Hessen, Baden-Württemberg and Saarland the range was between 4.5 and 10 percent.[3] Thus, the educational level gradient corresponds with the pattern of structural variables and the technological variables which as we will see below also deteriorate from north to south.

In this chapter, we will first look at the general technological trends and capital input. We will also look at the differences in the rate and extent of technological advance by farm size group and by type of crop and livestock and finally the general mechanization level in West Germany.

Capital Requirements

In recent times, labor productivity has been improved mainly by substituting capital for labor or by adding capital to existing labor. The greatest portion of the labor force which has left agriculture has been replaced by investment in machinery. The real value of machinery capital grew from 1.1 billion dollars in 1950/51 to 2.5 billion dollars in 1960/61. At the same time, the permanent labor force was reduced by 45 percent, the number of draft animals by 75 percent and the amount of land by 3.5 percent. Comparing the net machinery investment increase to the amount of labor leaving agriculture, we determine a capital investment of $3170 for each full-time laborer moving out in 1963/64.[4] (Table 31) In the early 1950's the figure was only about $1070. The rate of substitution increased particularly in the 1960's. Not included in these calculations is the increase in gross investment for new buildings. In 1964/65, 29 percent of the total 893 million dollars capital investment was for building maintenance, remodeling, and construction.

In Table 32, we turn to the average capital stock per hectare by farm size group. Since these data are compiled from the Green Report survey farms, and since the survey sample is not random, the values will exceed those for the average of all farms. Nevertheless, the differences between the size groups and years may be regarded as characteristic. The table confirms our assertion in the last chapter that the capital stock per hectare on large farms is less than on small farms. The gap between the largest and smallest classes of farms was about 13 percent in 1956/57 and increased to 17 percent in 1962/63. Farms in the 10-<50 hectare size groups show the largest increase in capital stock during the period amounting to 27 percent.

Table 32 also shows the increase in capital stock per hectare over time for three types of farms. The row crop farm carries the greatest capital investment per hectare followed by grain farms, and finally grass and fodder

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[3] H. U. Thimm, *Regionale Differenzierung der Fachlichen Vorbildung landwirtschaftlicher Betriebsleiter*, *Agrarwirtschaft*, 1963, p. 331.

[4] Based on a three year sliding average and 1960/61 prices. Because of changes in labor force statistics, these figures are only approximately correct. The sliding average compensates in part for the time lag between labor departure and capital investment.

Table 31. Capital Input for Mechanization in Agriculture in West Germany 1950/51-1964/65

Year	Real Investment in Machinery in Million Dollars 1/		Real Investment in Farm Buildings in Million Dollars 1/ 2/	Labor Units in 1000's	Real Machinery investment per Labor Unit Leaving Agriculture 1/ 3/ In Dollars		Animal Draft Units In 1000's 5/	Borrowed Capital and Other Liabilities in Million Dollars 6/
	Total 1/	New			Total 2/	New		
1950/51	250	146	65	3,885			1,824	928
1952/53	251	122	103	3,611	2,040	1,070	1,739	1.215
1954/55	379	201	130	3,324	2,360	1,150	1,572	1,550
1956/57	409	183	177	2,997	3,110	1,460	1,360	2,081
1958/59	501	231	206	2,748	3,500	1,620	1,143	2,522
1960/61	663	335	230	2,400	4,260	1,970	879	2,995
1961/62	601	247	232	2,318	5,840	2,510	775	3,260
1962/63	545	169	224	2,251	8,480	3,000	667	3,630
1963/64	598	200	244	2,195	9,170	3,170	570	3,930
1964/65	633	245	260	2,125 4/			472	4,240

[1] 1960/61 prices paid by farmers used as the deflator.

[2] Replacement + new investment, figures for investment in buildings are estimates by the Ministry of Agriculture.

[3] Sliding three years average.

[4] Estimated because of changes in the statistic 1964/65

[5] 1 horse = 1; 1 ox = .5; 1 cow = .2 units.

[6] Nominal; calendar years 1950-1964.

Source: *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten* 1957, 1960, 1964, *Grüner Bericht* 1960, 1966.

Table 32. Average Capital Stock[1] by Farm Size Group and Type of Farming in the Green Report Survey Farms[2] 1956/57--1962/63 in Dollars per Hectare.

Farm Size Group in Hectares	1956/57	1957/58	1958/59	1959/60	1960/61	1961/62	1962/63	Percentage Change 1956/57--1962/63
<10	1370	1419	1496	1554	1559	1627	1668	+ 22%
10-<20	1248	1294	1346	1386	1413	1534	1586	+ 27%
20-<50	1175	1223	1261	1292	1346	1478	1491	+ 27%
50-over	1184	1209	1257	1268	1321	1363	1382	+ 17%
Type of Farming[3]								
Row-Crop	1339	1385	1444	1479	1513	1617	1649	+ 23%
Grain	1177	1215	1255	1295	1322	1451	1501	+ 27%
Grass and Other fodder	1159	1206	1265	1315	1332	1425	1471	+ 27%

[1]Includes land and farm buildings evaluated by capitalized net rents; livestock, machinery, operating capital.

[2]8,000 farms throughout West Germany used as basis for various calculations in the annual Green Report. They are not representative because the sample is not random.

[3]These types indicate only the emphasis of production; in most cases they are still "General Farming" type farms.

Source: *Landwirtschaftliche Buchführungsergebnisse* 1961/62 u. 1963. *Hersg: Bundesministerium für Ernährung, Landwirtschaft u. Forsten.* Bonn, 1964.

farms have been increasing their capital stock at a slightly higher rate than the row crop farms, but the absolute differences have widened.

We can go a step further and look at the breakdown of per acre capital composition by farm size group. Table 33 shows this for the state of Niedersachsen in 1962/63. The most marked difference between types of farms is in the relative share of the livestock and machinery components. The grass and fodder farms have by far the highest livestock-machinery ratio of the three farm types.

Also interesting to note is that the machinery share increases with farm size up to the 50 hectare and over size group in row crop and grass and fodder farms before declining whereas the decline comes in the 20-<50 hectare size group for grain farms. The indication here is that a relatively higher level of mechanization may be reached in the grain farms at a lower size level than in the other farm types thus causing the unit fixed costs to drop sooner.

The land and building capital component increases as a percent of total capital per 100 hectares in all farm types with farm size. The reason is probably not so much that more capital is invested in buildings but rather that some economies of size operate with respect to the other capital components particularly machinery and operating capital, and the livestock enterprise becomes less intensive as farm size increases.

Debt and Liabilities Level

Along with the increase in capital stock has come large increases in liabilities and debt. The prewar debts were largely erased after World War II. Then liabilities increased again by more than 400 percent between 1950/51 and 1964/65. (Table 31) Of the total gross return in agriculture in 1965, 3.6 percent had to be reserved for interest alone.

The level of liabilities in various farm size groups is indicated in Table 34. A slight tendency for the large farms to have heavier per acre debts exists. Long-term debt remains fairly stable across the farm size groupings but short-term debt increases with farm size at the expense of intermediate term debt and pensions. Presumably, large farms find it more profitable to borrow yearly operating funds under the short term debt and use their own money to a greater extent for intermediate term outlays. The pension cost is more nearly correlated with family size than with farm size, ergo the decreasing proportion.

The extent of the debt within individual states deviates considerably from the West German average. Schleswig-Holstein, Niedersachsen and Hessen have above average per hectare liabilities while Nordrhein-Westfalen has the lowest. With this exception liabilities decrease from north to south. This becomes obvious when we consider the fact that mechanization and land consolidation have progressed farther in the north.

Table 33. Composition of the Capital Stock by Farm Size Group and Type of Farming in Niedersachsen[1] 1962/63 in Dollars per Hectare.

Type of Capital	Farm Size in Hectares			
	<10	10-<20	20-<50	50-over
		Row-Crop Farms (Sugar Beets)		
Total in Dollars Per Hectare	1740	2155	1903	1668
Percent of Total				
Land + Buildings	49	56	58	62
Livestock	16	11	9	9
Machinery	15	17	18	13
Operating Capital	20	16	15	16
		Grain-Row-Crop Farms		
Total in Dollars Per Hectare	1662	1695	1468	1425
Percent of Total				
Land + Buildings	48	42	49	52
Livestock	19	19	17	17
Machinery	14	20	18	16
Operating Capital	19	19	16	15
		Grassland and Other Fodder Crop Farms		
Total in Dollars Per Hectare	1642	1410	1297	1189
Percent of Total				
Land + Buildings	49	47	49	55
Livestock	26	25	24	23
Machinery	8	11	12	10
Operating Capital	17	16	15	12

[1] Green Report Survey Farms

Source: *Landwirtschaftliche Buchführungsergebnisse* 1961/62 *und* 1962/63 *Hersg: Bundesministerium für Ernährung Landwirtschaft und Forsten*, Bonn, 1964.

An interesting picture emerges when we relate debt level to the farm unit value index or *Einheitswert*. The results are shown in Table 35. First, we see that the 10 to 20 hectare size group of farms are carrying the heaviest debt burden relative to the productive capacity of their real estate.

Table 34. Liabilities by Farm Size Group in West Germany July 1, 1964[1] in Dollars per Hectare.

Type of Liability	5-<10	10-<20	20-<50	50-over	Total
Total in Dollars Per Hectare	288	336	342	343	329
Short Term[2]	28	29	40	41	34
Intermediate Term[2]	33	24	18	17	23
Long Term[2]	29	38	35	37	35
Pensions[2,3]	10	9	7	5	8

[1] 6879 Green Report survey farms with over 5 hectares agricultural land

[2] Percent of Total

[3] Pensions mostly paid to family members (retirees) similar to certain types of life estate provisions in the U.S.

Source: H. J. Müller: *Fremdkapital und Guthaben in landwirtschaftlichen Betrieben zum Stichtag* 1.7.1964. *Berichte über Landwirtschaft* 1965, p. 684.

The greatest activity in terms of mechanizing and increasing farm size centers in this group at the present time.

Above, we stated that the debt level is highest in the north and declines southward. But, when related to *Einheitswert*, we find the lowest debt-*Einheitswert* ratio in the north indicating relatively high *Einheitswert* or productivity capacity and generally lower debt burden. Thus, even though it already has the highest absolute debt, the north still has on the average more capacity to carry further credit than the south.

Finally, when we look at the distribution of farms by the extent of debt relative to *Einheitswert* as shown in Table 36, we find considerable liabilities in German agriculture. In 1964, 27 percent of the Green Report survey farms recorded a debt in excess of 200 percent of their *Einheitswert* while 49 percent were above 100 percent. Nevertheless, on the average there is still room for more debt. Banks will loan up to 2 to 3 times the *Einheitswert* depending on the quality of management on the farm. Thus, we may conclude that at this point in time the debt burden is not a strong deterrent to structural change and modernization.

Mechanization Level Development

By 1949, most farms in West Germany had access to electric power. Draft power, however, was provided for the most part by animals since only 75,000 tractors were in use on farms. Row crop harvesting was in a low state of mechanization and even in grain harvesting only 149 combines were available

Table 35. Liabilities as Percent of *Einheitswert* by Farm Size Group in West Germany July 1, 1964.[1]

Region	Farm Size in Hectares				
	5-<10	10-<20	20-<50	<50	Average All Size Groups
	Percent of *Einheitswert*				
Northwest Germany[2]	97	118	104	97	105
Middlewest Germany[3]	118	128	97	88	116
Southwest Germany[4]	110	118	102	85	110
West Germany	108	120	103	94	108

[1] 6879 Green Report survey farms with over 5 Hectares agricultural land

[2] Schleswig-Holstein, Niedersachsen, Nordrhein-Westfalen

[3] Hessen, Rheinland-Pfalz, Saarland

[4] Baden-Württemberg, Bayern

Source: H. J. Müller; *Fremdkapital und Guthaben im landwirtschaftlichen Betrieben zum Stichtag* 1.7.1964. *Berichte über Landwirtschaft* 1965, p. 684.

in all of West Germany. Mechanization levels in livestock enterprises are indicated by the fact that only 5600 farms milked with machines.

The slow pace of mechanization in the early 1950's was plagued with conflicting ideas by different experts and influential farmers on the direction to proceed. Ways of thinking and customs based on previous conditions had to be altered and this turned out to be a painful and expensive process. For example, small family farms were advised to buy 12 to 15 horsepower tractors because of their low average cost. But after buying, many farmers found them not powerful enough to pull certain machines such as combines and in

Table 36. Distribution of Farms[1] by "liabilities as Percent of *Einheitswert*" Groups in West Germany, July 1, 1964.

Liabilities as Percent of *Einheitswert*					
0	.1-<50	50-<100	100-<200	200-<300	over 300
Distribution of Farms in Percent[1]					
6	27	18	22	11	16

[1] Green Report survey farms with >5 hectares agricultural land

Source: *Grüner Bericht* 1966, p. 62

many cases not adaptable to auxiliary equipment such as a front loader. Combines were loaded with extra equipment including straw baler, chaff wagon, and grain bagging platform. The bagging platform was necessary because no equipment had been developed for handling loose grain. With the chaff wagon the farmers hoped to prevent weed contamination as well as to collect the chaff for livestock feed. These innovations such as the bagging platform either soon became obsolete or it was found the process could be handled better with a separate operation such as the baling of the straw. The experimental period in mechanization which reached its peak in the late 1950's and is still in evidence, has been a very costly era for German farmers. A great deal of technical obsolescence and capital destruction has occurred as a result of a very rapid rate of technical invention and progress in production methods and techniques.

To discuss the development and future tendencies in mechanization in detail for the whole array of capital production items would be an impossible task here. Therefore, we will look only at certain selected key items to include power, mechanization of crop production, mechanization of harvest, and mechanization in livestock production. Data on the level of mechanization come primarily from the 1960 census.

Power

A rapid introduction of tractors occurred after World War II. Nevertheless, in 1960, 38 percent of all farmers had at least 1 horse and 19 percent still used cows for draft purposes. (Table 37) Cows were used for draft primarily on farms with less than 10 acres and the greatest concentration of these animals was in southern Germany while horses were found more frequently in the north.

Table 37. Draft Animals by Farm Size Group in West Germany[1] 1960.

Farm Size Group Hectares	Farms With Horses[2] As Percent of All Farms	Average Number of Horses[2] Per Farm	Farms With Draft Cows As Percent Of All Farms	Draft Cows As Percent Of All Cows
2-<5	12	1.1	39	42
5-<7.5	31	1.2	24	18
7.5-<10	44	1.3	12	7
10-<20	62	1.5	4	
20-<50	56	1.8	.5	.5
50-over	38	2.9	.2	.3
Total	38	1.5	19	11

[1]Without Saarland

[2]Three years of age and older

Source: P. von Harder, *Wirtschaftliche Voraussetzungen und Entwicklungslinien der Mechanisierung in der Landwirtschaft der BRD seit* 1949.

The rate of decrease in the use of draft animals was probably greater in the early years of the change to tractor power than the decrease in numbers of these animals would imply. Many farmers were a bit distrustful of the dependability of the tractor so they kept some draft animals around for a few years just in case the tractor did not perform up to expectations. As Table 38 indicates, the number of draft animals decreased by over half between 1949 and 1960 and then decreased again by half between 1960 and 1965. The number of draft cows decreased relatively more than the number of horses but we must remember the increased use of horses for pleasure and sport partially offsets the difference in rates.

West Germany has more tractors per land area than any other country in the world.[5] The large number is less significant when we consider that the average tractor had only 22 metric horsepower in 1964. The trend, however, is toward more powerful machines as evidenced by the fact that tractors purchased new in 1964 averaged 30 metric horsepower. In 1960 43 percent of all farms with more than .5 hectares used operator owned tractors. If we consider only farms with 5 hectares or more, the figure is about 85 percent. With increases in farm size comes an increasing portion of farms with tractors. (Table 39)

Table 38. Number of Draft Animals and Tractors in West Germany. (in 1000's)

	1949	1960/61	1961/62	1962/63	1963/64	1964/65
Horses 3 Years And Older	1,208	660	573	520	452	374
Oxen	323	29	22	16	12	8
Draft Cows	1,830	690	561	435	335	235
Tractors	95	857	938	999	1053	1107
	1959/60	1960/61	1961/62	1962/63	1963/64	1964/65
Animal Power Per 100 Hectares Metric Horsepower	7.0	6.2	5.5	4.7	4.0	3.3
Tractor Power Per 100 Hectares Metric Horsepower	104.2	118.2	134.1	147.0	158.9	171.2

Source: *Die Zugkräfte der Landwirtschaft im Bundesgebiet. Agrarwirtschaft* 1965, p. 380.

The use of not individually owned tractors[6] is of little importance. Users of such tractors in the 2-<5 hectare size group amount to less than 10 percent of all farms. In all other farm size groups less than 5 percent of the farms use not individually owned tractors.

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[5] von Harder, p. 68.

[6] This includes custom work, neighbor help and various types of cooperatives.

Table 39. Use of Operator Owned Tractors as Percent Of All Farms by Farm Size Group in 1960.

Farm Size Group in Hectares					
.5-<5	5-<10	10-<20	20-<50	50-over	Total
Use of tractors as percent of all farms within each size group					
16	63	79	91	95	43
Percent distribution of the tractors					
19	27	30	19	5	100

Source: *Statistisches Jahrbuch über ELF*, 1964, Bonn 1965.

Farmers had electric power at their disposal before they had tractors. As far back as 1930 most farms had the use of electricity for lights and by 1960 the portion of all farms stood at 99.5 percent. But on farms of less than 10 hectares mechanization was restricted because quite often the lines were not adequate to carry the power for electric motors. This bottleneck is rapidly being corrected, primarily through Green Plan funds.[7]

Mechanization of Crop Production (excluding harvest)

Table 40 has 2 columns of percentages under each size group. The first column (IO) designates the percentage of total farms within each size group which use the various types of machines listed and where the machines are owned by the farm which uses them. The second column (IO + NIO) includes the first column plus the additional percentage of farms from the size group total which use the various machines but do not own them. These farms which do not own the machines use them as custom hire, neighbor help, or under machine cooperative arrangements. Double counting has not been eliminated so the percentages show the maximum number of farms which could have used those machines and in some cases this will exceed 100 percent. Farms with more than one machine or machines which work on more than one farm both bias the data upward thus making the mechanization level appear greater than is actually the case.

Small farms make heavy use of nonowned machines in an attempt to mechanize without the large capital investments necessary to own them. Even the large farms take part in some form of nonowning use of specialized and relatively expensive machines such as chemical sprayers and manure spreaders.

The table demonstrates that such activities as seeding, weeding, and fertilizing on farms with less than 20 hectares are in quite a low state of mechanization. This is rather surprising at first since most machines of this type can be adapted for multi-purpose operation without substantially changing the cost per foot of machine width. But with such small machines only a modest saving of labor can be accomplished at best. On the small and numerous middle size farms, especially those with a high proportion of grass-

[7] *Grüner Plan*, 1966, pp. 10-11.

Table 40. Mechanization of Seed Bed Preparation, Cultivation and Seeding by Farm Size Group in West Germany - 1960.

	Farm Size Group in Hectares													
	2-<5		5-<10		10-<20		20-<50		50-<100		100-over		Total	
	IO	IO + NIO	IO	IO + NIO	IO	IO + NIO	IO	IO + NIO	IO	IO + NIO	IO	IO + NIO	IO	IO + NIO
	Machine Use as Percent of all Farms With Arable Land Within Each Size Group													
Tractor Plow	21	N/A	48	N/A	69	N/A	87	N/A	95	N/A	98	N/A	49	N/A
Grain Drill	10	23	38	59	64	82	81	93	97	101	112	114	41	58
Row Cultivator[1/]	3	7	15	22	37	49	66	76	102	107	135	136	24	31
Chemical Sprayer	3	15	4	29	4	41	7	53	23	73	60	95	4	31
	Machine Use as Percent of all Farms With Agricultural Land within Each Size Group													
Fertilizer Spreader	2	7	12	24	41	56	72	85	91	99	93	99	23	34
Manure Spreader	0	2	2	4	12	18	35	46	45	61	48	60	8	12
	Machine Use as Percent of All Farms With Potatoes Within Each Size Group													
Potato Planter	1	3	3	8	8	16	17	30	34	48	45	49	5	11

N/A = Not Available.
IO = Individually owned and used machines.
NIO = Not Individually Owned and used machines (Custom work, neighbor help, coop.)[2]

[1]Animal and tractor pulled machines.

[2]Double counting not eliminated; hence (IO + NIO) shows the maximum number of farms which could have used those machines.

Source: *Statistisches Bundesamt*/Wiesbaden . *Ergebnisse der Landwirtschaftszahlung* 1960. Vorbericht 15, 17

land, it is not profitable to employ machinery in all of the numerous work activities. In many instances machines would at best lighten the labor task without saving labor time.

Mechanization or innovation of labor saving technology is not an automatic process. Rather, certain conditions must be simultaneously present in order for its accomplishment. First, the technology must be available and at a cost which bears a favorable relationship to the opportunity cost of the labor it is to replace. Second, labor must have alternative employment opportunities either outside or within agriculture which will lower the surplus labor on the farm and cause labor costs to be high relative to the cost of mechanization if we assume no production increase. Some yield increasing technologies such as the application of chemicals or commercial fertilizer when none was used before, may actually be labor requirement increasing since some amount of labor is necessary to perform this function which is new to the farm. This may cause not only mechanization to handle the new function, but further mechanization of existing processes in order to free some labor time for the new function. But in many cases the smaller farms do not have the space or building capacity to accommodate or the size to warrant some of the more advanced technologies. And in other cases, they do not have the capital necessary for the size investment mechanization entails. Thus, to a large extent, mechanization potential is tied to farm structure and particularly the structural variable of size.

Finally, the use of commercial fertilizer is increasing throughout West Germany with a north to south level of use differential. Table 41 presents the fertilizer use per hectare in each state of the four major types of fertilizer for the 1960/61 - 1964/65 period. The use of fertilizer is increasing in all areas and as might be expected since they are using it at a lower level the south is increasing at a slightly faster rate than the north. During the next decade the north-south use gap will continue to narrow but will most certainly not close. While the marginal increase in yields would push for a closing of the gap by the south, the offsetting influences are farm structure and the educational level of the farmers.

Mechanization of Crop Harvest

In the harvest of fodder and hay, it is difficult to briefly characterize the level of mechanization for such various tasks as mowing, turning, loading, transporting, unloading, and storing since numerous technical combinations are possible and these must be evaluated differently from one region to another. We will therefore limit the discussion here to mechanization levels in the mowing and loading operations which will serve as a proxy for all the activities noted above. By 1949, few farmers still used only a scythe. In the 10-<20 hectare farm size group, 85 percent of the farmers owned horsemowers, while on larger farms the percentage was even greater.

By 1960, the number of horse mowers was reduced by half. They were replaced by some 575 thousand tractor mowers and on small farms by 96 thousand small self-propelled mowers. The turning and windrowing of hay was also highly mechanized by this time except on farms of less than 10 hectares.

Table 41. Use of Commercial Fertilizer in West Germany by State and Type 1960/61-1964/65 in Kg per hectare Agricultural Land.

Type State	1960/61	1961/62	1962/63	1963/64	1964/65[1]
Nitrogen (N)					
West Germany	43.1	43.7	54.1	52.7	55.5
Schleswig-Holstein	54.8	56.6	67.4	64.3	69.3
Niedersachsen	52.6	53.9	65.4	63.7	69.4
Nordrhein-Westfalen	59.5	62.4	72.5	71.1	72.7
Hessen	41.6	42.4	50.9	50.1	52.4
Rheinland-Pfalz	46.0	46.3	56.2	53.0	55.5
Baden-Württemberg	27.6	27.3	37.1	34.8	37.3
Bayern	32.0	31.0	41.5	41.8	42.6
Saarland	18.9	20.4	29.8	22.8	28.9
Phosphate (P_2O_5)					
West Germany	46.2	44.6	50.7	53.9	57.7
Schleswig-Holstein	57.2	55.1	61.0	60.9	64.6
Niedersachsen	49.6	47.7	54.6	57.8	62.1
Nordrhein-Westfalen	54.7	49.9	54.1	61.0	63.0
Hessen	41.9	42.7	49.1	51.0	57.0
Rheinland-Pfalz	49.5	45.5	53.5	56.5	61.4
Baden-Württemberg	37.3	35.8	41.0	44.9	48.5
Bayern	41.4	41.8	48.1	50.9	54.4
Saarland	19.9	17.9	24.3	25.7	29.3
Potash (K_2O)					
West Germany	70.2	72.9	77.5	79.4	83.8
Schleswig-Holstein	72.8	74.9	80.9	78.7	75.8
Niedersachsen	82.9	85.2	92.6	95.5	98.0
Nordrhein-Westfalen	87.4	91.0	94.8	101.2	104.6
Hessen	61.8	64.4	67.5	69.1	73.6
Rheinland-Pfalz	65.9	66.6	69.9	74.0	77.2
Baden-Württemberg	54.3	55.4	59.3	60.3	67.3
Bayern	63.3	67.7	71.1	71.1	78.8
Saarland	24.5	25.7	30.1	33.0	34.6
Lime (CaO)					
West Germany	37.5	38.3	34.1	34.6	37.4
Schleswig-Holstein	36.2	38.6	34.6	31.8	36.2
Niedersachsen	48.6	51.5	43.9	46.3	54.0
Nordrhein-Westfalen	48.2	54.2	45.2	52.0	58.0
Hessen	39.3	38.6	29.0	28.4	24.7
Rheinland-Pfalz	31.7	34.0	29.3	28.3	31.9
Baden-Württemberg	15.0	15.0	11.0	12.4	12.3
Bayern	36.2	33.3	35.3	32.5	32.4
Saarland	5.4	5.0	6.0	7.4	9.6

[1]Preliminary

Source: *Bundesministerium für Ernährung, Landwirtschaft und Forsten Jahresberichte über die Düngemittelversorgung im Bundesgebiet. Statisches Bundesamt, Fachserie D, Industrie und Handwerk, Reihe 6.*

Loading machines were not in very widespread use by 1960 since they require large tractors for power which are not available on the small farms. Of the 1960 total of 56 thousand loading machines, there were 20 thousand tractor mounted machines, 17 thousand loose hay cart loaders, 12 thousand balers and 7 thousand choppers. Most of these machines were on farms with more than 50 hectares. Since 1960, although figures are not available, hay and forage loaders have been one of the preferred purchases of mechanizing farmers. Nevertheless, full mechanization of the loading process is far from being reached.

Full mechanization of hay and fodder harvest in general will be slow in coming because of the influence of external factors such as type of buildings at the farmstead, method of feeding, extent of land fragmentation, distances between farmsteads and fields, and extent of slope. A wide variety of equipment combinations are available and decisions as to the best combination for individual cases are often very difficult.

Fodder beets offer strong competition to other fodder crops on many farms because of their relatively high yields and excellent nutritional characteristics. Their greatest disadvantage is the large labor requirement during harvest which has been reduced very little by mechanization up to the present time. The tractor mounted front loader is the most widely used machine in fodder beet harvest. But this is not very important as evidenced by the fact that in 1960, 922 thousand farms with more than 2 hectares of land were raising fodder beets while only 200 thousand tractor front loaders were in use. No less important are the small areas devoted to fodder beets even on the larger farms which tend to limit the investment in specialized harvest equipment for this crop. In the future more and more farms will forego fodder beet production.

The number of combines for grain harvesting increased markedly since 1955 as Table 42 shows. Table 43 indicates that about 30 percent of the grain hectares in 1960 were harvested by combine. Although figures are not available for 1965, we can make a reasonable estimate. By referring again to Table 42, we find that the number of combines increased from 54 thousand in 1960 to 120 thousand in 1965, an increase of 122 percent. Now applying this increase to the percentage of grain hectares harvested in 1960 by combine we estimate that about 67 percent was harvested by combine in 1965. This may even be a bit low because capacity of new combines purchased probably increased during the period.

Ownership and use of combines representing the new and binders representing the technological level being replaced show an interesting pattern. According to Table 44, in 1960 use through ownership exceeded nonownership use of binders already at the 10-<15 hectare size group while for combines this was not the case until the over 50 hectare size group was reached. Fur-

thermore, even on the larger farms the binder was still predominant. It may be some time before the binder is completely replaced, and then it may not be entirely by the combine but by a combination of the combine and some of the various forms of haying equipment. The use of binders is competitive as long as the cost of transition to the combine is not offset by the saving in labor cost and timeliness of operation.

Table 42. Number of Combines in West Germany 1949-1965

1949	1955	1960	1961	1962	1963	1964	1965
145	7,500	54,000	72,000	85,000	95,000	107,000	120,000

Source: *Statistisches Jahrbuch* 1960, 1965.

The combine is a very expensive piece of equipment to purchase and the grain area in most farms is small relative to the capacity of most combines. Thus, a very high average cost per hectare harvested is normally incurred through individual ownership. The table indicates that the majority of farmers using combines have not purchased a combine individually but rather have access to one through machine hire, a neighbor help arrangement, or by belonging to a machinery cooperative.

Table 43. Use of Machines in Grain Harvesting By Type of Machine in West Germany[1,2] 1960

Type of Machine	Used By Farms As Percent Of All Farms With Grain	Hectares Harvested As Percent of Total Hectares with Grain
Grass and Grain Mower or Scythe	30-40	10-15
Binder	40-45	60-65
Combine	17-19	25-30

[1] Farms >2 Hectares Agricultural Land

[2] Estimates

Source: P. von Harder, *Wirtschaftliche Voraussetzungen und Entwicklungslinien der Mechanisierung in der Landwirtschaft der BRD seit* 1949. *Berichte über Landtechnik H.* 85, 1965, p. 120.

Between 1949 and 1960 the number of farms with 2 or more hectares using machines for potato digging doubled to include about 55 percent of all farms with potatoes. The main form of mechanization was the potato spinner and occurred primarily in southern Germany. More advanced machines such as elevator diggers and complete potato harvesters were found more frequently in northern Germany.

Table 44. Use of Binders and Combines in Grain Harvesting by Type of Ownership and Farm Size in West Germany 1960.

Type of Machine and of Ownership 1/	Farm Size Group in Hectares								
	2-<5	5-<7.5	7.5-<10	10-<15	15-<20	20-<30	30-<50	50-over	total
	Used in . . . % of all farms with grain within each size group								
1. Binder (Individually Owned)	2	10	24	43	58	66	76	89	27
Binder (Not Individually Owned) 2/	13	24	30	27	21	15	8	3	20
2. Combines (Individually Owned)	.2	.4	.8	2	4	9	18	43	3
Combines (Not Individually Owned) 2/	17	14	14	16	19	23	29	34	17

[1]Individually owned and used or not individually owned and used.

[2]Double counting not eliminated.

Source: *Statistisches Bundesamt*/Wiesbaden, *Ergebnisse der Betriebszählung* 1960, *Vorbericht* 12, 15, 17.

In 1960, 40 to 45 percent of the farms representing 15 to 20 percent of the potato crop harvested at a very low level of mechanization. (Table 45) The technical implements included the hand hoe and the harrow. A similar percentage of farms representing 55 to 60 percent of the crop harvested with the potato spinner while 11 to 14 percent of the farms with 25 to 30 percent of the crop area used elevator diggers or complete potato harvesters. The more advanced machines are used on the larger farms and even here they are usually owned under a cooperative arrangement or are brought in as custom hired machines. Small farms prefer the potato spinner because it requires less draft power.

In areas with heavy soil the less advanced machines are generally preferred. The more sophisticated machines work best in the more sandy soils. The general stage of mechanization in potato harvesting is relatively low with large labor requirements. It appears that most farms will divert potato hectares to other crops before they will mechanize due to the high relative cost of the specialized equipment required.

Table 45. Use of Machines in Potato Harvesting By Type of Machine in West Germany[1,2] 1960

Type of Machine	Used By Farms As Percent Of All Farms With Potatoes	Hectares Harvested As Percent of Total Hectares With Potatoes
Hand Drag or Plow	40-45	15-20
Potato Spinner	40-45	55-60
Elevator Digger	9-11	20-25
Complete Potato Harvester	2-2.5	5-7

[1]Farms >2 Hectares Agricultural Land

[2]Estimated

Source: P. von Harder, *Wirtschaftliche Voraussetzungen und Entwicklungslinien der Mechanisierung in der Landwirtschaft der BRD seit* 1949. *Berichte über Landtechnik H.* 85, p. 120, p. 133. 1965.

On the average, the 1960 sugar beet harvest was more mechanized than the potato harvest. This was partly a result of the available techniques and partly because sugar beet production is concentrated on medium and large farms which can make use of more advanced machines. According to Table 46 about half the farms with about one third the total sugar beet area used a very low mechanization level. The Pommritz method represents this level and is a substantial improvement over the single operation hand method. According to the Pommritz method, the beet tops are cut and gathered while the beets are still in the ground. Then the beets are dug with a simple plow. A labor saving of 30 to 40 percent over the old hand method is accomplished.

Table 46. Use of Machines in Sugar Beet Harvesting By Type of Machine in West Germany[1,2] 1960.

Type of Machine	Used by Farms As Percent Of All Farms With Sugar Beets	Hectares Harvested As Percent of Total Hectares With Sugar Beets
Pommritz and Other Simple Harvest Methods	50-55	25-35
Multirow Beet Lifter	20-23	24-28
Beet Lifter-Loader (Beets or tops)	4-5	7-10
Complete Beet Harvester (Beets and Tops)	17-20	30-35

[1]Farms >2 Hectares Agricultural Land

[2]Estimated

Source: P. von Harder, *Wirtschaftliche Voraussetzungen und Entwicklungslinien der Mechanisierung in der Landwirtschaft der BRD seit* 1949. *Berichte über Landtechnik* H. 85, 1965, p. 120, p. 142.

Since 1960, mechanization has spread rapidly in beet harvesting. Many farms which previously harvested beets with animal labor switched directly to the highest level of mechanization. But on heavy soils or steep slopes, this change is difficult and in these areas the tendency is to give up the sugar beet enterprise.

The crop sector is moving toward a higher level of mechanization but at different rates for various crops, and from different levels depending on the crop, the area, and the farm size. The most highly mechanized are the grain crops, followed by sugar beets, hay and forage crops, and finally fodder beets and potatoes. Mechanization levels for any given crop are higher in the north and deteriorate toward the south. The larger the farm, the higher the mechanization level.

Future mechanization of forage and fodder beet harvests presents a complex problem. One sure trend is the increase in silage production which will work to the disadvantage of fodder beets and hay. The grain harvest should be at least 90 percent combined by 1975. A similar high order of mechanization of the sugar beet harvest is not anticipated and this is even more true of the potato harvest. A continued increase in the number of complete harvesters is expected but the rate of increase will be strongly limited by the rate of change in farm structure.

The general lines of mechanization in crop production are clear. Generally, larger more complicated machinery which results in a higher labor productivity is being preferred. Along with this development, at least for a short run period, will be an increase in the use of nonowned machinery by the small farms. In this respect, along with custom hire, neighbor help, and

machine coops is a new institution commonly called a machine ring. This is an organization in which the purchase and use of machinery is coordinated among a group of farms usually by a hired manager. Payments and receipts of individual farmers in the ring are made on the basis of services performed.

In looking at probable development of specific types of machinery we expect virtually all draft animals to be replaced by tractors within the next decade. The medium-sized multipurpose tractor which can pull a 2-bottom plow will become the most popular. Farms which cannot utilize this level of mechanization due to size or other factors will cease to exist as separate units at an ever increasing rate.

Other production and cultivation machine development will emphasize improvement in labor productivity by several means. First, machines purchased will be larger even to the extent of outrunning farm structure change. They will also be capable of operating at higher speeds as partially evidenced by the increase in average horsepower of new tractors purchased from year to year. Second, machines will be more multipurpose or capable of being hitched together to perform several tasks simultaneously. An example would be cultivating, seeding, fertilizing, and spraying for weeds in one operation. Third, mechanized operations will be replaced to some extent by chemicals in combination with minimum tillage operations. And fourth, a tendency for some enterprise specialization is growing. But here again farm structure change is a limiting factor.

Farm size and degree of specialization are important factors in determining the level and type of mechanization. Table 47 presents the approximate number of hectares upon which various machines must be used annually to warrant ownership. Table 48 presents for three states the percentage distribution of farms and hectares of land engaged in the production of various crops by groupings of number of hectares in the particular crop on the individual farm.

By comparing the minimum hectares for economic ownership of machines from Table 47 with the percentage of farms and hectares with at least that many hectares per farm of a given crop in Table 48, we find few farms capable of economic ownership of the machines listed in Table 47. We also find that

Table 47. Approximate Size of Production Necessary to Warrant Ownership of Various Machines in West Germany[1,2]

Type of Machine	Minimum Annual Use to Warrant Ownership
Tractor drawn binder 7'	40
Tractor drawn Combine 7'	50
Potato Elevator Harvester	30
Potato Complete Harvester (Bunk Hopper)	30
Sugar Beet Complete Harvester (Bunk Hopper) Small	30
Sugar Beet Complete Harvester (Bunk Hopper) Large	40

[1]For intermediate weather and structural conditions. [2]In Hectares

Source: KTL -- *Kalkulationsunterlagen* Bd. 1 + 2.

Table 48. Percentage Distribution of Farms and Land with Selected Crops By Size of Production in Hectares per Farm in That Crop 1960.

Hectares Of Crop Per Farm	Niedersachsen		Hessen		Baden Württemberg	
	% of Farms With Crop	% of Land With Crop	% of Farms With Crop	% of Land With Crop	% of Farms With Crop	% of Land With Crop
Grain						
2-<5	47.8	19.5	60.0	34.7	73.6	50.7
5-<10	31.2	27.3	32.0	38.8	21.8	32.0
10-<20	15.1	26.2	6.5	15.0	3.7	10.3
20-<50	5.1	18.6	1.1	6.1	.7	3.8
50-over	.8	8.4	.4	5.4	.2	3.2
Potatoes						
2-<5	78.4	54.9	8.9	72.4	9.1	7.8
5-<10	16.8	28.0	.7	13.4	.9	1.2
10-<20	4.2	12.8	.4	9.4	.0	.7
20-<50	.6	3.9	.0	4.0	.0	.3
50-over	.0	.4	.0	.8	.0	.0
Sugar Beets						
2-<5	66.5	36.0	81.3	51.6	8.2	47.4
5-<10	22.4	27.2	10.9	17.1	.8	12.8
10-<20	7.9	19.4	6.2	20.5	.5	16.8
20-<50	2.9	12.9	1.6	9.9	.5	20.3
50-over	.3	4.5	.0	.9	.0	2.7

Source: *Statistisches Bundesamt. Ergebnisse der Betriebszählung* 1960.

the proportion of farms able to economically innovate the level of mechanization represented in the table varies considerably from one state to another with the northern state of Niedersachsen having the greatest potential and the southern state of Bayern having the least. Further, we see that a larger proportion of the grain area can be mechanized than the sugar beet or potato areas. From this and other evidence presented above, it is obvious that the size and diversified organization of the average West German farm greatly restricted high level mechanization in 1960. While change has taken place rapidly since 1960 in relative terms, absolute progress toward farm organization for optimum use of available technology has fallen far short of that necessary in most areas of production to make the German farmer competitive in the framework of the Common Market.

Mechanization in Livestock Production

According to a rough estimate about half the labor input in West German agriculture is required in the livestock sector. Statistics concerning mechanization in this sector are not necessarily an accurate guide to the mechanization level because numbers of machines do not reveal quality or the efficiency of the physical plant within which these machines are operating. Therefore, any conclusions must be viewed with caution.

Table 49. The Use of Technology in Cattle Production by Farm Size Group in West Germany - 1960

Farm Size Group Hectares	Number of Cows Per Farm	Total Number of Cows in 1000's	Cows Milked By Machines As Percent Of All Cows	Farms With Self Waterers As Percent of All Farms	Manure Collecting Equipment As Percent of All Farms With Cattle
		Within Each Size Group			
2-<5	2.4	806	4	29	.1
5-<7.5	3.7	703	14	45	.3
7.5-<10	4.7	666	27	53	.5
10-<15	5.9	1086	45	60	1.4
15-<20	7.5	723	63	66	3.1
20-<30	9.5	737	77	71	5.2
30-<50	12.9	535	86	76	7.9
50-<100	19.3	248	87	76	12.5
100-over	43.2	106	86	68	22.0
Total	5.2	5610	46	48	1.6

Source: *Statistisches Bundesamt*/Wiesbaden. *Ergebnisse der Betriebszählung* 1960. *Vorbericht* 13, 15, 18.

The cattle enterprise has a dual output of milk and meat. We can say very little of a quantitative nature about beef and veal production. Qualitatively, we can say that mechanization is generally at a very low level. The last two columns in Table 49 show in 1960 an average of 48 percent of the farms with cattle including dairy had self watering systems and only 1.6 percent had mechanical manure collecting equipment. Only a very few farms have beef and veal herds of over 100 head and no feedlot operations exist as we know them in the U.S. Automatic feeding systems are almost nonexistent except on a few farms, primarily those which have had their farmsteads moved onto the land from the village and these are found mostly in the north.

Again referring to Table 49, 46 percent of all cows on farms over 2 hectares were milked by machine in 1960. As farm size and herd size increases, this percentage also increases from 4 percent in the 2 to 5 hectare size group and then levels out at about 86 percent on farms with 30 or more hectares. Farms with less than 10 cows only ease the labor by milking with machines because labor time remains essentially the same. Nevertheless, 60 to 70 percent of all cows milked by machine were found in 1960 on farms with less than 10 head. In 1960, some 295 thousand milking machines were counted. By 1965 this figure had jumped to 440 thousand and the percentage of all cows milked by machine had climbed to about 67 percent.[8] Milking machines are the easiest technology to innovate in dairying. The rate of increase in pipeline systems, bulk tanks, herringbone or other modern milking parlor arrangements, automatic feeding systems, and manure collecting equipment is much slower due to both high cost and difficulty in adapting present building and farmstead facilities to this new technology. Thus, using the increase in milking machine numbers as a proxy for technological advance in the cattle enterprise without reservation would paint a much too rosy picture.

One barrier to the use of U.S. type technology is the dependence of the cattle enterprise on home grown feed in the form of roughages. Under present cost conditions, farmers in high roughage yield areas can produce the same nutritional level with roughage for about one third the cost of concentrates.[9] Thus, concentrates are used primarily to supplement other feed. In 1963/64 only 19 percent of the nutrient input in cattle production was from concentrates.[10] Ten years prior the proportion was only 12 percent. The use of concentrates will probably increase as the labor cost of producing and feeding roughage increases but will remain low in cattle feeding programs compared to the U.S.

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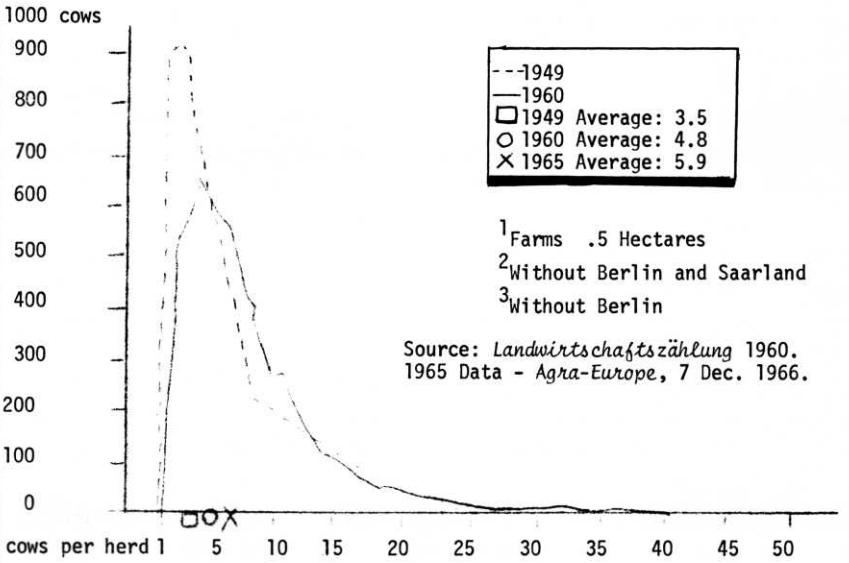
[8] *Agra-Europe* No. 45, 1965.

[9] E. Reisch, *Betriebswirtschaftliche Aspekte der Rindviehhaltung in der BRD*, *Züchtungskunde*, 1965, *Heft* 9/10, p. 404.

[10] R. Plate, *Marktwirtschaftliche Aspekte der Rindriehhaltung in der BRD* *Züchtungskunde*, 1965, *Heft* 9/10, p. 388.

Figure 6. Distribution of Milk-Cow Population by Size of Herd[1] 1949[2], 1960[3]

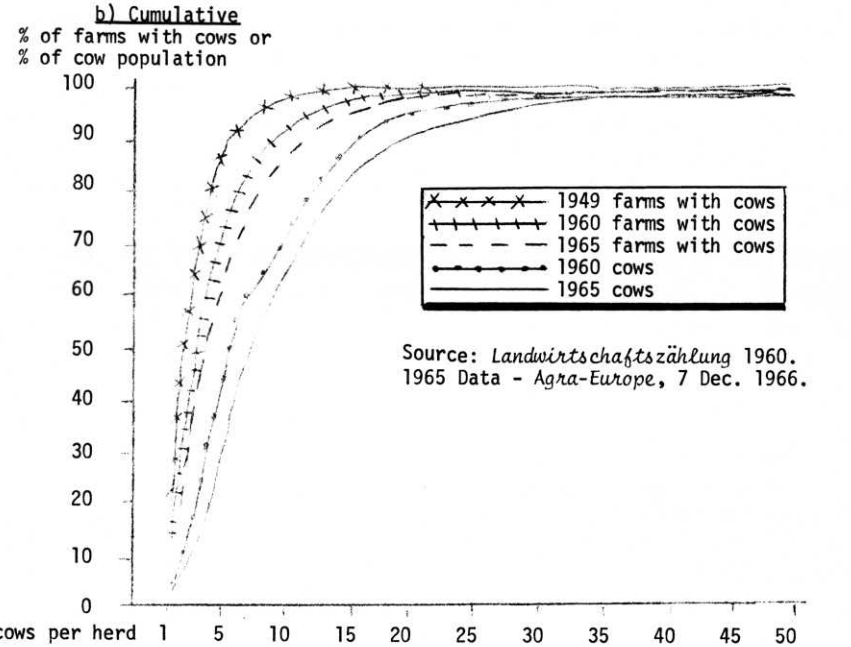
a) Distribution of Cow Population



[1]Farms .5 Hectares
[2]Without Berlin and Saarland
[3]Without Berlin

Source: *Landwirtschaftszählung* 1960.
1965 Data - *Agra-Europe*, 7 Dec. 1966.

b) Cumulative



Source: *Landwirtschaftszählung* 1960.
1965 Data - *Agra-Europe*, 7 Dec. 1966.

Another factor is the concentration of cattle in farm herds too small to efficiently use existing technology. Figure 6a presents the distribution of the cow population by herd size and the change from 1949 to 1960 to 1965. The distribution of the cow population is extremely one sided in favor of small herds and a very small portion of the population is in herds of over 25 cows. To be sure, the distribution shifted to the right between 1949 and 1960 but the average herd size increased only from 3.5 to 4.8 cows per farm. The rate of shift speeded up between 1960 and 1965 when the average herd size stood at 5.9 cows. Figure 6b shows the cumulative distribution of farms with cows and cows by herd size. In 1960, 92 percent of all farms had less than 10 cows and 72 percent of the cows were in herds of less than 10 cows. By 1965 the percentages had changed to 88 percent and 66 percent respectively.

If a herd of 25 cows were considered the lowest economic threshold for highly mechanized milk production, only 2 percent of the farms and 6 percent of the cow population were above this threshold in 1960. And when we move from this minimum herd size for high level mechanization to one of 70 cows the capital cost per cow can be cut about in half.

In swine production the type of building is more critical in determining mechanization potential as well as feed efficiency than in cattle production. The building must be relatively well insulated and ventilated which means high initial cost as well as more costly installation of new technology. In 1960, only about .2 percent of all farms with pigs used mechanical manure clearing equipment and few had automatic feeding installations. One reason for the lack of automatic feeding is that only about 43 percent of the pork output is produced with grain. The next most popular feed is potatoes. About half the West German potato crop in the past several years has been used for feed and in 1962/63, 91 percent of that was fed to pigs. Ensiling of the feed potatoes results in a considerable reduction in labor requirements as contrasted to daily steaming before feeding. Despite the advantage of silage, only 11 to 15 percent of the feed potato crop is currently being ensiled. We do not look for the absolute amount ensiled to increase. Rather, due to the high labor cost of both growing and feeding potatoes, the potato area will decrease markedly and grain will be substituted in the feeding process.

To be sure, per hectare productivity of potatoes for feed in favored areas is unsurpassed. To raise a pig to a sale weight of 110 Kg on potatoes requires approximately 1000 Kg potatoes plus 110 Kg grain plus 30 Kg protein concentrate. A good potato yield is 24 thousand to 25 thousand Kg per hectare. Thus, one hectare will produce about 24 hogs fed on potatoes. With grain feeding a 110 Kg hog requires about 350 Kg grain plus 25 Kg protein concentrate. A good grain yield is 3200 to 3500 Kg per hectare. Therefore, only 9.5 to 10 hogs can be produced per hectare when fed on grain. But the

labor cost differential in raising and feeding potatoes versus grain is great enough that even with the technical relationship favoring potato feeding by about 2.5:1, pig producers are switching from potato to grain feeding. Furthermore, the rate at which they are switching will probably be even higher in the next decade because technical improvements are coming along more rapidly in raising and feeding grain than potatoes.

The switch from potato to grain feeding is partly a phenomenon of herd size. Once the herd size becomes large enough to utilize the technology associated with grain feeding the labor cost differential tips the economic scales toward grain. And herd size is increasing as shown by Figure 7. In 1949, less than 2 percent of the farms with pigs had herds of 20 or more. By 1960 the percentage had increased to about 8 percent with 37 percent of the pig population in herds of 20 or more. Unfortunately, no data are available for years since 1960 but the trend toward more large herds is known to be continuing.

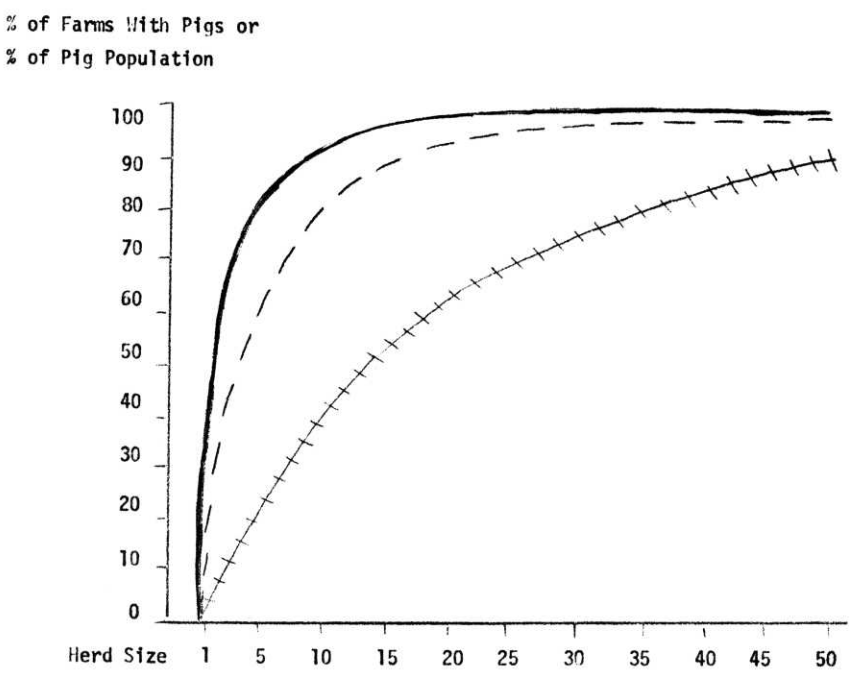
Pig production may develop more closely along poultry production lines. Tested techniques such as automatic feeding and watering, slatted floors, and liquid manure handling decrease the labor requirement considerably. Other improvements seem probable. A north German feed producer for example is attempting to raise piglets in a specialized sow-piglet operation and then turn them over to specialized pig fattener enterprises with weight and health guaranteed. This type operation will probably not spread very fast in the next 10 years but is a promising possibility in the long run.

Statistical information concerning mechanization of poultry and egg production is almost nonexistent. Generally, we can say that the technical plants on farms with large flocks for commercial purposes are highly specialized and mechanized corresponding to those in regions of similar climate in the U.S. The "broiler factories" use the same techniques and methods as those in the U.S. and are equally efficient. Advanced techniques are also applied to flocks of 500 or more layers. In 1960 only 2 percent of the farms with layers and 20 percent of the laying population fit into the over 500 bird flock category. Thus, 80 percent of the layers were in flocks on farms with a low level of labor efficiency. In the other direction, .3 percent of the farms and 12 percent of the layers were in flocks of 1000 or more birds. Between 1960 and 1965, poultry and egg production greatly expanded in the factory type of enterprise and we can expect the farm barnyard flock to be a thing of the past by 1970 for meat and by 1975 for eggs.

Future technical development in livestock production is much less clear than for crops. An exception is poultry and egg production since it is apparent that the same techniques as are currently being used in the U.S. are rapidly being innovated.

More questionable is the development of cattle and pig production since

Figure 7. Distribution of Farms With Pigs[1] And of the Pig Population by Size Of Herd in Percent, Cumulative 1949[2] and 1960[3]



[1]Farms >.5 Hectares
[2]Without Saarland and Berlin
[3]Without Berlin

Source: *Landwirtschaftszählung* 1949 and 1960.

the mass production technique here is not nearly so well defined. An essential factor is the dependence of cattle and pig production on home grown feeds in the form of roughage fodder and potatoes respectively. The farm structure particularly with respect to size, buildings, and enterprise organization has a direct effect on future potential. In cattle production it is presently not economically possible to build new stalls and equip with the latest technology except in rare instances so the optimum technical solution is not attainable.

General State of Mechanization

The 1960 census offers new data by presenting calculations on the degree of mechanization in West German agriculture. The degree of mechanization is expressed in percentage terms and is found by comparing the present stage of mechanization on a farm with the lowest mechanization level possible. The formula for arriving at the degree of mechanization is:

$$100 - \left(\frac{\text{Labor requirement for present mechanization stage}}{\text{Labor requirement for lowest mechanization stage}} \times 100\right)$$

In order to find the degree of mechanization, the labor requirement on a farm is divided into 7 sectors, and 4 degrees or levels of mechanization are delineated. With the help of standardized labor requirements, the lowest and present level of mechanization can be compared. Table 50 shows the qualitative interpretation of the degree of mechanization scale. The 1960 census data established the degree of mechanization for those farms which the Government Statistical Office defines as full time viable farms on the basis that they be large enough to provide adequate income for one full time family.

Table 50. Degree of Mechanization Used by the West German Census 1960.

A Degree of Mechanization of ____%	Characterizes the Average Mechanization As ____%
<20	extremely low
20-<30	very low
30-<40	low
40-<50	moderately high
50-<60	high
60-over	very high

Table 51 shows the degree of mechanization by farm size group for West Germany as a whole and for three of the eight states. A strong concentration of farms in the 30 to 50 percent mechanization columns is in evidence. Accordingly, the majority of farms had achieved a low to moderate level of mechanization by 1960. The mechanization level patterns are surprisingly similar in the different areas of the country although the tendency for the lower stages are more prevalent in the south. No area or farm size group

average was above the 60 percent mechanization degree which would put them in the "very high" category.

Summary

With the extremely high rate of wage increases during the past 15 years relative to other farm input prices the pressure on German farmers to mechanize and adopt labor saving techniques has been strong. Capital has been available on reasonably favorable terms for mechanization in those areas which did not include a major structural change in the farm. In general, the total credit capacity in agriculture has not been completely used.

Table 51. Degree of Mechanization by Farm Size Group and Region in West Germany 1960

Farm Size Hectares	Degree of Mechanization in Percent <20	20-<30	30-<40	40-<50	50-<60	60-over
	Number of Farms as Percent of All Farms Within Each Size Group					
			West Germany			
<10	33	26	32	9	0	0
10-<20	14	17	36	30	3	0
20-<50	4	6	24	50	15	1
50-<100	2	1	8	49	35	5
100-over	2	1	2	24	54	17
Total	16	16	31	30	6	1
			Schleswig-Holstein			
<10	39	33	24	4	0	0
10-<20	23	25	39	12	1	0
20-<50	5	8	35	46	5	1
50-<100	3	1	10	59	25	2
100-over	5	1	3	30	50	11
Total	13	14	34	33	5	1
			Nordrhein-Westfalen			
<10	25	34	35	5	1	0
10-<20	8	17	52	22	1	0
20-<50	2	4	30	54	9	0
50-<100	1	1	6	50	37	5
100-over	1	0	1	28	52	18
Total	10	17	40	28	4	1
			Bayern			
<10	37	26	26	11	0	0
10-<20	13	16	29	38	4	0
20-<50	3	4	12	48	31	2
50-<100	2	1	5	25	56	11
100-over	3	1	4	16	53	23
Total	19	17	25	30	8	1

Source: *Statistisches Jahrbuch über ELF*, 1964, p. 64 P. von Harder, *Wirtschaftliche Voraussetzungen u. Entwicklungslinien der Mechanisierung in der Landwirtschaft der BRD seit* 1949. *Berichte über Landtechnik* Heft 85, 1965, p. 163.

While mechanization has advanced very rapidly in certain directions, the total picture which emerges is one of a moderate degree of mechanization and an inability to go further without major farm structural reform. Only a very

few farms representing a low percentage of the agricultural land can economically own and operate the more advanced forms of technology such as grain combines, complete sugar beet harvesters, fully mechanized dairying facilities and the like.

A definite north to south decline is evident in all the factors surrounding the level of technology from extent of unused credit capacity to the per hectare use of fertilizer, from the educational level of farmers to the number of farms which can economically own combines, and from the average cow herd size to the continuing use of draft animals. Except for the educational level all the above factors are to a large extent conditioned by the farm structure, particularly farm size, which declines markedly from north to south. Within each state we also find the larger farms more highly mechanized and with a larger output per worker. Since farm structure is so important in determining the level and type of mechanization possible and since this in turn affects the final production level and mix, we devote the next chapter to a quantification of these effects.

Chapter 6

Crop Projections

We have stated in previous chapters that the variables influencing the kind and level of agricultural production in West Germany include changes in farm structure, differential rates of technological advance between enterprises, and relative prices and costs of producing the different agricultural products. For crop production, the effect of these variables can be measured in terms of yield and surface devoted to the various crops.

Crop Yields

Table 52 presents historical yields and projections to 1970 and 1975 of the various grain and other crops we are concerned with in this study. The historical yields are presented only back as far as 1960 but the procedure used for yield projection utilizes yield data as far back as 1921. The IFO - Institut für Wirtschaftsforschung projected yields by state for the crops we were interested in for an agricultural supply and demand analysis study they undertook for the USDA and completed in 1966.[1] Through conversations with the people involved in the projections as well as access to progress reports and the final study, we decided to use their yield projections. Their methodology appeared sound and their adjustments in line with our evaluation of yield increasing technological progress and perception of the changing yield situation.

Per Hectare yields of various crops grown in West Germany depend on weather and soil conditions and on technical progress. Weather and soil conditions are considered to be constant during the projection period leaving only technical progress to consider. Yield increasing technology which they considered includes commercial fertilizers, chemicals, improved seed varieties, and more efficient cultivation methods. Also considered were limitations to increases in yields such as change in crop rotations, lodging problems in grain, and marginal increases or decreases in the surface in specific crops.

As the first approximation to the projections, regression equations including historical yield as the dependent variable and time as the independent variable were utilized. Adjustments were then made to the regression derived projections to take account of conditions and factors considered to be not highly correlated with time and thus not compensated for in the equations. First attempts to project yields were made with 1948-1963 as the base period. Using data only from this period resulted in very steeply increasing yield trends and improbably high projection values for 1970 and 1975. The reason for this includes the very rapid innovation of technology such as fer-

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[1] IFO - Institut für Wirtschaftsforschung E. V. *Long-Term Development of Demand and Supply for Agricultural Products in the Federal Republic of Germany*, München, June 1966.

Table 52. Selected Crop Yield Projections by State in Germany -- 1960 to 1965 with Projections to 1970 and 1975 in 100 Kg per Hectare

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland-Pfalz	Baden-Württemberg	Bayern	Saarland	West Germany
Wheat									
1960	37.5	40.5	32.9	38.4	37.4	34.3	33.9	29.1	35.6
1961	34.2	28.0	27.4	26.8	27.2	29.2	30.0	23.3	28.9
1962	37.6	36.6	35.3	32.0	28.7	34.0	35.9	21.8	34.8
1963	36.2	37.1	34.3	37.9	34.6	34.3	34.4	30.2	35.1
1964	42.2	34.5	38.0	34.0	34.3	34.2	34.8	29.4	36.0
1965	36.4	34.5	30.6	30.8	33.9	29.8	28.2	29.5	30.8
1970	42.0	38.5	37.0	38.0	36.0	35.5	34.5	33.8	36.5
1975	45.0	41.0	39.5	40.5	38.5	38.0	36.5	36.3	39.0
Rye									
1960	26.6	28.8	28.8	32.1	28.6	27.2	27.2	25.7	28.8
1961	21.7	20.7	20.7	20.3	21.4	21.2	21.2	21.7	21.2
1962	24.9	27.3	30.7	26.2	21.0	28.6	25.8	20.5	27.1
1963	25.5	28.3	30.8	32.0	29.0	26.9	25.4	28.9	28.4
1964	29.5	32.4	34.6	30.9	27.8	30.4	28.5	27.2	31.5
1965	23.8	27.2	25.9	25.6	24.4	23.1	20.4	25.5	25.0
1970	29.5	31.5	33.5	33.0	31.0	30.0	28.5	28.5	31.0
1975	31.5	33.5	36.0	35.0	33.0	32.0	30.0	30.5	33.0
Winter Barley									
1960	36.2	41.6	32.3	38.2	37.2	32.7	31.4	27.2	36.2
1961	32.1	30.2	27.0	24.7	24.2	25.0	23.6	22.4	27.8
1962	37.5	34.7	35.7	27.7	29.9	31.8	29.3	20.8	34.4
1963	33.7	36.5	32.7	33.9	30.8	28.4	28.4	26.1	33.5
1964	41.0	41.2	37.4	33.5	34.8	31.7	30.3	26.1	38.0
1965	38.4	37.8	34.9	31.8	34.3	27.3	25.4	26.2	35.4
1970	42.5	41.5	38.0	37.5	35.5	33.5	31.0	32.5	39.0
1975	45.0	43.5	39.5	39.5	37.5	35.0	32.5	34.3	41.0

Table 52 continued.

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland-Pfalz	Baden-Württemberg	Bayern	Saarland	West Germany
Summer Barley									
1960	32.0	33.2	32.1	31.8	34.2	28.6	32.2	25.8	31.6
1961	25.1	22.5	27.1	21.8	21.1	22.4	23.8	19.1	23.0
1962	33.2	34.5	32.8	33.8	28.9	33.8	32.0	21.7	32.5
1963	31.6	31.6	32.3	32.1	33.9	28.0	29.5	26.7	30.3
1964	37.1	30.8	32.8	32.0	28.3	33.2	22.3	22.3	32.4
1965	31.6	30.8	25.9	29.1	30.6	22.8	22.3	23.4	25.4
1970	37.0	35.0	34.0	34.5	35.0	32.0	32.5	31.5	33.0
1975	39.0	37.0	36.0	36.5	37.0	33.5	34.5	33.3	35.0
Oats									
1960	31.2	31.8	28.2	31.4	27.9	28.2	26.8	22.9	29.1
1961	31.5	27.6	26.0	25.3	26.4	25.4	24.8	23.8	26.5
1962	31.2	31.3	29.1	28.8	24.3	31.7	27.2	19.9	29.0
1963	31.8	33.4	30.9	31.8	28.1	27.7	27.0	25.5	30.1
1964	37.2	34.6	30.5	27.3	23.9	29.1	27.0	24.8	30.1
1965	36.1	32.3	27.9	27.9	28.2	25.0	22.0	20.6	28.2
1970	34.0	33.5	32.5	32.5	29.5	32.5	28.0	29.0	31.0
1975	36.5	36.0	35.0	35.0	32.0	35.0	30.5	31.5	33.5
Mixed Grain									
1960	29.4	30.9	29.2	31.8	30.1	29.5	28.9	24.5	29.8
1961	27.4	26.0	23.5	24.3	25.1	25.5	25.1	23.4	25.3
1962	28.8	29.5	29.2	29.1	23.4	32.2	29.3	21.2	29.3
1963	27.9	29.4	30.3	32.3	29.3	28.6	25.6	25.9	29.3
1964	32.5	32.0	31.5	29.1	26.6	31.0	28.5	22.4	31.1
1965	31.0	30.0	27.2	28.6	29.2	24.6	23.0	24.7	27.5
1970	31.5	31.0	32.0	32.0	29.5	30.5	29.0	28.0	31.0
1975	33.5	33.0	34.0	34.0	31.5	32.5	31.0	30.0	33.0

Table 52 continued

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland-Pfalz	Baden-Württemberg	Bayern	Saarland	West Germany
Potatoes									
1960	238.2	252.4	220.0	234.9	224.9	230.7	234.6	234.0	235.8
1961	247.5	228.8	198.0	192.0	231.6	228.3	222.8	203.3	220.4
1962	242.9	206.0	289.3	280.3	248.0	252.9	248.9	246.4	260.6
1963	256.7	279.0	283.4	308.8	275.1	264.6	279.5	237.7	279.0
1964	278.2	265.3	294.7	202.7	200.8	207.7	220.8	194.5	242.2
1965	259.4	265.3	225.1	235.6	239.0	213.3	214.0	204.8	231.1
1970	279.0	286.0	277.0	272.0	274.5	279.0	281.5	274.8	280.0
1975	299.0	306.5	296.5	291.5	294.0	299.0	302.0	294.5	300.0
Sugar Beets									
1960	357.3	404.3	440.2	420.4	490.1	476.8	393.8	421.1	419.9
1961	338.3	317.1	372.5	350.9	410.1	429.1	377.6	374.5	355.8
1962	303.6	303.5	343.6	296.0	354.0	375.9	357.1	296.5	328.3
1963	355.4	410.4	415.3	405.9	434.7	458.5	422.4	395.7	415.5
1964	372.4	350.8	428.5	301.4	343.4	382.7	367.2	331.3	393.1
1965	320.5	350.8	357.4	350.8	466.4	409.8	372.5	345.2	366.1
1970	370.0	393.5	434.0	414.0	468.5	484.5	437.5	474.5	420.0
1975	387.5	412.5	454.5	434.0	491.0	508.0	458.5	497.5	440.0

tilizers and chemicals over a short period of time in the mid to late 1950's -- a situation which has not been sustained into the 1960's. So, in spite of some data comparability problems, the base period finally settled upon was 1921 to 1939 and from 1949 to 1963. The years between 1939 and 1949 were omitted because little or no yield progress was made during World War II and this would incorporate a downward bias in the trend.

Use of chemical fertilizers has increased in all states as shown in Table 41, page 86. Data on application rates of fertilizer on specific crops are not available. But, in general we know that per hectare rates of application in West Germany have increased between 1960/61 and 1964/65 by 29 percent for nitrogen, 25 percent for phosphate and 19 percent for potash. Application of lime has remained quite constant in the aggregate although some states have increased and others decreased their rates of use.

A pronounced difference in the application rates of all types of fertilizer from higher in the north to lower in the south is evident. Table 53 shows the percentage change in application rate for each state between 1960/61 and 1964/65. Generally, a higher rate of increase is shown in the

Table 53. Percentage and Absolute Change in the Per Hectare Rate of Fertilizer Application by State and by Type of Fertilizer between 1960/61 and 1964/65.

State	Nitrogen		Phosphate		Potash		Lime	
	%	Kg.	%	Kg.	%	Kg.	%	Kg.
Schleswig-Holstein	26.0	14.5	12.9	7.4	4.1	3.0	-0-	-0-
Niedersachsen	31.9	16.8	25.2	12.5	18.2	15.1	11.1	5.4
Nordrhein-Westfalen	22.2	13.2	15.2	8.3	19.7	17.2	20.3	9.8
Hessen	26.0	10.8	36.0	15.1	19.1	11.8	-37.2	-14.6
Rheinland-Pfalz	20.7	9.5	24.0	11.9	17.1	11.3	.6	.2
Baden-Württemberg	35.1	9.7	30.0	11.2	23.9	13.0	-18.0	-2.7
Bayern	33.1	10.6	31.4	13.0	24.5	15.5	10.5	-3.8
Saarland	52.9	10.0	47.2	9.4	41.2	10.1	77.8	4.2
West German Average	28.8	12.4	24.9	11.5	19.4	13.6	-.3	-.1

Source: Own calculations.

south than in the north. These percentage changes are based on such widely different beginning levels that we have included the absolute difference in fertilizer application in kilograms between the two time periods. Here the picture looks quite different. The absolute increase in quantity applied is less in the south than in the north in the case of nitrogen and quite similar for phosphate and potash. Thus, no tendency for the south to catch up to the north on rate of fertilizer application is discernible, and in fact the gap may be widening. Account has been taken of this fact in the projections resulting in a larger absolute increase over the projection period for yields in the north than in the south.

Fertilizer use appears to be sensitive to price. Fertilizer prices were quite stable between 1960/61 and 1962/63. Then they jumped an average of 10 percent in 1963/64 and settled back by slightly less than 3 percent in 1964/65. A rough indication of demand elasticity for fertilizers can be attained by calculating the percentages that the 1963/64 application rate is off trend and dividing by the percentage change in price. We must stress that these elasticities are calculated from the aggregate West German data, are very rough, and do not have any statistical level of significance attached. For nitrogen, we calculate a demand price elasticity of about 1.0, for phosphate about .6 and for potash about .25. Nitrogen is the most price elastic because it can be more easily substituted for by livestock manure as well as green manure, and it has little carryover effect from one year to the next. As the commercial fertilizer market becomes larger, we would expect some economies of size to operate with some lower fertilizer prices resulting. The price decline in 1964/65 would seem to attest to this possibility and if the tendency continues we should expect a faster rate of increase in fertilizer application in the future.

Little data is available concerning the use of plant projection chemicals. Table 54 presents use and price data on protection chemicals including seed treating, fungicides, insecticides and herbicides in West Germany for the period 1960 to 1964. A gradual increase in use is shown by the table as well as a decrease in cost in the latter part of the period. We expect at least a maintenance, if not an increase in the trend shown with regard to use and the leveling off of the price for reasons similar to those stated for fertilizer.

Experimental farms are presently doing research in three main areas with respect to grain. First, they are attempting to perfect grain varieties, particularly wheat, which do not lodge. With the relatively wet climate, the lodging problem is quite profound and seed varieties which would not lodge would increase efficiency in harvest, increase the harvestable yield, and allow higher fertilizer application rates.

Table 54. Use and Price of Plant Protection Chemicals Including Seed Treating, Fungicides, Insecticides, and Herbicides in West Germany, 1960-1964.

	1960	1961	1962	1963	1964
Use in 1000 tons	92.3	93.6	98.6	108.3	101.4
Price (1962 = 100)	101	101	100	96	94

Source: *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten*, 1965.

Second, they are trying to develop higher quality varieties of wheat which can be grown in Germany. At the present time, high quality wheat must be imported to be mixed with domestically raised wheat for milling purposes. According to the IFO study[2], 9 percent of the wheat area was in quality wheat in 1964. They project about 400 thousand tons of quality wheat production domestically by 1975 which amounts to about half their present requirement.

And, third, attempts are being made to perfect varieties of corn which will be more adaptable to the German climate and growing conditions. Although corn production since the war has increased at a very high rate, only 26,821 hectares of corn were produced in 1965. By far, the major portion of the corn grown in Germany was produced in Baden-Württemberg and Bayern. Corn production, with present varieties which are not well adapted to the soil and climate conditions, is a very risky business. Liesegang, in a study of corn production potential of Germany, related present hybrid varieties of corn to soil and climate conditions to determine areas where corn production would be technically feasible.[3] Figure 8 from his study shows that the three southern states of Hessen, Baden-Württemberg and Bayern with some minor exceptions are the only areas where corn production for grain purposes is technically possible. Hoffman points out that only very few areas have a long enough dry period in the fall to efficiently produce kernel corn. In other areas the drying cost is extremely high.[4] Liesegang found that it would be technically possible to raise corn for silage in almost all areas of Germany but the quality would be very low in the northern areas. Even in southern Germany only a few areas would find corn production economically superior to other crops.

Professor Reisch estimates that from a base of 27 thousand hectares of corn raised presently, the amount of corn surface will increase to about 40 to 50 thousand hectares by 1975.[5] This represents a large percentage increase but in absolute terms is rather insigificant. Others disagree. Dr. W. Vor Schulte believes the next ten years will bring the realization of successful corn production north of the Main River line in many small valleys and other locations with a mild micro-climate. Even under the unfavorable weather conditions of 1965, corn yields were comparable to other grains and he estimates by 1975 could be comparable to present sugar beet surface which now stands at about 294 thousand hectares.[6] Table 55 presents past develop-

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[2]See footnote, p. 105.

[3]F. Liesegang, *Der Natürliche Standort für den Anbau von Korner - und silomais in Westdeutschland, Landwirtschaft und Gartenbau der Technischen Hochschule*, München, 1965.

[4]Interview with Dr. Hoffman, Bayerische Landestierzuchtanstalt, Grub.

[5]Interview with Professor Reisch, Institut fur Angewandte Landwirtschaftliche Betriebslehre, Stutt-gart-Höhenheim.

[6]Interview with Dr. W. Vor Schulte, Saatzucht Lochow Petkus G.M.B.H., Hasselhorst bei Bergen/Celle.

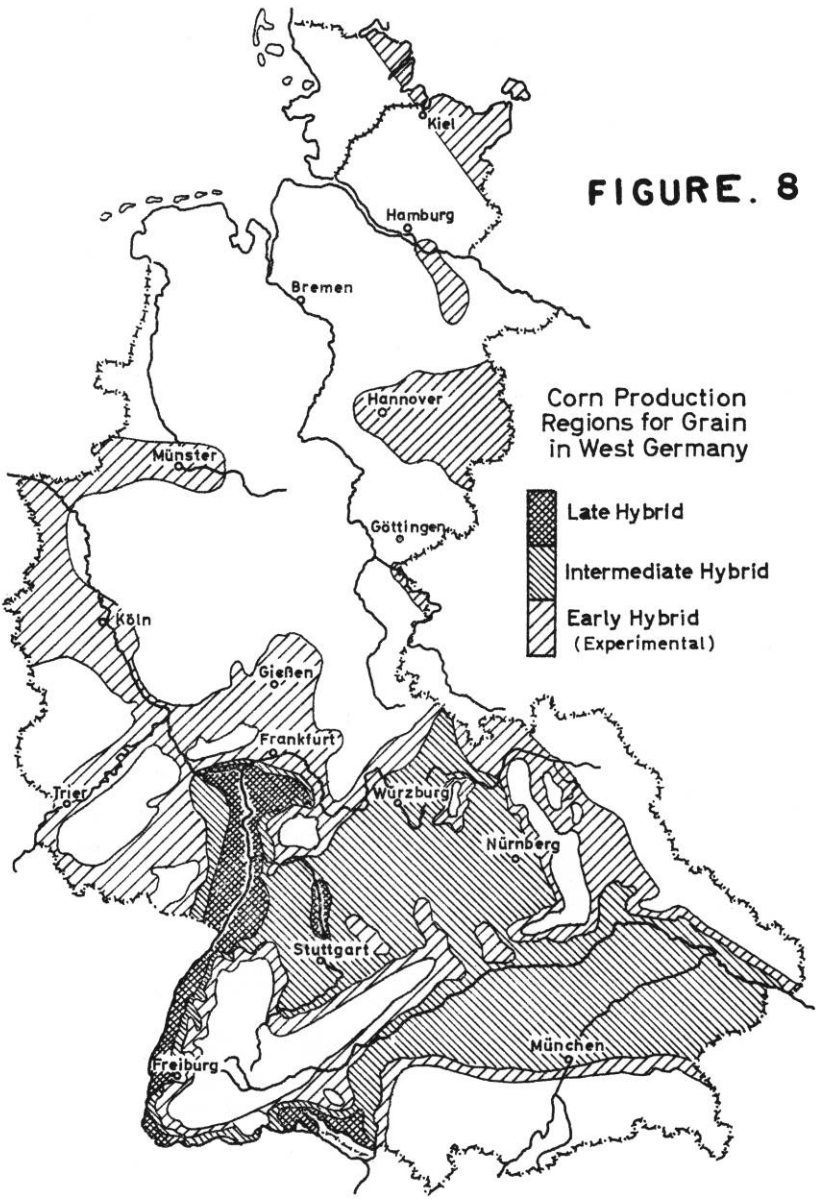
Kiel
Hamburg
Bremen
Hannover
Münster
Göttingen
Köln
Gießen
Frankfurt
Trier
Würzburg
Nürnberg
Stuttgart
Freiburg
München
Corn Production Regions for Grain in West Germany
Late Hybrid
Intermediate Hybrid
Early Hybrid (Experimental)

FIGURE. 8

Table 55. Hectares, Yield, and Production of Corn in Germany, 1960-1965

	1935/38	1960	1961	1962	1963	1964	1965
Corn Hectares	13,300	6,249	7,557	12,720	13,098	18,096	26,821
Corn Yields 100 Kg/Ha	27.1	31.3	30.7	33.6	36.4	34.6	35.9
Corn Production Tons	38,000	19,567	23,220	42,726	47,691	62,610	96,402

Source: *Statistisches Bundesamt, Fachserie B, Land und Forstwirtschaft Fischerei, Reihel, Bodennutzung und Ernte*, 1960-1965.

ment of surface and yields of corn in West Germany. Without major developments in more adaptable varieties, we expect the rate of increase to level off more nearly in line with the estimate by Professor Reisch than that by Dr. Vor Schulte. Developments in corn production, however, should be watched very closely since this could have a profound impact on total feed grain production.

Finally, average yields will be influenced by shifts in surface devoted to different crops. Land shifted into the production of a certain crop will normally be marginal at least in the sense that the yields and production of that land will be lower than the former average. Land shifted away from a crop will normally be that which produces lower yields than the average and therefore the average will rise. At a somewhat higher level of aggregation than individual crops is the proportion of all grains grown in the crop rotation. According to Professor Steinhauser the tendency in recent years for the grain portion to increase has some detrimental effect on yields. But the use of commercial fertilizer to maintain yields is less costly in terms of net profitability than continuing a high portion of row crops in the rotation. Fertilizer and other techniques enumerated above have been very successfully used in that grain yields have continued to increase even under the increasingly grain weighted rotation.[7]

For the past ten years, a seed breeding company in Niedersachsen has changed more and more of their land to a straight grain rotation consisting of rye-rye-oats. The farms are operated without livestock and therefore without manure used as fertilizer but with a high proportion of green manure. Soil fertility testing and fertilizer application are done with extreme care and yields are showing a significant upward trend. Dr. Vor Schulte, a company representative, stated that in his opinion the common reservations a-

[7] Interview with Professor Hugo Steinhauser, *Institut für landwirtschaftliche Betriebs und Arbeitslehre*, Kiel.

gainst intensive grain rotations are unfounded for any grain including wheat.[8]

Crop Surface Projections

Along with the yield projections in order to project production, we must project hectares of surface devoted to each crop. Table 56 presents the historical data on number of hectares in each of six grain crops, three-row crops, other feed crops, other crops, and grassland in each state over the period 1955-1965. We begin our projections by looking at historical trends in surface devoted to three main categories of use -- grassland, grain and other crops.

The historical data was converted to percentage terms to remove the influence of fluctuating total land area. Regression analysis in combination with the analysis of the past four chapters was used on these transformed data to estimate the proportionate share of grass, grain and other crops in the total surface area in 1970 and 1975. The projection results along with the 1965 data are presented in Table 57. We see that the proportionate share of the other crop category declined in all states. The main influences in the decline in this category are potatoes and fodder beets which have declined historically; and according to our technology and structure analysis, will continue to do so in the future. We project a slight increase in the proportionate share of grassland. The main influence here is marginal arable land reverting to grass due to not being economically feasible to mechanize. For the most part, this is land with a high degree of slope or land with poor drainage but also includes some of the land around major industrial areas which is abandoned in favor of urban employment. The grain proportionate share increases in all states, but because land is moving out of agriculture due to its being submarginal or urbanized the actual grain area increases only slightly in the aggregate.

When the proportionate shares are applied to the census hectare figures of Table 45, we find the area to be less than the sum of that reported by the states for the various crops. A large part of the difference is due to double cropping. But, some portion of that difference is undoubtedly error of which we know neither magnitude nor source. We assumed the total error to be in the census figures and adjusted the projected crop hectares upward by a constant percentage based on the difference between the census and state report numbers in the historical period. The difference was quite constant in percentage terms in the historical data so the constant percentage adjustment assumes this relationship to continue into the future.

Next we used regression analysis to project the proportionate share of each of the six types of grain in total grain surface and applied these re-

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[8]Interview with Dr. Vor Schulte, Saatzucht Lochow Petkus, G.M.B.H. Hasselhorst bei Bergen/Celle.

Table 56. Hectares in Various Crops by State in West Germany, 1955-1965

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland-Pfalz	Baden-Württemberg	Bayern	Saarland	West Germany*
Wheat									
1955	59,032	140,484	157,041	106,355	76,938	235,094	395,336	n/a	1,170,280
1956	74,814	144,085	163,580	108,125	70,711	204,611	386,067	n/a	1,151,993
1957	75,265	151,035	166,994	117,046	87,342	229,474	392,747	10,429	1,230,332
1958	82,708	158,730	173,977	120,718	99,933	247,368	418,188	10,984	1,312,606
1959	86,333	172,608	179,406	123,815	100,697	248,149	419,025	10,296	1,340,329
1960	88,406	179,554	183,460	128,137	112,149	246,245	445,545	10,716	1,394,212
1961	87,802	180,908	183,710	133,868	111,089	246,062	447,375	11,141	1,401,955
1962	91,428	188,716	178,551	115,650	96,269	193,475	445,116	8,594	1,317,799
1963	87,299	183,599	163,109	125,928	119,022	232,069	457,053	12,369	1,380,488
1964	87,430	182,825	188,020	131,794	116,718	250,560	475,219	12,324	1,444,890
1965	89,017	185,821	172,073	120,616	119,515	247,344	477,995	12,930	1,425,311
Rye									
1955	119,574	422,541	268,836	140,789	100,896	48,639	369,993	n/a	1,471,268
1956	133,254	446,894	273,710	135,650	92,032	44,513	353,085	n/a	1,479,138
1957	129,529	448,444	276,156	129,386	89,501	41,877	346,849	9,099	1,470,841
1958	124,116	452,136	290,787	134,263	100,259	39,961	347,555	9,042	1,498,119
1959	111,536	440,551	279,147	129,151	91,484	37,031	325,352	7,246	1,421,498
1960	114,953	438,654	271,511	120,610	81,461	30,835	248,008	7,038	1,313,070
1961	94,022	400,221	236,386	103,231	68,914	28,261	241,711	6,468	1,179,214
1962	91,666	371,973	240,938	88,179	52,188	23,032	215,381	4,719	1,088,076
1963	92,303	372,375	254,936	106,050	62,846	28,348	211,240	6,645	1,134,743
1964	89,600	379,889	259,502	107,023	69,049	25,827	203,871	7,123	1,141,884
1965	87,292	377,870	254,634	98,814	70,454	34,373	193,046	8,093	1,124,576

*Does not include Saarland for years 1955 and 1956.

Table 56 continued

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein-Westfalen	Hessen	Rheinland-Pfalz	Baden-Württemberg	Bayern	Saarland	West Germany *
Winter Barley									
1955	16,792	40,256	55,389	10,381	3,694	4,609	10,885	n/a	142,006
1956	23,759	49,657	30,332	11,192	3,464	3,360	11,711	n/a	133,475
1957	25,240	58,029	59,143	15,242	4,775	4,635	12,228	510	179,802
1958	21,558	64,011	73,023	18,290	6,798	4,538	12,626	745	201,589
1959	24,096	74,404	86,235	20,900	9,243	4,728	18,072	686	238,364
1960	31,732	79,854	91,893	21,485	10,438	9,274	17,317	744	262,737
1961	31,082	92,920	104,324	27,295	14,298	9,714	28,720	793	309,146
1962	34,208	75,937	95,258	15,535	5,712	2,608	20,899	311	250,468
1963	36,383	96,413	107,333	21,445	10,021	5,658	29,275	629	307,157
1964	37,094	104,541	113,080	23,330	10,753	5,291	24,387	818	319,294
1965	45,898	113,347	117,873	23,407	9,420	5,696	19,892	976	336,509
Summer Barley									
1955	19,630	29,210	28,837	27,960	63,659	146,442	323,147	n/a	638,885
1956	17,838	28,494	41,751	31,954	77,026	171,880	348,135	n/a	717,078
1957	24,283	28,304	34,324	34,823	77,370	149,524	343,470	3,309	695,407
1958	40,245	38,501	25,503	29,026	62,259	146,346	334,141	3,059	679,080
1959	46,892	44,370	27,605	30,396	63,368	149,124	347,189	2,853	711,797
1960	43,332	44,317	27,931	30,255	60,752	143,244	363,312	2,985	716,128
1961	54,798	74,558	47,654	42,548	72,296	145,953	368,512	1,779	808,098
1962	40,461	81,722	48,458	60,622	83,720	177,588	388,953	648	882,172
1963	48,214	90,590	50,294	47,866	74,037	148,137	371,881	4,424	835,443
1964	50,386	98,964	44,497	48,276	71,865	145,318	369,115	4,381	832,802
1965	52,648	117,964	49,181	48,021	67,324	145,839	369,040	5,076	855,093

*Does not include Saarland for years 1955 and 1956

Table 56 continued

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein-Westfalen	Hessen	Rheinland-Pfalz	Baden-WÜrttemberg	Bayern	Saarland	West Germany*
Oats									
1955	77,171	215,736	142,798	106,119	96,496	87,357	234,540	n/a	960,217
1956	66,225	207,893	130,068	102,998	105,020	87,727	249,216	n/a	949,147
1957	62,908	204,104	120,292	101,762	91,688	84,226	238,544	11,353	914,877
1958	58,554	188,762	105,366	95,647	80,780	77,515	291,189	10,213	908,026
1959	63,586	177,725	97,044	93,067	82,240	75,465	212,235	8,730	810,092
1960	61,358	156,684	99,544	88,767	79,712	67,242	184,578	8,547	746,432
1961	69,748	155,000	89,579	87,167	75,280	64,064	172,751	7,966	721,555
1962	71,659	174,008	100,981	98,123	88,277	86,931	174,431	9,851	804,261
1963	77,190	171,706	99,021	89,165	76,831	75,517	172,183	7,423	769,036
1964	82,840	172,998	94,212	86,826	75,011	74,136	171,224	7,981	765,228
1965	82,087	167,888	87,291	78,005	68,123	70,623	164,083	7,924	726,024
Mixed Grain									
1955	93,334	108,950	95,616	8,437	10,052	45,314	37,487	n/a	399,200
1956	80,881	109,959	110,668	10,435	12,324	50,673	46,208	n/a	421,148
1957	77,762	110,007	100,400	10,227	11,333	48,445	44,947	1,546	404,667
1958	77,745	110,742	96,689	9,673	11,631	48,192	54,058	1,637	410,367
1959	75,912	118,981	103,255	10,402	13,314	50,109	56,220	1,809	430,002
1960	68,461	122,895	95,956	15,962	19,839	56,946	69,405	2,508	451,972
1961	74,489	129,390	109,160	16,618	16,421	56,432	68,343	2,536	473,389
1962	71,113	146,613	124,428	26,377	22,982	65,317	68,372	4,115	529,317
1963	64,238	136,447	112,488	17,949	16,900	54,271	74,268	3,418	479,979
1964	60,292	133,451	103,074	18,580	16,669	53,988	76,863	3,210	466,127
1965	51,158	118,896	93,228	16,222	21,459	53,223	79,522	2,943	436,651

*Does not include Saarland for years 1955 and 1956

Table 56 continued

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein-Westfalen	Hessen	Rheinland-Pfalz	Baden-Württemberg	Bayern	Saarland	West Germany*
Potatoes									
1955	53,948	276,059	159,189	97,448	98,526	127,318	313,092	n/a	1,125,580
1956	49,794	267,944	161,744	100,221	101,683	132,368	318,099	n/a	1,131,853
1957	52,975	271,682	152,369	94,198	96,566	134,260	314,803	12,465	1,129,318
1958	43,752	253,905	142,111	94,187	94,422	129,897	300,275	12,053	1,070,602
1959	43,143	248,266	136,706	90,329	90,632	127,467	304,151	10,466	1,051,160
1960	42,140	245,689	132,641	88,364	87,314	125,055	307,912	9,966	1,039,081
1961	33,695	227,558	124,521	84,103	81,019	117,006	296,361	9,397	973,660
1962	31,610	218,903	118,268	83,543	85,239	117,662	295,847	9,838	960,910
1963	28,515	209,216	112,632	80,644	77,941	111,999	292,434	9,416	922,797
1964	22,911	183,458	101,780	74,070	73,603	102,731	281,449	9,160	849,162
1965	17,963	168,305	89,661	67,531	65,538	102,390	262,010	8,318	781,716
Fodder Beets									
1955	28,799	73,317	92,346	58,252	49,143	60,407	120,538	n/a	482,802
1956	25,818	70,184	94,815	55,367	48,679	58,158	118,637	n/a	471,658
1957	24,613	72,240	86,381	51,785	48,920	57,484	114,037	5,590	461,050
1958	24,323	71,375	83,355	50,862	47,708	57,568	111,836	5,284	452,311
1959	24,074	70,890	80,796	49,468	47,156	56,737	109,072	4,691	442,884
1960	28,977	67,147	76,578	48,630	42,831	56,562	120,028	4,591	445,344
1961	30,395	70,193	75,217	47,283	41,543	53,896	120,196	4,636	443,359
1962	28,502	66,854	73,397	46,679	41,951	56,293	119,622	4,617	437,915
1963	25,850	62,714	68,691	44,787	38,037	51,800	111,645	4,323	407,847
1964	24,977	59,761	63,573	42,686	37,294	49,089	101,409	4,137	382,926
1965	20,270	57,769	61,327	39,358	34,757	48,156	94,659	3,759	360,055

*Does not include Saarland for years 1955 and 1956

Table 56 continued

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein-Westfalen	Hessen	Rheinland-Pfalz	Baden-Württemberg	Bayern	Saarland	West Germany*
Sugar Beets									
1955	13,183	108,430	61,422	17,644	14,617	15,567	30,832	n/a	261,695
1956	13,308	107,199	64,045	18,479	17,240	15,559	33,039	n/a	268,869
1957	13,315	97,323	58,422	19,144	18,648	17,432	34,473	68	258,825
1958	15,730	104,187	60,478	19,238	20,793	18,008	45,243	141	283,818
1959	14,120	105,807	63,391	18,844	20,391	18,140	46,194	165	287,052
1960	13,706	108,160	66,909	19,495	19,096	18,718	47,226	152	293,462
1961	12,040	95,894	57,793	16,132	15,867	15,867	46,300	117	260,010
1962	14,747	103,533	63,476	17,986	21,003	17,876	51,245	156	290,022
1963	15,081	102,530	67,637	18,823	22,080	19,640	54,671	106	300,568
1964	17,088	110,271	69,072	20,856	23,671	21,821	64,232	93	327,104
1965	14,088	102,171	64,166	18,781	19,476	18,230	56,917	127	293,956
Other Feed Crops									
1955	167,316	117,500	119,161	86,166	104,048	261,550	386,653	n/a	1,242,394
1956	160,819	111,855	107,553	73,852	91,604	256,644	365,352	n/a	1,167,679
1957	151,836	109,767	106,770	81,414	85,996	264,229	350,518	12,587	1,163,117
1958	151,738	103,768	102,393	77,648	82,242	258,955	343,086	12,253	1,132,083
1959	150,752	94,365	91,261	79,136	83,881	256,371	342,013	12,005	1,109,784
1960	152,204	84,436	86,963	67,453	76,738	244,020	343,744	10,406	1,065,964
1961	155,503	78,865	87,719	72,875	95,081	257,514	339,764	11,300	1,098,621
1962	149,949	75,454	76,324	69,160	80,200	247,433	343,826	10,448	1,052,794
1963	150,668	72,777	109,393	70,489	79,463	250,003	339,971	10,972	1,083,736
1964	149,420	69,003	75,012	66,895	81,332	230,368	340,317	11,538	1,023,885
1965	152,248	69,003	67,876	58,378	72,127	243,828	358,460	13,674	1,035,594

*Does not include Saarland for years 1955 and 1956.

Table 56 continued

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland-Pfalz	Baden-Württemberg	Bayern	Saarland	West Germany*
Other Crops									
1955	63,302	128,432	134,581	55,540	115,522	98,236	117,482	n/a	713,095
1956	63,642	122,569	149,116	58,890	106,259	100,760	112,960	n/a	714,196
1957	78,274	133,965	151,050	55,573	105,261	98,614	116,384	24,044	763,165
1958	76,331	133,883	150,718	58,548	104,875	98,852	123,903	25,389	772,499
1959	73,531	131,710	148,694	59,092	105,491	94,279	115,177	29,257	757,231
1960	79,031	127,710	149,174	64,742	110,770	106,860	115,725	30,147	784,159
1961	78,726	143,493	160,437	61,880	100,992	106,631	120,567	31,767	804,493
1962	88,657	132,687	150,621	64,546	112,759	107,685	119,708	34,603	811,266
1963	86,181	140,496	115,522	61,735	112,703	113,340	123,780	28,248	782,005
1964	88,362	129,739	143,078	61,164	112,235	133,871	126,014	27,135	821,598
1965	93,868	145,866	152,763	67,457	118,083	126,006	140,124	24,907	869,074
Grass-land									
1955	476,509	1,280,505	733,418	319,282	263,503	824,060	1,681,093	n/a	5,578,370
1956	481,006	1,310,596	736,733	323,766	263,463	828,302	1,674,676	n/a	5,618,542
1957	473,400	1,300,600	744,500	318,200	268,100	820,100	1,691,000	46,200	5,662,100
1958	471,700	1,303,300	745,600	318,000	268,500	819,700	1,689,700	46,200	5,662,700
1959	473,300	1,305,000	747,600	316,000	268,600	819,400	1,689,800	46,200	5,665,900
1960	462,800	1,309,000	748,700	320,700	268,800	823,000	1,703,900	45,800	5,682,700
1961	468,600	1,298,900	749,600	318,400	272,100	818,200	1,711,200	45,600	5,682,600
1962	469,800	1,306,600	753,000	321,200	271,000	831,600	1,715,100	45,600	5,713,900
1963	468,311	1,303,137	758,968	322,700	271,039	812,033	1,715,429	45,519	5,697,136
1964	469,900	1,298,700	761,200	325,100	270,400	801,700	1,716,300	45,600	5,688,900
1965	469,878	1,298,700	792,020	354,768	298,552	790,382	1,691,452	44,755	5,740,507

*Does not include Saarland for years 1955 and 1956.

Table 57. Percentage Distribution Projections of Crop Surface Between Grass, Grain & Other Crops by State (1970 and 1975)

State Year	Grassland	Grain Crops	Other Crops
	in % of total land		
Schleswig-Holstein			
1965	39.2	34.7	25.4
1970	40.3	35.7	24.0
1975	40.8	36.6	22.6
Niedersachsen			
1965	44.4	37.0	18.6
1970	44.9	38.9	16.2
1975	45.4	41.0	13.6
Nordrhein-Westfalen			
1965	39.6	38.6	21.8
1970	40.5	40.8	18.7
1975	41.5	42.3	16.2
Hessen			
1965	35.8	38.8	25.4
1970	36.0	41.2	22.8
1975	36.4	41.9	21.7
Rheinland-Pfalz			
1965	30.9	36.9	32.2
1970	31.4	38.0	30.6
1975	32.5	38.5	29.0
Baden Württemberg			
1965	41.9	29.5	28.6
1970	41.5	29.4	29.1
1975	41.1	29.8	29.1
Bayern			
1965	43.3	33.4	23.3
1970	44.7	32.3	23.0
1975	45.7	31.4	22.9
Saarland			
1965	33.6	28.4	38.0
1970	33.5	31.5	35.0
1975	33.2	33.9	32.9
West Germany			
1965	41.2	35.1	23.7
1970	41.7	35.8	22.5
1975	42.4	36.4	21.2

sults to the adjusted total grain surface projections. These results were then used as a base from which to adjust for circumstances and changes of the behavior of influencing variables which according to the analysis of the past four chapters are assumed to be different than during the base period. The projections of crop surface for 1970 and 1975 thus obtained are presented for each state in Table 58.

As we pointed out in the last chapter, changes in farm structure favor increases in surface of wheat, barley and sugar beets and decreases in surface of rye, oats, mixed grain, fodder beets and potatoes. Future technological advance also appears, based on past observation to have a greater poten-

Table 58. Crop Surface Projections by State in West Germany -- 1970 and 1975 in 1000 Hectares

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland Pfalz	Baden Württemberg	Bayern	Saarland	West Germany
Wheat									
1965	89.0	185.8	172.1	120.6	119.5	247.3	478.0	13.0	1425.3
1970	94.0	205.8	186.7	126.5	137.4	246.8	499.8	16.3	1513.3
1975	97.8	227.7	193.8	133.2	150.7	256.6	501.2	17.9	1578.9
Rye									
1965	87.3	377.9	254.6	98.8	70.4	34.3	193.0	8.1	1124.6
1970	61.4	323.2	227.7	77.1	51.3	22.8	110.8	8.1	882.4
1975	42.9	271.3	208.5	55.8	41.8	22.2	73.3	8.1	723.9
Food Grains									
1965	176.3	563.7	426.7	219.4	189.9	281.6	671.0	21.1	2549.9
1970	155.4	529.0	414.4	203.6	188.7	269.6	610.6	24.4	2395.7
1975	140.7	499.0	402.3	189.0	192.5	278.8	574.5	26.0	2302.8
Winter Barley									
1965	45.9	113.3	117.9	23.4	9.4	5.7	19.9	1.0	336.5
1970	66.2	156.0	163.5	34.5	15.3	7.1	33.3	1.6	477.5
1975	83.7	197.0	206.0	43.7	19.5	9.8	39.1	2.7	601.5
Summer Barley									
1965	52.6	118.0	49.2	48.0	67.3	145.8	369.0	5.1	855.1
1970	75.2	168.4	59.4	67.4	75.2	154.9	394.0	5.5	1000.0
1975	98.7	225.4	70.4	83.1	78.1	160.0	411.4	6.5	1133.6
Oats									
1965	82.1	167.9	87.3	78.0	68.1	70.6	164.1	8.0	726.0
1970	82.1	159.4	76.9	69.4	64.8	63.3	119.4	6.9	642.2
1975	76.5	151.0	58.8	62.0	57.2	58.0	100.5	6.2	570.2

Table 58
Crop Surface Projections continued

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland Pfalz	Baden Württemberg	Bayern	Saarland	West Germany
Mixed Grain									
1965	51.2	118.9	93.2	16.2	21.5	53.2	79.5	2.9	436.7
1970	38.9	117.7	87.3	16.9	19.5	46.5	73.8	3.1	403.7
1975	25.6	107.4	80.1	12.7	19.4	35.8	56.6	2.7	340.3
Feed Grains									
1965	231.8	518.1	347.6	165.6	166.3	276.3	632.5	17.0	2354.3
1970	262.4	601.5	387.1	188.2	174.8	271.8	620.5	17.1	2523.4
1975	284.5	680.8	415.3	201.5	174.2	263.6	607.6	18.1	2645.6
Total Grains									
1965	408.1	1081.8	774.3	385.0	356.2	557.9	1303.5	38.1	4904.2
1970	417.8	1130.5	801.5	391.8	363.5	541.4	1231.1	41.5	4919.1
1975	425.2	1179.8	817.6	390.5	366.7	542.4	1182.1	44.1	4948.4
Potatoes									
1965	18.0	168.3	89.7	67.5	65.5	102.4	262.0	8.3	781.7
1970	5.0	133.3	69.4	58.2	55.8	92.7	242.9	5.9	663.2
1975	1.0	89.2	44.6	47.2	46.2	79.5	222.4	4.2	534.3
Fodder Beets									
1965	20.3	57.8	61.3	39.4	34.7	48.1	94.7	3.8	360.1
1970	19.9	48.9	48.6	33.0	30.0	45.6	91.6	2.9	320.5
1975	17.0	39.9	35.0	27.1	24.9	41.3	88.8	2.0	276.0
Sugar Beets									
1965	14.1	102.2	64.2	18.8	19.5	18.2	56.9	.1	294.0
1970	15.4	98.5	64.5	18.4	23.7	22.0	69.6	.3	312.4
1975	15.5	94.9	64.7	18.4	25.4	25.9	78.2	.6	323.6

Table 58
Crop Surface Projections continued

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland Pfalz	Baden Württemberg	Bayern	Saarland	West Germany
Other Feed Crops									
1965	152.2	69.0	67.9	58.4	72.1	243.8	358.5	13.7	1035.5
1970	137.6	52.7	58.5	52.5	68.7	234.6	329.6	13.0	947.2
1975	126.2	41.8	44.2	44.5	61.6	231.0	327.5	13.0	889.8
Other Crops									
1965	93.9	145.9	152.8	67.5	118.1	126.0	140.1	24.9	869.1
1970	102.9	137.5	136.2	65.2	118.3	140.8	142.9	24.0	867.8
1975	103.0	125.5	124.6	65.0	118.1	151.9	145.2	23.1	856.4
Grassland									
1965	469.9	1298.7	792.0	354.8	298.6	790.4	1691.4	44.7	5740.5
1970	471.6	1304.9	795.6	342.4	300.4	774.2	1708.1	44.1	5741.3
1975	474.1	1306.3	802.3	339.3	309.6	758.2	1710.3	43.2	5743.3

tial for increasing yields and decreasing costs of producing grain crops than row crops.

Sugar beets occupy a unique position as a row crop, however. One of the attractions for sugar beet cultivation aside from their being a very lucrative cash crop is the use of the tops for cattle feed. Thus, the sugar beet enterprise essentially produces two crops -- beets for sale and tops for forage. Professor Reisch indicated in an interview with the author that the tops and pulp from one sugar beet hectare in the Allgau region are equal to one hectare of grassland when measured in terms of nutritional value. This essentially means that for each hectare of sugar beets, the net return from the beets themselves are additional profit or conversely tops and pulp by-products of the beets are equivalent to an extra hectare of grassland.[9] Nevertheless with the newer technology in grain feeding of livestock and techniques which allow more efficient handling, storing and utilization of silage the importance of sugar beet crops as a livestock feed will probably decline.

Historical crop surface trends for oats have followed a rather peculiar pattern in northern Germany. Throughout Germany, surface in oats declined sharply until 1961. Since oats is the main feed for horses, the decline was directly related to the decline in the number of horses as they were phased out in favor of tractor power on farms. This was particularly true in the north where more horses were used relative to draft cattle than in the south. After 1961, the oats surface continued to decline in Bayern and Saarland. In Niedersachsen, Nordrhein-Westfalen, Hessen, Rheinland-Pfalz and Badden-Württemberg, oats surface jumped substantially in 1962 and has since declined at a slower rate than in the late 1950's. In Schleswig-Holstein, oats surface has gradually increased since 1961. The most plausible explanation for this phenomenon is that northern Germany has rather markedly increased the portion of total surface devoted to grain during the period and farmers in that area concluded that a certain amount of oats was necessary in the crop rotation to maintain soil fertility. Southern Germany has a lower portion of total surface devoted to grain and thus has less need for oats in the rotation. As fertilizer use increases, the necessity of planting oats to maintain soil fertility will decline. Therefore, oats surface projections take this into account.

Rye has lost some of its market with the German consumer as tastes have changed and incomes increased. Further, rye has less nutritional value and smaller per hectare yields than wheat. Therefore, rye surface has declined sharply and will continue to do so throughout the next decade mainly in favor of wheat.

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[9] Interview with Professor E. Reisch, Institut für Angewandte landwirtschaftliche Betriebslehre, Stuttgart-Höhenheim.

With the increasing emphasis on the use of feed grains along with the normal growth in the livestock sector, barley surface has increased sharply and will continue to do so since barley is a major feed grain source. Summer barley is also a major ingredient in the brewing industry and beer consumption is increasing through population increase and rising per capita consumption.

The Influence of Price and Costs on Production

Under the Common Agricultural Policy, the EEC grain prices are going to fall throughout Germany. The price decrease will not be uniform across the country because the new policy uses a different mechanism to set grain prices at the various market points than was formerly in effect. For the purpose of this study, several questions concerning the effect of this policy change immediately come to mind. Our primary concern is the effect on production levels of the various grains and on grain in total. In other words, what is the production response to this change in price structure? Our second line of inquiry is to ask an explanation of the mechanism by which the change in price structure is transmitted to changes in production.

Production theory tells us that the normal response of a farmer faced with a decrease in the price of the output from one of his enterprises provided all other things remain constant is to shift resources out of that enterprise and into their formerly next-best alternatives in other farm enterprises or elsewhere. Thus, the output level from the enterprise in which the price fell will decrease and the output from the alternative resource use enterprises will increase. But, our problem is not quite that simple. Under the CAP prices of all grains as well as prices from certain other crops which compete for surface with grains and also prices of the products of certain grain-using livestock enterprises, change simultaneously. Thus, if we were to attempt to trace through and quantify the effects of each of the price changes on output of the various enterprises, we would need a complete matrix of supply price and cross-price elasticities covering all combinations of the agricultural products with which we are dealing. And even if this were possible, we would need to assume that all other things such as input prices, farm structure, and technology would remain constant. Further, if this supply elasticity matrix were to be of any generalizable value we would need to assume all supply functions and cross supply functions to be completely reversible. As long as so many other parameters are changing along with price, this assumption would be totally invalid. Our attempts to formulate statistical models to estimate supply elasticities for grains all showed statistically more significant results due mainly to the extreme constancy of the grain price structure in the base period. Supply elasticities estimated by Willms were considered in making our projections but we tended to view his estimates

as being on the high side.[10]

We are left then with a much less sophisticated type of analysis which nevertheless is probably more valid under the circumstances. When we look at historical price behavior of various agricultural products in Table 59, we find that the absolute as well as the relative price levels of grain have remained virtually constant since 1958. With the structural and technological considerations which we have discussed above, it appears that a good case for the threshold argument with respect to price changes may be quite readily substantiated. That is, over a reasonably large range of price changes, farm organization will not be changed due to fixity of resources in certain enterprises, inflexibility in the crop rotation, and difficulty of adapting specialized technology to the fixed plant in order to adjust the enterprise mix. If we subscribe to this argument, then we must look elsewhere other than the price structure of grains alone; internally and *vis à vis* each other, in order to explain the historical trends in grain surface.

Another look at Table 59 shows that prices of livestock products have increased during the past two years. Since grain prices have remained constant, those livestock enterprises depending upon feed grain as a large input have become relatively more profitable over time. Thus, we would expect pressure for increased feed grain surface relative to other crops.

Another factor which we have not considered is the differential change in yields over the base period and projected for the future. By combining the price of the product and the yield per hectare, we can derive some gross hectare return figures to compare in the base period and with the projected prices under the CAP for 1970. Table 60 presents gross hectare return data for wheat, rye, and barley. Within these grain enterprises where similar production costs would apply, we find the highest return for wheat followed by barley and rye in that order for all states during the base period. One exception occurs in the projection period in Niedersachsen where the gross hectare return for barley exceeds that for wheat. A similar hectare profitability pattern from that in the base period carries over into the projected returns for 1970. Barley does, however, become more profitable in 1970 relative to wheat than it was in the base period.

One aspect of the decrease in prices due to the Common Agricultural Policy in Germany which we have not yet touched upon and which may turn out to be the most important of all is the effect on production of the decrease in income generated by the lowering of prices. A decrease in farm prices causing lower farm incomes without a corresponding reduction in off farm incomes and opportunities will lower the opportunity cost wage which farm la-

[10] Enno F. Willms, *Versuch einer Quantifizierung von Getreideangebots funktionen in der Europaischen Wirtschaftsgemeinschaft*, Kiel, 1966.

Table 59. Producer Price Indexes of Various Agricultural Products 1958/59-1964/65 in West Germany (Base 1961/62 - 1962/63 = 100)

	1958/59	1959/60	1960/61	1961/62	1962/63	1963/64	1964/65
Grain & legumes	100	99	99	99	101	99	100
Wheat	99	99	99	99	101	100	100
Rye	101	98	98	98	102	99	99
Feed Barley	99	100	98	98	102	99	101
Brewing Barley	100	99	100	100	100	99	100
Oats	98	99	95	96	104	102	107
Legumes	101	110	101	96	104	101	99
Root Crops	97	109	85	103	97	81	110
Table potatoes 1/	94	115	72	106	94	65	112
Sugar beets	100	100	100	100	100	100	107
Slaughter livestock	102	101	102	101	99	110	111
Beef cattle	101	102	102	102	98	110	124
Veal calves	101	99	103	102	98	108	120
Pigs	102	100	102	99	101	110	100
Milk	94	96	94	98	102	108	111
Eggs	102	96	107	91	109	96	98
All cultivated crops	91	101	83	100	100	89	99
All livestock production	99	99	100	99	101	109	110
All agricultural products	98	100	95	99	101	104	107

[1] No market prices reported for feed potatoes or fodder beets.

Source: *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten* 1965, table 351, p. 225.

borers look at in making the decision to move to an urban job. Under this situation, we might expect an increase in the rate of off farm migration which in turn will have an effect on farm structure. With less farmers remaining on the farm those who are left will have an opportunity to expand the size of their units and to incorporate higher levels of technology. Increases in farm size and improvement in farm structure allowing higher levels of technological innovation have a tendency to shift the enterprise mix as we have seen in previous chapters toward grains and away from root crops. Within the grain mix, we find increases in wheat and barley with corresponding decreases in rye, oats and mixed grain; and within the root crop enterprises, increases in sugar beets and decreases in potatoes and fodder beets. We are convinced that a change in commodity prices as indicated by the Common Agricultural Policy will have a greater impact on production through the income

Table 60 Gross Hectare Returns for Grain Crops and Sugar Beets by State for 1960, 1964, and 1970 Projected

	1960				1964				1970			
	$/100 Kg Price	100Kg/Ha Yield	$ Gross Return/Ha	Relative Crop Returns Wheat=100	$/100 Kg Price	100Kg/Ha Yield	$ Gross Return/Ha	Relative Crop Returns Wheat=100	$/100 Kg Price	100Kg/Ha Yield	$ Gross Return/Ha	Relative Crop Returns Wheat=100
Schleswig-Holstein												
Wheat	10.14	37.5	380.25	100	10.56	42.2	445.63	100	9.67	42.0	406.14	100
Rye	9.26	26.6	246.32	65	9.76	29.5	287.92	65	8.98	29.5	264.91	65
Winter Barley	9.77	36.2	353.67	93	9.94	41.0	407.54	91	9.39	42.5	399.08	98
Summer Barley	10.78	32.0	344.96	91	10.60	37.1	393.26	88	9.80	37.0	362.60	91
Niedersachsen												
Wheat	10.34	40.5	418.77	100	10.82	39.2	424.14	100	9.70	38.5	373.45	100
Rye	9.38	28.8	270.14	65	9.78	32.4	316.87	75	8.93	31.5	281.30	75
Winter Barley	9.58	41.6	398.53	95	9.91	41.2	408.29	96	9.17	41.5	380.56	102
Summer Barley	10.78	33.2	357.90	85	10.60	30.8	326.48	77	9.56	35.0	334.60	90
Nordrhein-Westfalen												
Wheat	10.29	32.9	338.54	100	10.89	38.0	413.82	100	9.74	37.0	360.38	100
Rye	9.23	28.8	265.82	79	9.72	34.6	336.31	81	8.96	33.5	300.16	83
Winter Barley	9.37	32.3	302.65	89	9.65	37.4	360.91	87	8.75	38.0	332.50	92
Summer Barley	10.91	32.1	350.21	103	10.61	32.8	348.01	84	9.22	34.0	313.48	88
Hessen												
Wheat	10.10	38.4	387.84	100	10.29	34.0	349.86	100	9.73	38.0	369.74	100
Rye	9.24	32.1	296.60	76	9.47	30.9	292.62	84	8.95	33.0	295.35	80
Winter Barley	9.07	38.2	346.47	89	9.25	33.5	309.88	89	8.66	37.5	324.75	88
Summer Barley	10.79	31.8	343.12	88	10.46	32.0	334.72	96	8.88	34.5	306.36	87

Table 60 continued

	1960				1964				1970			
	$/100 Kg Price	100Kg/Ha Yield	$ Gross Return/Ha	Relative Crop Returns Wheat=100	$/100 Kg Price	100Kg/Ha Yield	$ Gross Return/Ha	Relative Crop Returns Wheat=100	$/100 Kg Price	100Kg/Ha Yield	$ Gross Return/Ha	Relative Crop Returns Wheat=100
Rheinland-Pfalz												
Wheat	10.48	37.4	391.95	100	10.53	34.3	361.18	100	9.80	36.0	352.80	100
Rye	9.54	28.6	272.84	70	9.46	27.8	262.99	73	9.04	31.0	280.24	79
Winter Barley	9.02	37.2	335.54	86	9.24	34.8	321.55	89	8.74	35.5	310.27	88
Summer Barley	10.78	34.2	368.68	94	10.51	28.3	297.43	82	8.85	35.0	309.75	92
Baden-Württemburg												
Wheat	10.71	34.3	367.35	100	10.92	34.2	373.46	100	9.74	35.5	345.77	100
Rye	9.82	27.2	267.10	73	10.06	30.4	305.82	82	9.07	30.0	272.10	79
Winter Barley	9.35	32.7	305.75	83	9.58	31.7	303.69	81	8.89	33.5	297.82	86
Summer Barley	10.78	28.6	308.31	84	10.88	33.2	361.22	96	9.26	32.0	296.32	86
Bayern												
Wheat	10.51	33.9	356.29	100	10.60	34.8	368.88	100	9.50	34.5	327.95	100
Rye	9.59	27.2	260.85	73	9.76	28.5	278.16	75	8.85	28.5	252.23	77
Winter Barley	9.19	31.4	288.57	81	9.31	30.3	282.09	76	8.63	31.0	267.53	82
Summer Barley	10.88	32.2	348.40	98	10.70	22.3	238.61	65	8.98	32.5	291.85	90
Saarland												
Wheat	10.59	29.1	308.17	100	10.72	29.4	315.17	100	9.77	33.8	330.23	100
Rye	9.68	25.7	248.78	81	10.36	27.2	281.79	89	9.06	28.5	258.21	78
Winter Barley	9.18	27.2	249.70	81	9.41	26.1	245.60	78	8.82	32.5	286.65	87
Summer Barley	10.78	25.8	278.12	90	10.69	22.3	238.39	76	9.03	31.5	284.45	88

Source: Donald J. Epp, *The Impact of Agricultural Policies on Regional Grain and Livestock Prices in the European Economic Community*, unpublished Ph.D. dissertation, Michigan State University, 1967.

effect than through the direct price effect in Germany.

Crop Production Projections

Since we now have projections of crop yields for 1970 and 1975 as well as projections for crop surface, it is a simple matter to calculate the production projections by multiplying the yields times the surface. Table 61 presents the historical production of the various grain crops along with sugar beets, and potatoes for the 1960 through 1965 period and projections to 1970 and 1975.

In general, the 1965 weather conditions in West Germany were unfavorable for crop production. Yields were below normal trend causing low production levels for most crops. Therefore, in viewing the production projections in Table 61 comparisons with only 1965 are less illuminating than when the projections are viewed in the perspective of the total production data array from 1960 through 1965. In line with the analysis of preceding chapters and projections of yields and crop surface, we are projecting an increase in total grain production of 10.4 percent in 1970 and 19.2 percent in 1975 from a 1963/65 base. A much larger increase in feed than in food grain production is projected. From a 1963/65 base, food grain production increases by 3.3 percent and 6.8 percent while feed grain production increases by 18.2 percent and 33.1 percent by 1970 and 1975 respectively. These increases are accomplished by a more than proportionate increase in barley and wheat and an absolute decline in oats, rye and mixed grain.

Potato production does not decline as fast as one might suspect from the substantial decline in surface, due to rather large offsetting increases in yield. Increases in sugar beet production are limited due to institutional restrictions imposed in the form of surface quotas to control production.

To summarize the factors influencing these projections, we can say that technological advance has by far the greatest impact on projected output. The differential rates of technological innovation possible and levels of technology reached in various crops have shifted the crop production cost structure. Since labor is one of the highest cost factors, technology which replaces large portions of the labor input will shift crop surface toward those crops which can most efficiently use that technology. The primary limiting factor in technological innovation through more advanced levels is farm structure. Thus the speed at which farm structure changes also has a substantial impact on production. Finally, since price relationships do not change to a large extent under the Common Agricultural Policy but only fall in an absolute sense, the direct price effect is very small. The main way in which price changes affect production patterns is through the income effect.

Table 61. Production of Various Crops in West Germany by State 1960-1965 with Projections for 1970 and 1975 in 1000 tons

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland Pfalz	Baden Württemberg	Bayern	Saarland	West Germany
Wheat									
1960	331.7	727.9	603.9	491.9	419.2	843.8	1511.4	31.2	4964.9
1961	279.8	505.7	503.3	358.1	301.7	717.7	1342.0	26.0	4038.5
1962	343.8	690.2	629.8	370.6	276.0	657.6	1599.4	18.7	4591.5
1963	316.0	681.5	558.8	477.7	411.3	795.0	1573.4	37.3	4856.0
1964	369.0	619.0	714.1	448.3	400.2	857.4	1654.8	36.2	5202.6
1965	306.2	641.1	525.8	371.9	405.6	706.3	1348.0	38.1	4347.7
1970	394.8	792.3	690.8	480.7	494.6	876.1	1724.3	55.1	5508.7
1975	440.1	933.6	765.5	539.5	580.2	975.1	1829.4	65.0	6128.4
Rye									
1960	305.9	780.7	780.7	386.9	233.3	675.6	675.6	18.1	3797.9
1961	203.5	489.1	489.1	210.0	147.4	512.2	512.2	14.0	2514.6
1962	228.4	1014.7	740.3	230.8	109.7	65.9	555.0	9.7	2965.6
1963	235.8	1052.0	785.9	339.5	182.2	76.3	536.6	19.2	3238.8
1964	264.1	1231.8	898.0	331.2	192.0	78.6	581.4	19.4	3608.8
1965	207.7	1028.7	660.1	253.0	172.3	79.5	394.4	20.6	2825.0
1970	181.1	1018.1	762.8	254.4	159.0	68.4	315.8	23.1	2782.7
1975	135.1	908.9	750.6	195.3	137.9	71.0	219.9	24.7	2443.4
Food Grains									
1960	637.6	1508.6	1384.6	878.8	652.5	1519.4	2187.0	49.3	8762.8
1961	483.3	994.8	992.4	568.1	449.1	1229.9	1854.2	40.0	6553.1
1962	572.2	1704.9	1370.1	601.4	385.7	723.5	2154.4	28.4	7557.1
1963	551.8	1733.5	1344.7	817.2	593.5	871.3	2110.0	56.5	8094.8
1964	633.1	1850.8	1612.1	779.5	592.2	936.0	2236.2	55.6	8811.4
1965	513.9	1669.8	1185.9	624.9	577.9	785.8	1742.4	58.7	7172.7
1970	575.9	1810.4	1453.6	735.1	653.6	944.5	2040.1	78.2	8291.4
1975	575.2	1842.5	1516.1	734.8	718.1	1046.1	2049.3	89.7	8571.8

Table 61 continued

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland Pfalz	Baden Württemberg	Bayern	Saarland	West Germany
Mixed Grain									
1960	201.3	379.7	279.8	50.8	59.7	167.8	200.6	6.1	1349.2
1961	204.1	336.4	256.5	40.3	41.2	144.0	171.2	5.9	1203.1
1962	204.8	432.2	362.9	76.7	53.8	210.6	200.1	8.7	1553.5
1963	179.0	401.0	341.4	57.9	49.5	155.2	212.6	8.8	1409.2
1964	175.9	427.6	325.0	54.1	44.3	167.3	211.8	7.2	1452.7
1965	158.6	356.2	253.6	46.4	62.8	131.0	183.1	7.3	1201.1
1970	122.5	364.9	279.4	54.1	57.5	141.8	214.0	8.7	1242.9
1975	85.8	354.4	272.3	43.2	61.1	116.4	175.5	8.1	1116.8
Feed Grains									
1960	646.3	1357.3	947.0	507.8	528.7	797.4	1919.6	35.5	6749.0
1961	661.2	1212.2	871.5	421.0	427.2	658.1	1545.2	32.9	5838.5
1962	691.2	1523.2	1156.1	607.1	527.3	1093.5	1982.4	39.1	7630.7
1963	699.9	1613.1	1161.0	567.7	546.9	795.4	1537.9	41.2	7291.8
1964	823.4	1810.9	1181.3	524.0	464.6	882.4	1548.5	38.8	7676.1
1965	797.2	1690.9	1035.8	478.2	493.3	655.0	1416.0	38.3	6617.6
1970	961.2	2135.7	1352.6	641.6	566.2	867.0	1932.0	51.2	8507.5
1975	1126.6	2589.0	1545.2	736.1	606.2	889.7	2028.4	58.6	9579.8
Total Grains									
1960	1283.9	2865.9	2331.6	1386.6	1181.2	2316.8	4106.6	84.8	15511.8
1961	1144.5	2207.0	1863.9	989.1	876.3	1888.0	3399.4	72.9	12391.6
1962	1263.4	3228.1	2526.2	1208.5	913.0	1817.0	4136.8	67.5	15187.8
1963	1251.7	3346.6	2505.7	1384.9	1140.4	1666.7	3647.9	97.7	15386.6
1964	1456.5	3661.7	2793.4	1303.5	1056.8	1818.4	3784.7	94.4	16487.5
1965	1311.1	3360.7	2221.7	1103.1	1071.2	1440.8	3158.4	97.0	13790.3
1970	1537.1	3946.1	2806.2	1376.7	1219.8	1811.5	3972.1	129.4	16798.9
1975	1701.8	4431.5	3061.3	1470.9	1324.3	1935.8	4077.7	148.3	18151.6

Table 61 continued

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland Pfalz	Baden Württemberg	Bayern	Saarland	West Germany
Winter Barley									
1960	114.9	332.2	296.8	82.1	38.8	30.3	54.4	2.1	953.1
1961	99.7	280.5	281.8	67.4	34.6	24.3	67.9	1.8	859.5
1962	128.3	263.7	339.8	43.0	17.1	8.3	61.2	.6	863.8
1963	122.6	352.4	351.0	72.8	30.9	16.1	83.1	1.6	1032.2
1964	152.2	430.5	423.0	78.2	37.4	16.7	73.9	2.1	1216.2
1965	176.2	428.5	411.4	74.4	32.3	15.6	50.6	2.6	1193.3
1970	281.4	647.4	621.3	129.4	54.3	23.8	103.2	5.2	1866.0
1975	376.7	857.0	813.7	172.6	73.1	34.3	127.1	9.3	2463.8
Summer Barley									
1960	138.7	147.1	89.7	96.2	207.8	409.7	1169.9	7.7	2268.1
1961	137.7	167.5	100.3	92.8	152.7	326.8	877.7	6.2	1863.0
1962	134.5	282.3	159.0	204.8	241.9	599.4	1246.3	10.8	2880.5
1963	152.4	286.4	162.6	153.8	250.8	414.8	1095.6	11.8	2529.4
1964	186.9	353.5	146.0	154.7	203.5	483.0	801.4	9.8	2699.3
1965	166.1	363.9	127.3	139.8	206.1	331.8	821.5	11.9	2171.2
1970	278.2	589.4	202.0	232.5	263.2	495.7	1280.5	17.3	3358.8
1975	384.9	834.0	253.4	303.3	289.0	536.0	1419.3	21.7	4041.6
Oats									
1960	191.4	498.3	280.7	278.7	222.4	189.6	494.7	19.6	2178.6
1961	219.7	427.8	232.9	220.5	198.7	163.0	428.4	19.0	1912.9
1962	223.6	545.0	294.4	282.6	214.5	275.2	474.8	19.0	2332.9
1963	245.9	573.3	306.0	283.2	215.7	209.3	146.6	19.0	2321.0
1964	308.4	599.3	287.3	237.0	179.4	215.4	461.4	19.7	2307.9
1965	296.3	542.3	243.5	217.6	192.1	176.6	360.8	16.5	2052.0
1970	279.1	534.0	249.9	225.6	191.2	205.7	334.3	20.0	2039.8
1975	279.2	543.6	205.8	217.0	183.0	203.0	306.5	19.5	1957.6

Table 61 continued

Crop Year	Schleswig-Holstein	Niedersachsen	Nordrhein Westfalen	Hessen	Rheinland Pfalz	Baden Württemberg	Bayern	Saarland	West Germany
Potatoes									
1960	100.7	6201.7	2917.7	2076.1	1964.0	2885.0	7223.6	233.2	24558.9
1961	834.0	5205.8	2465.2	1614.6	1876.7	2671.6	6602.8	191.0	21515.6
1962	767.7	5822.0	3420.9	2342.0	2114.0	2975.5	7362:4	242.4	25103.6
1963	732.1	5837.9	3192.1	2490.5	2146.3	2963.2	8174.3	223.8	25812.4
1964	637.5	4380.6	2999.0	1501.5	1477.6	2133.6	6213.7	178.1	20624.0
1965	466.0	4464.6	2018.4	1591.2	1566.5	2183.6	5606.7	170.4	18094.6
1970	139.5	3812.4	1922.4	1583.0	1531.7	2516.3	6837.6	162.1	18505.0
1975	29.9	2734.1	1322.4	1375.9	1258.3	2377.1	6716.5	123.7	15937.9
Sugar Beets									
1960	489.7	4372.9	2945.3	819.6	935.9	892.5	1859.8	6.4	12324.8
1961	407.3	3040.8	2152.8	506.1	650.7	680.9	1748.3	4.4	9253.4
1962	447.7	3142.1	2181.0	532.4	743.4	671.9	1799.2	4.6	9524.9
1963	536.0	4207.5	2809.0	764.0	959.7	900.6	2309.3	4.2	12493.1
1964	636.3	3666.6	2959.7	753.7	812.8	835.1	2358.6	3.1	12862.6
1965	451.6	3753.8	2293.3	658.8	908.3	747.1	2120.2	4.4	10938.8
1970	569.8	3876.0	2799.3	761.8	1110.3	1065.9	3045.0	14.2	13242.3
1975	600.6	3914.6	2940.6	788.6	1247.1	1315.7	3585.5	29.9	14422.6

Chapter 7

Livestock Projections

Introduction

No single method for projecting production levels of all livestock products is satisfactory. The method of projection must be adapted to fit the production circumstance of the particular product. Therefore, we develop individually the method and project output of each livestock product under consideration. Since feed grains are the primary feed for poultry meat, eggs, and pork production, and are fed to a lesser degree in milk and beef production, we project the derived demand for feed grain required to sustain projected production levels of these livestock products.

Poultry Meat and Eggs

Commercial poultry meat and egg production are increasing rapidly in West Germany. The technological level in these enterprises is similar to that found in the U.S. in operations of comparable size. The largest concentration of production is found in Niedersachsen and Nordrhein-Westfalen near the Ruhr industrial complex which is the largest market and also near the ports of Rotterdam, Bremen, and Hamburg, the main channels through which imported feed grains flow. Future agricultural policy in Germany and in the EEC aimed at commercial type enterprises such as found in the poultry and egg sector will have a strong influence on the rate of future growth of these enterprises. Presently the tax laws include a 4 percent turnover tax on gross incomes plus an additional excise tax amounting to 5/8 the turnover tax on livestock production which does not meet the requirements of being agricultural rather than commercial production. The basis for exempting agricultural firms is one of several policies directed toward the goal of retaining a family farm agriculture. The test to determine if the farm is tax exempt agriculture or taxable commercial relates the number of livestock units to the number of hectares. The livestock unit is a measure which converts different livestock types to a common denominator based on nutritional requirements.[1]

Table 62 presents the maximum number of animals of various types for farms of stated sizes assuming a single type of livestock on a given farm. Under present production conditions, a substantial number of poultry and egg firms exceed this maximum for tax exempt status, and pressure against these maximums are found in the pig enterprises on a number of farms. Since no feedlot operations are found for beef feeding, the maximums are no encumbrance in the cattle fattening or dairy enterprises at present.

For large scale poultry meat or egg production the present tax law merely means that for a small range in enterprise size at the taxable size margin, firms would find it more profitable to avoid that size range by either

[1] See Appendix B for livestock unit conversion table.

staying just below, or operating far enough above the taxable size that size economies offset the cost of the tax.

During 1966 a proposal to fix an absolute upper limit on the number of livestock units on farms of given sizes was much discussed in Germany. This type of legislation would be very damaging to future growth of an efficient large scale poultry meat or egg industry. Germany would be economically imprudent to pass this kind of law without the other EEC member countries taking similar steps. Since this appears unlikely, we will assume that Germany will not follow through on the proposal.

Because commercial poultry meat production is based on relatively new technology and methods and is normally carried out with purchased feed inputs, it is not encumbered in expansion by existing production facilities and fixed structure. Therefore, expansion can come quickly in response to demand and is limited only by its relative profitability to other commercial endeavors.

Table 62. Maximum Number of Various Types of Livestock For Classification As Agricultural Production Under the Turnover Tax Law.

Kind of Livestock	5	10	20	30	40	50	100
	Size of Farm in Hectares						
Only cows	50	90	150	180	210	230	330
Only beef cattle (annual production)	50	90	150	180	210	230	330
Only sows (including piglets)	68	123	205	247	288	315	452
Only pigs (annual production)	300	540	900	1,080	1,260	1,380	1,980
Only laying hens	2,500	4,500	7,500	9,000	10,500	11,500	16,500
Only broilers (annual production)	30,000	54,000	90,000	108,000	126,000	138,000	198,000

Sources: G. Vogel, *Abgrenzung und Umfang von Tierbeständen im Rahmen des landwirtschaftlichen Vermögens. Betriebswirtschaft Mitt.* Kiel, 1965, Nr. 133.
A. Sandfort, *Steuerfragen der Geflügelhaltung. Mitt. der DLG*, 1965, Nr. 44, p. 1686.

Table 63 presents the poultry meat supply-demand balance over the past decade and the projected balance for 1970 and 1975. The production trend has been increasing at an increasing rate over the base period. With no change in grain or broiler prices we would expect a continuation of this trend. But since feed grain prices will decrease in Germany under the CAP and rise in the other EEC countries, a sharp relative increase in profitability is seen for West German poultry meat production. Further, since technology has advanced so rapidly in poultry production, later built plants using the latest in technology should be more efficient than those already exist-

ting. Thus, domestic competition with imports particularly from the Netherlands will be very strong. This will be the case even though poultry meat prices are expected to decline following increases in internal production efficiency.

With no institutional restrictions to commercial production, the small farm flock for eggs and poultry will rapidly disappear. By 1970, sale of poultry meat from these flocks will be near zero and by 1975 sale of eggs will also be nil. The only effect the farm flock will have is through providing eggs and poultry meat to the farm family who otherwise would need to buy these products on the market. That is, the farm flock affects the demand picture for the commercial enterprises but not the market supply. The effect will in any case be negligible.

Table 63. Demand and Supply of Poultry Meat in Germany 1954/55-1964/65 With Projections to 1970 and 1975.

	(1) Domestic Production (1000 Tons)	(2) Imports (1000 Tons)	(3) Domestic Consumption (1000 Tons)	(4) Per Capita Consumption (Kilograms)	(5) % of Self-Sufficiency (Column 1) / (Column 3)
1954/55	65	20	85	1.7	76
1955/56	60	28	88	1.7	68
1956/57	66	40	106	2.0	62
1957/58	80	50	130	2.4	62
1958/59	90	74	164	3.1	55
1959/60	97	120	217	3.9	45
1960/61	101	144	245	4.4	41
1961/62 1/	111	220	315	5.6	35
1962/63 1/	120	176	310	5.4	39
1963/64 1/	130	196	325	5.6	40
1964/65	146	204	350	6.0	42
1970	307	204	511	8.4	60
1975	472	157	629	10.1	75

[1] In 1961/62, 15 tons added to the national reserve. In 1962/63, national reserve decreased by 15 tons. In 1961/62, 1962/63, 1963/64 exports amounted to 1 ton per year.

Sources: *Statistisches Jahrbuch über Ernährung, Landwirtschaft, und Forsten* 1960 Table 278, 1965 Table 285. Demand Projections by Vernon Sorenson, Michigan State University. Supply projections own calculations.

With these factors in mind, we are projecting domestic production to cover 60 percent of the demand in 1970 and 75 percent in 1975. Due to the locational advantages for both imported feed grains and proximity to a major portion of the Ruhr area market, the Netherlands will be able to supply part of the German market more profitably than can domestic producers. It is therefore doubtful that Germany will become fully self-sufficient in poultry meat and will probably remain at a 75-80 percent self-sufficiency level after

it is once reached.

With the increase in demand through both population and per capita consumption increases, production is expected to increase from 146 thousand tons in 1965 to 307 thousand tons in 1970 and 472 thousand tons in 1975. With this sharp production increase, we project no change in imports in 1970 from 204 thousand tons in 1964/65 and then a decrease to 157 thousand tons in 1975.

Estimates of the regional production distribution can be calculated for poultry meat based on past distribution. Table 64 shows the percentage distribution of the poultry meat production in Germany for each year between 1961 and 1965. Niedersachsen and Nordrhein-Westfalen are the large producing states in the north accounting for 62 percent of the total in 1965. The firms in this area depend to a large extent on imported feed grain. Bayern is the large producer in the south with 17 percent of the total production and depends primarily on domestically produced grains. According to Table 64, the production pattern has been quite stable over the last three years shown. We therefore expect a stabilizing of the pattern over the projected period with variation mainly along with population movements.

Egg production will progress similar to poultry meat production in the next decade. The main difference is in the rate of production development and the stabilizing or equilibrium degree of self-sufficiency. Table 65 presents historical egg balance data for Germany which indicates the self-sufficiency rate did not fall as far as poultry meat self-sufficiency during

Table 64. Percentage Distribution of Poultry Meat Production by State in West Germany 1961 - 1965

State	1961	1962	1963	1964	1965
Schleswig-Holstein	6	7	6	5	5
Niedersachsen	23	29	37	43	42
Nordrhein-Westfalen	32	26	24	21	20
Hessen	9	7	5	5	6
Rheinland-Pfalz	3	4	3	2	2
Baden-Württemberg	10	9	7	7	7
Bayern	16	17	17	16	17
Saarland	1	1	1	1	1
West Germany	100	100	100	100	100

Source: *Bundesministerium für Ernährung, Landwirtschaft, und Forsten*, and own calculations.

the late 1950's. The self-sufficiency gap began closing again for eggs earlier than for poultry meat and stood at 80 percent in 1965. We expect an 88 percent self-sufficiency level to be reached by 1970 and thereafter production to equal about 90 percent of demand.

Table 65. Demand and Supply of Eggs in Germany 1954/55 - 1964/65 With Projections to 1970 and 1975.

Year	Domestic Production	Imports Including Egg Products	Exports	Change In Reserve Stocks	Domestic Consumption	Per Capita Consumption[1]		Self-Sufficiency
	tons	tons	tons	tons	tons	Kg.	eggs	percent
1954/55	327	186	0	0	513	10.0	177	64
1955/56	309	209	1	0	517	10.0	174	60
1956/57	333	259	0	0	592	11.3	198	56
1957/58	354	262	1	0	615	11.6	201	58
1958/59	370	305	1	+3	671	12.5	217	55
1959/60	404	321	1	0	724	13.1	228	56
1960/61	435	301	1	0	735	13.1	229	59
1961/62	468	308	1	+6	769	13.6	237	61
1962/63	513	308	1	-6	726	12.7	220	71
1963/64	580	204	1	+6	777	13.4	234	75
1964/65	628	153	0	-4	785	13.4	234	80
1970	887	110			997	16.4	288	88
1975	1008	112			1120	18.0	316	90

[1] One Kilogram = 17.54 eggs

Sources: *Statistisches Jahrbuch über Ernährung, Landwirtschaft, und Forsten* 1960, Table 304, 1965, Table 312.
Demand projections by Vernon Sorenson, Michigan State University, Supply projections own calculations.

Some danger of over-supply is present in that The Netherlands has been supplying a large portion of the German egg imports and pressure to continue exporting at early 1960's levels particularly to the Ruhr area will be evident. This coupled with the drop in feed grain prices in Germany may cause an over-commitment of resources in egg production resulting in surpluses. Since egg producing technology is completely mobile, it is doubtful that Germany would readily find export markets for these potential surpluses. No EEC intervention mechanism is present in the CAP as it now stands, nor is there any proposal for an egg protection policy inclusion. Thus, if surpluses accumulate, egg prices will fall and pressure will build for an egg policy. At that point, however, the damage will have already been done, resources already over-committed, and an unstable situation with a potentially large capital destruction will have occurred.

The regional production pattern for eggs is slightly more dispersed than for poultry meat. Table 66 presents the percentage distribution pattern of egg production by state for 1961 through 1965.[2] As with poultry meat, the

[2] For egg production by state 1960-1965 see Appendix D.

production pattern appears quite stable through time and will probably remain so through our projection period. Again, Niedersachsen and Nordrhein-Westfalen are predominant producers in the north while Baden-Württemberg and Bayern share the honors in the south.

Feed Grain Requirements for Poultry

Grain is the principal feed for poultry in the production of both meat and eggs. Table 67 presents historical data on volume of feedstuffs used in poultry production over the 1953/54 - 1964/65 period. The feed requirements in the table are presented in terms of grain unit equivalents. That is, the

Table 66. Percentage Distribution of Egg Production By State in West Germany 1961 - 1965.

State	1961	1962	1963	1964	1965
Schleswig-Holstein	8	8	7	7	7
Niedersachsen	26	27	27	27	27
Nordrhein-Westfalen	22	23	23	22	22
Hessen	7	6	6	6	6
Rheinland-Pfalz	5	5	5	5	6
Baden-Württemberg	11	11	11	12	12
Bayern	20	19	20	20	19
Saarland	1	1	1	1	1
West Germany	100	100	100	100	100

feeds listed other than grain are converted to the tonnage of grain represented by these different feeds in terms of their relative nutritional value.[3] Poultry feed requirements slightly more than doubled over the period and the grain portion of the total requirements ranged as high as 78 percent in 1961/62 down to as low as 64 percent in 1964/65. The use of concentrates is increasing rapidly as is the use of milk, particularly in the form of skimmed milk powder. The use of potatoes as poultry feed has fluctuated greatly during the period but appears to be declining slightly in absolute terms and has declined greatly in relative terms. We will assume for the next decade that the grain share will remain between 65 and 70 percent of the total poultry feed requirement.

Table 68 presents the calculations for projecting feed grain requirements for poultry meat and eggs to 1970 and 1975. By starting with the year 1964/65 when production of poultry meat was known to be 146 thousand tons, egg production was known to be 680 thousand tons, and total feed grain use for poultry was known to be 2,872 thousand tons, we were able to calculate, using a feed grain-poultry meat conversion factor of 2.3 and a feed grain-egg conversion factor of 3.7, a total feed grain demand for poultry of 2,852 thou-

[3]See Appendix B for grain unit conversions.

Table 67. Poultry Feed by Type in West Germany in 1000 Tons Grain Units 1953/54 - 1964/65.

	Grain	Potatoes	Concentrates[1]	Miscellaneous[2]	Milk	Total	Grain as % of Total
1953/54	1614	130	N/A	N/A	N/A	2137	76
1954/55	1455	176	N/A	N/A	N/A	2247	65
1955/56	1577	101	N/A	N/A	N/A	2126	74
1956/57	1651	101	N/A	N/A	N/A	2294	72
1957/58	1877	98	N/A	N/A	N/A	2514	75
1958/59	1949	81	N/A	N/A	N/A	2678	73
1959/60	2157	78	494	130	50	2909	74
1960/61	2110	147	574	189	84	3104	68
1961/62	2615	42	583	71	50	3361	78
1962/63	2513	110	764	175	106	3668	69
1963/64	2662	117	947	203	170	4099	65
1964/65	2872	90	1129	195	190	4476	64

N/A - Not immediately available.

1/ Concentrates include bran, legumes, tapioca meal, oil cake, fishmeal, meat meal, molasses, and processing tailings.

2/ Miscellaneous includes sugar beet slices, fodder root crops (potatoes, fodder beets), beet tops, and miscellaneous tailings.

sand tons. Since the difference is only a magnitude of 20 thousand tons on a base of almost 3,000 thousand tons the percentage error is very small. For 1970 we assume an increase in the conversion efficiency for poultry meat and, therefore, a bettering of the feed grain-meat conversion factor from 2.3 to 2.0. In egg production, we assume a bettering of the feed grain egg conversion factor from 3.7 to 3.3 in 1970. This will come primarily through a larger number of eggs produced per hen per year. Thus, with the new conversion ratios and the production projections from earlier tables, we calculate a total feed grain need in 1970 for poultry meat and egg production of 3,541 thousand tons. For 1975 the conversion factors decrease again due to even greater efficiency to 1.8 for feed grain to meat conversion and 3.1 for feed grain to egg conversion. Again, using the projected production from earlier tables, we calculate a feed grain requirement for poultry in 1975 of 3975

thousand tons.

We have enough data to enable us to make regional feed grain use projections under a limited set of assumptions. First, we will assume the distribution of production for both poultry and eggs to be the same as we found in 1965. This assumption may not hold because of interregional price relationship changes. Second, we will assume that the feed grain to poultry meat conversion ratio is the same for all regions. This assumption is probably not quite true either because the main commercial operations are concentrated in Niedersachsen and Nordrhein-Westfalen and we would expect these two regions at least to have a more efficient conversion rate than the other states. Nevertheless, since we have no basis for adjusting these conversion rates by state, we will assume that the country average applies to each individual state. Third, we can adjust the feed grain to egg conversion ratio for each state because we have data on the number of eggs per hen per year produced in each state over a historical time period. Using these eggs per hen yields as an efficiency criteria, we project the yields for each state to 1970 and 1975, (Table 69) determine the percentage difference between the state yield and the national average yield, and adjust the conversion ratios by that figure. With this data and the estimates of total production of poultry meat and eggs, we can calculate our state feed grain use estimates. Table 70 presents the necessary known data and the calculations. Table 70 clearly shows

Table 68. Feed Grain Requirements for Poultry Meat and Eggs In 1970 and 1975 in West Germany in 1000 tons.

	unit	1964/65	1970	1975
Poultry Meat Production	1000 tons	146	307	472
Kilograms Feed Grain per One Kilogram Meat	Kilograms	2.3	2.0	1.8
Feed Grain for Poultry Meat Production	1000 tons	336	614	850
Egg Production	1000 tons	680	887	1008
Kilograms Feed Grain per One Kilogram Eggs	Kilograms	3.7	3.3	3.1
Feed Grain for Egg Production	1000 tons	2516	2927	3125
Total Feed Grain Demand For Poultry	1000 tons	2852[1]	3541	3975

[1]This calculated figure should correspond with the grain consumption figure for 1964/65 in Table 75 which is 2872 thousand tons. Error is due to rounding in calculation.

that over half the feed grain used in poultry and egg production is needed in the northern 3 states of Schleswig-Holstein, Niedersachsen and Nordrhein-Westfalen. These states are the most easily accessible for imports moving into Germany via the North Sea German ports and Rotterdam.

Table 69. Average Egg Yield Per Hen Per Year in West Germany 1955 - 1965 with Projections to 1970 and 1975

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1970	1975
Schleswig-Holstein & Hamburg	153.0	156.9	157.5	162.8	165.7	172.8	176.8	186.3	189.0	200.0	227	250
Niedersachsen & Bremen	149.8	149.5	156.7	161.1	168.8	176.4	180.2	182.7	193.2	204.0	233	255
Nordrhein-Westfalen	143.4	144.8	153.3	157.1	160.1	165.7	166.7	178.4	193.0	196.4	230	250
Hessen	129.0	127.6	131.5	136.5	141.4	144.9	148.9	150.7	162.2	174.3	203	230
Rheinland-Pfalz	126.0	125.8	133.6	135.2	133.6	144.5	148.2	155.4	172.4	180.5	209	235
Baden-Württemberg	129.3	127.9	134.5	136.8	140.1	142.1	146.7	154.2	165.4	180.0	204	235
Bayern	132.3	129.5	136.3	137.2	140.1	142.2	145.4	145.9	160.0	170.2	200	230
Saarland	--	--	--	--	--	145.0	149.0	156.0	174.0	188.0	216	240
West Germany	137.0	136.2	142.6	145.7	149.2	157.0	160.2	166.1	178.6	187.9	218	243

Source: *Der Bundesminister für Ernährung, Landwirtschaft und Forsten*, Bonn.

Table 70. Projections of Feed Grain Requirements and Number of Laying Hens By State for Poultry Meat and Egg Production to 1970 and 1975

	(1) 1965 Meat % Dist.of Prodn.	(2) 1970 Meat 1000 tons Prodn.	(3) Feed Utilization for Meat 1000 tons	(4) 1965 Egg % Prodn. Dist.	(5) 1970 Egg Prodn. 1000 tons	(6) 1970 Egg Yield Per Hen	(7) 1970 Eggs Supplied Mil.1/	(8) 1970 Hens Required 1000's	(9) 1970 Efficiency Kg Feed Grain/ Kg Eggs	(10) Feed Utilization for Egg Prodn. 1970 Col(5)xCol(9)	(11) 1970 Total Feed Grain Col(3)+Col(10)
Schleswig-Holstein	5	15	30	7	62	227	1,088	4,793	3.18	197	227
Niedersachsen	42	129	258	27	240	233	4,210	18,069	3.08	739	997
Nordrhein-Westfalen	20	61	122	22	195	230	3,421	14,874	3.13	610	732
Hessen	6	19	38	6	53	203	930	4,581	3.55	188	226
Rheinland-Pfalz	2	6	12	6	53	209	930	4,450	3.46	183	195
Baden-Württemberg	7	22	44	12	106	204	1,860	9,118	3.53	374	418
Bayern	17	52	104	19	169	200	2,965	14,825	3.59	606	710
Saarland	1	3	6	1	9	216	158	731	3.35	30	36
West Germany	100	307	614	100	887	218	15,562	71,444	3.30	2,927	3,541

Table 70. continued

	1965 Meat % Dist.of Prodn.	1975 Meat 1000 tons Prodn.	Feed Utilization for Meat 1000 tons	1965 Egg % Prodn. Dist.	1975 Egg Prodn. 1000 tons	1975 Egg Yield Per Hen	1975 Eggs Supplied Mil.1/	1975 Hens Required 1000's	1975 Efficiency Kg Feed Grain/ Kg. Eggs	Feed Utilization for Egg Prodn. 1975 Col(5)xCol(9)	1975 Total Feed Grain Col(3)+Col(10)
Schleswig-Holstein	5	24	43	7	71	250	1,246	4,984	3.02	215	258
Niedersachsen	42	198	347	27	272	255	4,772	18,714	2.95	802	1,159
Nordrhein-Westfalen	20	95	171	22	222	250	3,895	15,580	3.01	668	839
Hessen	6	28	50	6	60	230	1,052	4,574	3.28	197	247
Rheinland-Pfalz	2	9	16	6	60	235	1,052	4,477	3.22	193	209
Baden-Württemberg	7	33	60	12	121	235	2,124	9,038	3.22	390	450
Bayern	17	80	144	19	192	230	3,368	14,643	3.27	628	772
Saarland	1	5	9	1	10	240	175	729	3.15	32	41
West Germany	100	472	850	100	1,008	243	17,684	72,739	3.10	3,125	3,975

1/ 1 Kg = 17.544 eggs.

Since we have estimates of the yield per hen and the total number of eggs produced in each area we can estimate the number of hens required to yield this level of production. Our estimates show approximately 71.4 million laying hens necessary to yield the production level estimated in 1970 and 72.7 million or 1.3 million more to reach the estimated production level in 1975. These figures compare with about 61 million laying hens counted in 1965. An interesting point concerning the change in the distribution of laying hens between 1970 to 1975 shows that the primary producing regions of Schleswig-Holstein, Niedersachsen and Nordrhein-Westfalen along with Rheinland-Pfalz must increase the size of their laying flocks in order to reach the projected production level for 1975 but the other 4 states must reduce the size of their flocks. Since increases appear more probable than decreases, the possibility of an egg surplus by 1975 is emphasized.

Table 71. Pork Supply -- Demand Balance for West Germany 1954/1955 -- 1964/1965.

	Production	Change in National Reserve Stock	Net Imports	Consumption	Per Capita Consumption
	(1000 tons)	(1000 tons)	(1000 tons)	(1000 tons)	(kilograms)
1954/55	1,239	+3	37	1,273	24.9
1955/56	1,350	+15	35	1,370	26.5
1956/57	1,357	+13	74	1,418	27.1
1957/58	1,464	-6	57	1,527	28.8
1958/59	1,480	+6	97	1,571	29.3
1959/60	1,502	-6	111	1,619	29.4
1960/61	1,566	-2	116	1,684	30.2
1961/62	1,683	-1	94	1,778	31.4
1962/63	1,753	-3	74	1,830	31.9
1963/64	1,747	+5	63	1,805	31.2
1964/65	1,925	+4	53	1,974	33.7

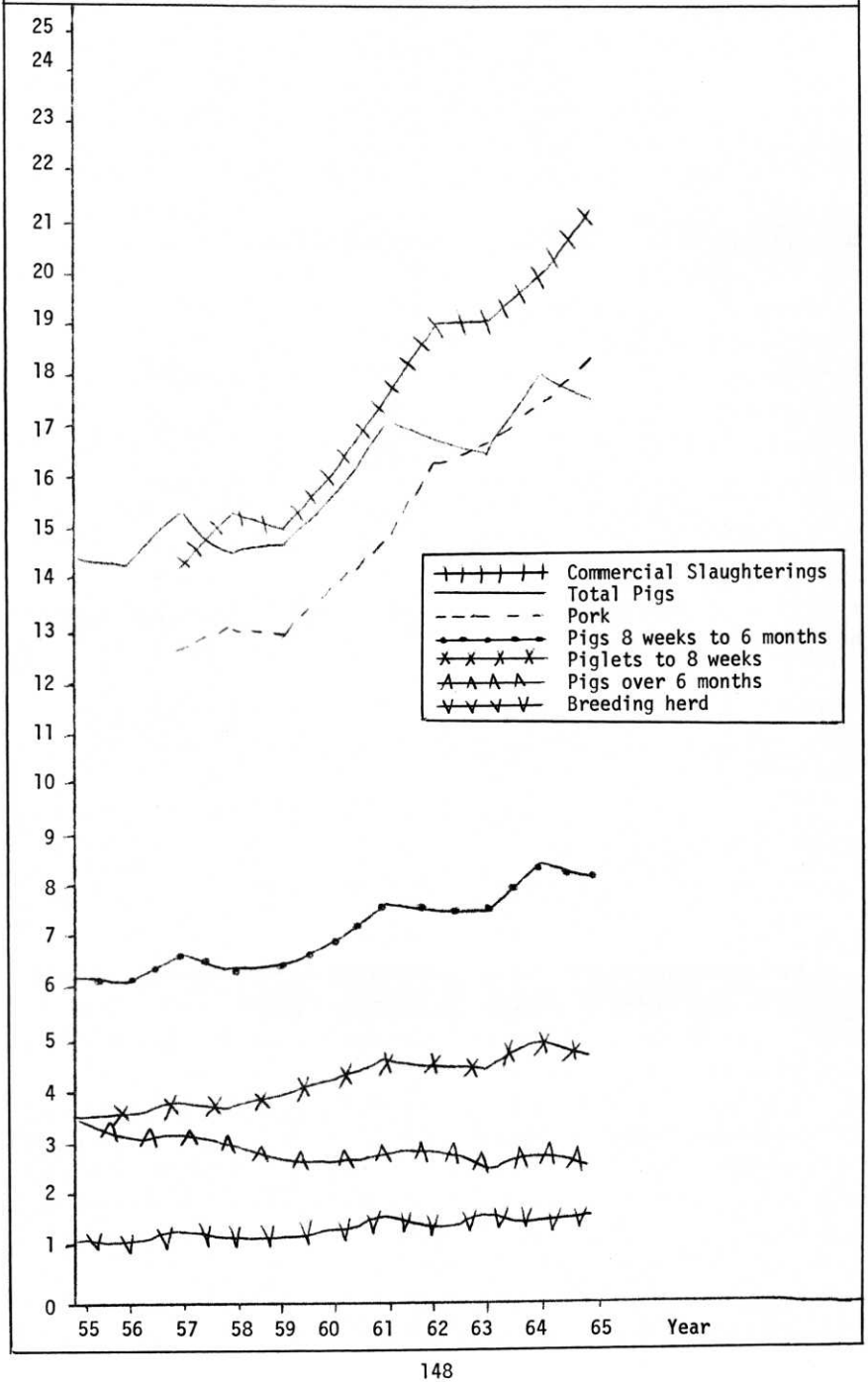
Pork

Pork production in West Germany has also become more commercialized over the past decade. Table 71 presents the national supply-demand balance in pork for each of the economic (1 July - 30 June) years 1954/55 to 1964/65. Demand increased faster than domestic supply until 1960/61 when net imports reached a peak of 116 thousand tons. Since 1960/61, production has increased faster than consumption and by 1964/65 Germany was 97.5 percent self-sufficient in pork. Pork supplies have increased in each year except in 1963/64 when a slight decrease occurred. When the pork supply data is converted from an economic to a calendar year the trend continues upward without interruption from the influence of the pig cycle.

A definite pig cycle is evident in Germany. Figure 9 presents the development of total pig numbers, a breakdown of trends by age group, commer-

Millions of Pigs or
Millions of Tons of Pork

Figure 9. Development of Pig Numbers And Pork Production in West Germany 1955-1965



cial slaughterings of pigs, and tons of pork production over the past decade. Clearly a four year cycle along with an increasing trend in pig numbers is shown. Due to a change in consumer tastes in favor of leaner pork, slaughter weights have decreased and thus we find a slight decline in the number of pigs for slaughter in the over six months age group. Partly due to this phenomenon and partly due to the interaction of the pig numbers cycle with the number of slaughterings, we find a relatively smooth upward trend in pork production. The pig numbers cycle effect is not fully transmitted to the pork production trend. We expect the slaughter weight to continue its decline during the next decade. Thus, the decline in number of pigs over six months will continue and the buffering effect this has in shielding the pork production trend from the pig cycle will be present throughout the projection period. We expect the pig cycle to peak again in 1968 or 1969 and once again in about 1973. Thus, the projection targets of 1970 and 1975 will both fall on the downswing of the cycle and 1975 may fall at the bottom. Our pork projections which follow are not cyclically adjusted but rather are on the hypothetical trend about which the cycle gyrates.

In order to make our pork projections, we will use data compiled for each of the eight states. The aggregation of the state data does not correspond with the data in Table 71 because the state data is on a calendar year basis while that in Table 71 is on an economic year basis. Our data extend from 1955, which appears to be at a midpoint in the cycle, to 1965 which also appears to be at a midpoint.

We use regression analysis in making our state-by-state projections and then aggregate the results for a national total. We have specified a model in which the level of pork production (Y) is dependent on the average slaughterweight (X_1), the size of the breeding herd (X_2), and the ratio of commercial slaughterings to total pig numbers (X_3). The value of each independent variable is estimated for 1970 and 1975 by a linear extrapolation of its individual time trend. Table 72 presents the historical data used in the equations for each state. Table 73 presents the estimated pork production levels for 1970 and 1975 along with the estimated values of the independent variables and the estimating equations for each state. The actual 1965 pork production level is listed along with that estimated by the equations. As can be seen the accuracy of the 1965 estimates compared to the actual production ranges from -.5 percent in Niedersachsen to 1.3 percent in Saarland.

As can be seen in both Tables 72 and 73 but shown more clearly by Figure 10 which indicates the number of pigs per 100 hectares of arable land, pork production is concentrated in the northwestern portion of Germany around the Ruhr industrial complex. Thus, we find the leading pork producing states to be Niedersachsen and Nordrhein-Westfalen followed by Schleswig-Holstein in the north while the main pork producing state in the south is Bayern. Figure

Table 72. Basic Data Used in Pork Projections by State in West Germany 1955-1965

Year	Pork 1/ 1000 (tons)	Total Pigs (1,000's)	Piglets to 8 Wks. (1,000's)	8 Wks. to 6 Mo. (1,000's)	6 Mo. & Over for Slaughter (1,000's)	Commercial Slaughterings (1,000's)	Slaughter weight 1/ Kg
				SCHLESWIG-HOLSTEIN			
1955	108.1	1210.9	340.8	558.0	196.2	N/A	90
1956	107.5	1236.3	362.9	568.4	177.3	N/A	92
1957	119.6	1335.9	401.8	603.7	189.2	N/A	90
1958	121.7	1307.3	396.5	601.2	177.6	N/A	88
1959	117.3	1351.6	409.1	637.5	164.0	1321.7	88
1960	129.8	1442.6	447.2	678.3	157.1	1484.7	87
1961	147.5	1658.3	507.7	794.1	178.3	1712.7	86
1962	176.2	1677.4	516.3	814.2	171.5	2011.9	88
1963	175.6	1627.2	501.1	804.1	150.1	2001.1	88
1964	186.2	1735.9	534.1	857.5	162.7	2104.7	88
1965	203.0	1720.2	528.4	860.1	155.2	2321.3	87
				NIEDERSACHSEN			
1955	216.5	4280.8	1140.0	1870.0	871.0	N/A	91
1956	227.3	4225.5	1162.4	1837.4	805.5	N/A	92
1957	242.4	4504.8	1233.1	1989.5	829.8	N/A	91
1958	259.1	4400.5	1205.3	1957.6	809.1	N/A	89
1959	260.8	4334.4	1214.0	1952.4	725.2	2918.9	89
1960	279.7	4539.1	1297.6	2053.0	707.4	2939.7	89
1961	307.6	4957.3	1386.7	2316.6	745.7	3512.6	88
1962	354.5	4921.2	1342.5	2311.0	785.8	4032.3	88
1963	372.4	4723.0	1262.1	2266.5	705.0	4168.4	89
1964	404.0	5178.2	1414.1	2486.9	764.7	4511.8	90
1965	430.6	5280.7	1449.2	2550.0	756.8	4881.2	89

Table 72. continued

Year	Pork 1/ 1000 (tons)	Total Pigs (1,000's)	Piglets to 8 Wks. (1000's)	8 Wks. to 6 Mo. (1,000's)	6 Mo. & Over for Slaughter (1,000's)	Commercial Slaughterings (1,000's)	Slaughter weight 1/ Kg
			NORDRHEIN-WESTFALEN				
1955	316.1	2675.6	599.3	1079.8	776.7	N/A	88
1956	330.5	2654.0	618.7	1074.6	725.1	N/A	87
1957	350.6	2781.9	609.4	1188.8	729.3	N/A	86
1958	364.9	2675.9	599.9	1134.6	707.0	N/A	84
1959	354.3	2578.5	605.5	1089.3	642.5	4200.2	84
1960	362.9	2726.7	651.0	1192.4	618.4	4330.9	84
1961	376.5	3015.3	735.7	1315.0	687.0	4557.9	83
1962	397.3	2968.5	698.5	1289.8	721.1	4766.9	83
1963	398.3	2878.9	687.0	1314.8	601.2	4690.5	85
1964	411.9	3167.0	777.0	1457.6	637.2	4824.5	85
1965	430.1	3237.9	789.1	1481.6	659.8	5104.8	84
			HESSEN				
1955	90.8	1209.2	228.0	497.7	401.1	N/A	87
1956	94.7	1196.1	237.2	491.7	381.0	N/A	87
1957	99.8	1214.9	243.9	501.3	378.4	N/A	86
1958	104.7	1141.6	232.9	477.1	347.9	N/A	84
1959	106.9	1140.1	235.9	494.3	319.0	1260.6	85
1960	111.8	1250.6	275.3	552.5	320.3	1323.3	85
1961	116.0	1341.5	296.8	600.2	338.7	1390.0	83
1962	120.2	1267.4	268.0	560.5	338.8	1347.2	83
1963	122.9	1290.9	294.8	581.6	303.3	1415.0	87
1964	123.2	1343.3	306.8	619.9	308.1	1432.4	86
1965	124.2	1336.2	301.4	620.1	305.1	1461.5	85

Table 72. continued

Year	Pork 1/ 1000 (tons)	Total Pigs (1,000's)	Piglets to 8 Wks. (1,000's)	8 Wks. to 6 Mo. (1,000's)	6 Mo. & Over for Slaughter (1,000's)	Commercial Slaughterings (1,000's)	Slaughter weight 1/ Kg
			RHEINLAND-PFALZ				
1955	55.2	732.5	130.8	341.5	215.8	N/A	90
1956	59.2	727.3	141.2	343.8	194.6	N/A	89
1957	63.3	739.0	151.5	343.9	193.5	N/A	89
1958	67.6	659.3	133.0	310.5	172.7	N/A	87
1959	68.0	668.2	143.8	319.3	157.3	776.1	88
1960	70.2	711.3	163.0	340.2	154.7	823.9	85
1961	72.4	768.7	170.8	364.2	173.6	879.8	82
1962	75.1	705.5	144.4	335.9	173.1	908.2	83
1963	74.1	711.7	154.4	354.5	145.3	876.6	85
1964	76.0	747.3	164.4	367.8	158.0	892.6	85
1965	76.9	721.8	161.1	362.0	141.4	918.7	84
			BADEN-WÜRTTEMBERG				
1955	127.4	1532.4	343.2	684.9	381.7	N/A	93
1956	134.6	1494.1	351.2	662.6	352.0	N/A	92
1957	145.3	1622.9	383.0	719.1	378.3	N/A	92
1958	154.4	1513.4	363.6	675.8	341.6	N/A	89
1959	155.9	1612.6	407.9	725.7	328.7	1736.1	90
1960	166.3	1724.0	452.8	767.4	339.7	1862.8	89
1961	176.6	1876.1	506.1	847.6	345.4	2020.1	87
1962	184.2	1822.3	465.9	833.0	355.9	2106.9	87
1963	189.1	1824.1	490.2	853.7	296.3	2114.1	89
1964	192.9	2000.7	539.0	939.5	334.5	2168.0	89
1965	199.4	1860.0	489.0	884.4	308.4	2287.6	87

Table 72. Continued

Year	Pork 1/ 1000 (tons)	Total Pigs (1000's)	Piglets to 8 Wks. (1,000's)	8 Wks to 6 Mo. (1,000's)	6 Mo. & Over for Slaughter (1,000's)	Commercial Slaughterings (1,000's)	Slaughter-weight 1/ Kg
			BAYERN				
1955	211.9	2951.9	797.2	1314.9	618.0	N/A	86
1956	219.8	2874.2	806.6	1293.4	534.4	N/A	88
1957	240.2	3218.9	846.4	1493.5	605.9	N/A	88
1958	250.2	2956.4	888.8	1318.4	500.0	N/A	84
1959	250.9	3115.5	1033.0	1349.8	443.7	2914.8	86
1960	271.2	3305.5	1076.7	1433.1	486.6	3135.5	86
1961	283.5	3506.4	1206.3	1524.9	452.0	3409.8	83
1962	305.8	3417.1	1119.4	1519.5	473.5	3608.7	85
1963	317.9	3500.4	1217.1	1525.3	409.5	3672.1	87
1964	338.5	3885.6	1332.2	1725.7	483.9	3859.4	88
1965	354.6	3484.5	1193.5	1575.8	400.1	4127.8	86
			SAARLAND				
1955							
1956	4.6	81.5	12.6	34.7	29.3	N/A	91
1957	5.8	76.7	12.5	35.4	23.5	N/A	90
1958	4.6	79.5	14.2	36.1	23.9	N/A	90
1959	5.0	74.8	12.0	34.3	23.4	60.1	83
1960	7.5	75.8	13.2	37.1	20.3	90.4	82
1961	8.9	83.1	15.7	40.4	20.8	107.1	83
1962	9.2	79.1	14.6	38.8	19.7	114.2	80
1963	10.8	76.8	14.7	38.1	17.9	131.3	82
1964	11.1	78.3	14.7	39.2	18.3	135.1	82
1965	10.7	73.1	13.1	37.6	16.5	127.1	84

Table 72. continued

Year	Pork 1/ 1000 (tons)	Total Pigs (1000's)	Piglets to 8 Wks. (1000's)	8 Wks. to 6 Mo. (1,000's)	6 Mo. & Over for Slaughter (1,000's)	Commercial Slaughterings (1,000's)	Slaughter-weight 1/ Kg
				WEST GERMANY 2/			
1955 3/	1126.0	14,595.3	3579.3	6346.8	3460.5	N/A	89
1956	1173.5	14,407.5	3680.2	6271.9	3169.9	N/A	89
1957	1260.7	15,418.3	3869.1	6839.8	3304.4	14,308	89
1958	1322.5	14,733.9	3834.2	6511.3	3079.8	15,413	86
1959	1318.5	14,875.7	4061.2	6602.6	2803.8	15,189	87
1960	1399.4	15,775.6	4376.7	7054.0	2804.5	16,349	86
1961	1489.1	17,206.9	4826.0	7803.1	2941.4	17,752	85
1962	1635.0	16,869.4	4570.5	7706.8	3045.0	19,148	85
1963	1675.9	16,643.0	4622.0	7742.0	2634.1	19,210	87
1964	1755.7	18,146.4	5083.0	8497.5	2873.1	20,061	88
1965	1841.3	17,722.9	4925.6	8374.4	2747.9	21,366	86

1/ Without offal and fat

2/ Includes West Berlin

3/ Without Saarland

N/A - Not immediatelv available

Source: *Statistisches Bundesamt, Agrarstatistische Arbeitsunterlagen*, Wiesbaden (annually)

10 presents data for 1963 and while the number of pigs per hectare may have changed to some extent, the general pattern has not.

In general, we find an increase in the breeding herd size in all states, a decrease in slaughter weight, an increase in the slaughter rate, an increase in commercial slaughterings and an increase in total pig numbers except in the state of Saarland. Pork production increases in all states and we project the level of pork production in West Germany to be 2,254 thousand tons in 1970 and 2,626 thousand tons in 1975. This figure does not include production in Berlin which is assumed to remain constant at 12 thousand over the projection period. From our data sources in Table 73, we calculate a pork production of 1829 thousand tons for 1965. This does not agree with the 1925 thousand tons of pork produced figure derived from Table 71. At least part of the discrepancy is accounted for by the fact that Table 71 data are on the calendar year and Table 73 on an economic year basis.

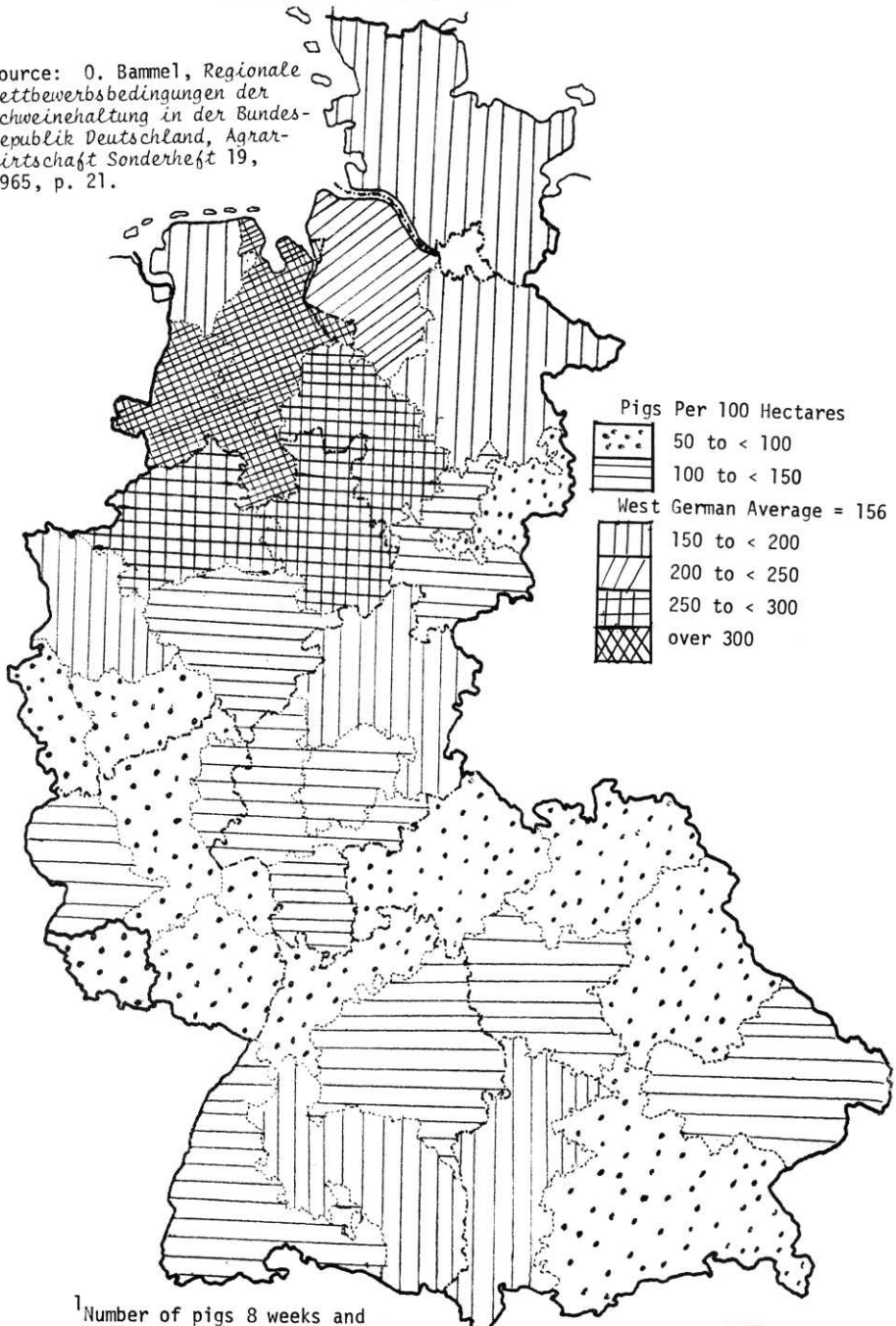
Data in neither Table 71 or 73 include pork slaughtered in other than commercial channels. Statistics are available which indicate the number of household slaughterings but not the amount of pork derived from these slaughterings. Bammel indicates that the average slaughterweight of household slaughtered pigs without offal and fat is 106 Kg. compared to 86 Kg. for commercially slaughtered pigs. The number of household slaughterings in 1965 amounted to about 17 percent of the number of commercial slaughterings. When the difference in slaughter weights is taken into consideration, household slaughterings would increase our pork production figures by about 20 percent. The number of household slaughterings has remained quite steady at about 3.8 million pigs since 1960. The percentage of household slaughterings will decrease primarily due to commercial slaughterings increasing rather than household slaughterings decreasing. We are assuming that the decrease in household slaughterings of pork during the next decade will correlate with the decline in the farm population but will be negligible as far as our projections are concerned. If household pig slaughterings decreased from 3.8 million to 3 million during the next decade, the decrease in pork produced via this channel would amount to only about 30 thousand tons.

Pork production in the past has been concentrated in small farms and small herds. In 1960, 60 percent of the farms raising pigs had herds of less than 5 animals and 88 percent of the farms had pigs in herd sizes of less than 15 animals. In the same year, 52 percent of the total number of pigs were found in herds of less than 15 and 88 percent were found in herds of less than 50.[4] Since this small farm, small herd pork production structure is likely to remain through our projection period and since household slaughterings are an integral part of this type of structure, we consider 3 million household slaughterings to be a lower limit by 1975.

[4]Peter von Harder, *Wirtschaftliche Voraussetzungen und Entwicklungslinien der Mechanisierung in der Landwirtschaft der Bundesrepublik Deutschland seit 1949*, *Berichte über Landtechnik*, Vol. 85.

Figure 10. Number of Pigs[1] Per 100 Hectares Arable Land in West Germany 1963.

Source: O. Bammel, *Regionale Wettbewerbsbedingungen der Schweinehaltung in der Bundesrepublik Deutschland*, Agrar-Wirtschaft Sonderheft 19, 1965, p. 21.



[1]Number of pigs 8 weeks and older for breeding and slaughtering by the December census 1963.

Table 73. Equations, Data and Projections for Pork Production to 1970 and 1975 by State in West Germany

Schleswig-Holstein

Pork Projection Equation*

$$\tilde{Y} = \underset{(.53)}{2010.8X_1} + \underset{(.04)}{709.8X_2} + \underset{(.00)}{172{,}319.6X_3} - \underset{(.28)}{331{,}406} \quad \bar{R}^2 = .98, \; R^2 = .99$$

Projection of estimating variables used in pork projection equation, each as a linear function of time.

	1970	1975	Level of Significance	$\bar{R}^2$
X_1 - Slaughter weight (Kg)	84.8	83.0	.02	.43
X_2 - Breeding Herd (1000's pigs)	221.5	254.9	.00	.86
X_3 - Slaughter Rate (X_5/X_4)	1.519	1.672	calculated from X_4 and X_5 below	
X_4 - Total Pigs (December count) in 1000's	2069.9	2363.8	.00	.90
X_5 - Commercial Slaughterings (1000's pigs)	3144.6	3953.0	.00	.94

	1965	1970	1975
Pork Production Projection (tons)	201,358	258,084	304,537
Actual 1965	202,977		
% Error	-.8		

Niedersachsen

Pork Projection Equation*

$$\tilde{Y} = \underset{(.38)}{6501.0X_1} + \underset{(.04)}{674.6X_2} + \underset{(.00)}{438{,}020.7X_3} - \underset{(.21)}{910{,}889} \quad \bar{R}^2 = .97, \; R^2 = .99$$

Projection of estimating variables used in pork production equation, each as a linear function of time.

	1970	1975	Level of Significance	$\bar{R}^2$
X_1 - Slaughter weight (Kg)	87.1	85.9	.04	.33
X_2 - Breeding Herd (1000's pigs)	583.5	641.6	.00	.86
X_3 - Slaughter Rate (X_5/X_4)	1.166	1.350	calculated from X_4 and X_5 below	
X_4 - Total Pigs (December count) in 1000's	5679.5	6185.4	.00	.81
X_5 - Commercial Slaughterings (1000's pigs)	6619.9	8349.7	.00	.97

	1965	1970	1975
Pork Production Projections (tons)	426,563	559,709	671,698
Actual 1965	430,639		
% Error	-.9		

*Numbers in parentheses are significance levels for each coefficient and the constant.

Table 73. continued

Nordrhein-Westfalen

Pork Projection Equation*

$$\tilde{Y} = \underset{(.91)}{39{,}209} - \underset{(.63)}{4860.4X_1} + \underset{(.04)}{1383.4X_2} + \underset{(.28)}{240{,}153.5X_3} \qquad \bar{R}^2 = .66 \quad R^2 = .83$$

Projections of estimating variables used in pork projection equation, each as a linear function of time

	1970	1975	Level of Significance	$\bar{R}^2$
X_1 - Slaughter weight (Kg)	81.7	80.2	.03	.34
X_2 - Breeding Herd (1000's pigs)	335.7	373.2	.00	.83
X_3 - Slaughter Rate (X_5/X_4)	1.681	1.738	calculated from X_4 and X_5 below	
X_4 - Total Pigs (December count) in 1000's	3412.4	3693.2	.00	.68
X_5 - Commercial Slaughterings (1000's pigs)	5734.7	6419.3	.00	.92

	1965	1970	1975
Pork Production Projections (tons)	434,800	510,220	583,077
Actual 1965	430,078		
% Error	1.1		

Hessen

Pork Projection Equation*

$$\tilde{Y} = \underset{(.64)}{50{,}408} - \underset{(.37)}{1901.0X_1} + \underset{(.04)}{1018.9X_2} + \underset{(.33)}{114{,}258.9X_3} \qquad \bar{R}^2 = .63 \quad R^2 = .81$$

Projections of estimating variables used in pork projection equation, each as a linear function of time

	1970	1975	Level of Significance	$\bar{R}^2$
X_1 - Slaughter weight (Kg)	83.9	83.2	.37	.00
X_2 - Breeding Herd (1000's pigs)	127.7	142.8	.00	.83
X_3 - Slaughter Rate (X_5/X_4)	1.138	1.173	calculated from X_4 and X_5 below	
X_4 - Total Pigs (December count) in 1000's	1421.5	1508.1	.01	.54
X_5 - Commercial Slaughterings (1000's pigs)	1617.5	1768.6	.00	.85

	1965	1970	1975
Pork Production Projections (tons)	125,476	151,054	171,769
Actual 1965	124,180		
% Error	1.0		

*Numbers in parentheses are significance levels for each coefficient and the constant.

Table 73 continued

Rheinland-Pfalz

Pork Production Equation*

$$\tilde{Y} = \underset{(.73)}{182.8X_1} + \underset{(.10)}{511.8X_2} + \underset{(.04)}{41{,}774.0X_3} - \underset{(.74)}{20{,}805} \qquad \bar{R}^2 = .77 \quad R^2 = .88$$

Projection of estimating variables used in pork projection equations, each as a linear function of time.

	1970	1975	Level of Significance	$\bar{R}^2$
X_1 - Slaughter weight (Kg)	79.5	76.3	.00	.63
X_2 - Breeding Herd (1000's pigs)	65.9	73.0	.00	.62
X_3 - Slaughter Rate (X_5/X_4)	1.409	1.534	calculated from X_4 and X_5 below	
X_4 - Total Pigs (December count in 1000's	730.0	736.1	.70	.00
X_5 - Commercial Slaughterings (1000's pigs)	1028.6	1128.9	.01	.68

	1965	1970	1975
Pork Production Projections (tons)	77,041	86,315	94,585
Actual 1965	76,936		
% Error	.14		

Baden-Württemberg

Pork Production Equation*

$$\tilde{Y} = \underset{(.01)}{829.8X_2} + \underset{(.06)}{116{,}207.4X_3} - \underset{(.68)}{840.6X_1} - \underset{(.89)}{18{,}946} \qquad \bar{R}^2 = .90 \quad R^2 = .95$$

Projection of estimating variables used in pork projection equation, each as a linear function of time.

	1970	1975	Level of Significance	$\bar{R}^2$
X_1 - Slaughter weight (Kg)	84.2	81.5	.00	.65
X_2 - Breeding Herd (1000's pigs)	224.7	258.1	.00	.88
X_3 - Slaughter Rate (X_5/X_4)	1.243	1.297	calculated from X_4 and X_5 below	
X_4 - Total Pigs (December count in 1000's	2184.7	2418.8	.00	.80
X_5 - Commercial Slaughterings (1000's pigs)	2716.2	3137.5	.00	.93

	1965	1970	1975
Pork Production Projections (tons)	198,708	241,177	277,437
Actual 1965	199,350		
% Error	-.32		

*Numbers in parentheses are significance levels for each coefficient and the constant.

Table 73 continued

Bayern

Pork Projection Equation*

$$\tilde{Y} = \underset{(.45)}{4004.0X_1} + \underset{(.14)}{698.4X_2} + \underset{(.03)}{312{,}650.8X_3} = \underset{(.21)}{582{,}294} \qquad \bar{R}^2 = .81 \quad R^2 = .91$$

Projection of estimating variables used in pork projection equation, each as a linear function of time.

	1970	1975	Level of Significance	$\bar{R}^2$
X_1 - Slaughter weight (Kg)	85.7	85.5	.81	.00
X_2 - Breeding Herd (1000's pigs)	406.5	463.5	.00	.79
X_3 - Slaughter Rate (X_5/X_4)	1.235	1.337	calculated from X_4 and X_5 below	
X_4 - Total Pigs (December count) in 1000's	4098.3	4501.3	.00	.74
X_5 - Commercial Slaughterings (1000's pigs)	5060.9	6016.1	.00	.98

	1965	1970	1975
Pork Production Projection (tons)	352,498	430,872	501,771
Actual 1965	354,615		
% Error	-.6		

Saarland

Pork Production Equation*

$$\tilde{Y} = \underset{(.86)}{11.2X_1} + \underset{(.05)}{1029.0X_2} + \underset{(.00)}{5191.5X_3} - \underset{(.49)}{5224} \qquad \bar{R}^2 = .99 \quad R^2 = .99$$

Projection of estimating variables used in pork projection equation, each as a linear function of time.

	1970	1975	Level of Significance	$\bar{R}^2$
X_1 - Slaughter weight (Kg)	75.1	70.0	.00	.88
X_2 - Breeding Herd (1000's pigs)	6.9	7.6	.00	.65
X_3 - Slaughter Rate (X_5/X_4)	2.673	3.507	calculated from X_4 and X_5 below	
X_4 - Total Pigs (December count) in 1000's	74.5	72.8	.33	.01
X_5 - Commercial Slaughterings (1000's pigs)	1991.7	2553.2	.00	.79

	1965	1970	1975
Pork Production Projections (tons)	10,813	16,594	21,587
Actual 1965	10,675		
% Error	1.3		

*Numbers in parentheses are significance levels for each coefficient and constant.

Table 73 continued

West Germany

Pork Production Projection for West Germany 1/	1965	1970	1975
(Sum of state projections in tons)	1,827,257	2,254,025	2,626,461
Actual 1965	1,829,450		
% Error	-.12		

1/ Without Berlin - Berlin pork production assumed to remain constant at 12,000 tons yearly.

Finally, we must consider pork and feed grain price relationships. We know that under the Common Agricultural Policy feed grain prices in Germany will decrease on the order of about 10 percent. According to calculations by Epp[5] the hog-barley price ratio will increase slightly between 1964 and 1970 creating additional incentive to increase production. Between 1970 and 1975 Epp projects a decrease in the ratio. This decrease will be offset by increased feed efficiency so should not cause any production curtailment.

Feed Grain Requirements for Pork Production

In estimating the feed grain requirements for pork production three main variables must be considered. First is the increased efficiency of feed conversion through better environmental conditions such as climate controlled housing, optimum size pens, and more efficient feeding methods which hold waste to a minimum. Also, in this category, are improved breeding and health measures which increase the pork produced from a given size breeding herd. Second, is the proportion of feed grains in the total pig feed utilization. And third, is the amount of pork produced. In order to measure the increased efficiency of feed conversion, we have related the total feed utilization of pigs converted to grain units[6] to total pork production. The first three columns of Table 74 present pork production, total pig feed utilized and the feed-pork factor (feed/pork) for the years 1954/55 through 1964/65. An im-

[5] Donald J. Epp, *The Impact of Agricultural Policies on Regional Grain and Livestock Prices in the European Economic Community*. Unpublished Ph.D. dissertation, Michigan State University, 1967, and published report in this series.

[6] A Grain Unit Conversion of other types of feed is made on the basis of relative nutritional values. Appendix B presents the grain unit conversion table used in this study.

Table 74. Calculations to Project Feed Grain Utilization in Pork Production in 1970 and 1975

	Pork Production 1000 tons	Total Pig Feed 1000 tons Grain Units	Feed-Pork Ratio	Grain Component of Total Feed 1000 tons Grain Units 1/	Grain as % of Total	Potato Component of Total Feed 1000 tons Grain Units 1/
	(1)	(2)	(3)	(4)	(5)	(6)
1954/55	1239	10,210	8.24	4265	41.8	2955
1955/56	1350	10,350	7.67	4425	42.8	2349
1956/57	1357	10,880	8.02	4951	45.5	2804
1957/58	1464	11,304	7.72	5014	44.4	3062
1958/59	1480	11,080	7.49	4784	43.2	2506
1959/60	1502	11,482	7.64	5358	46.7	2361
1960/61	1566	12,337	7.88	5109	41.4	2725
1961/62	1683	12,939	7.69	5555	42.9	2445
1962/63	1753	13,078	7.46	5632	43.1	2745
1963/64	1747	13,796	7.90	5607	40.6	3127
1964/65	1925	14,491	7.53	6201	42.8	2618
1970	2254.0	16,342	7.25	7566	46.3	1912
1975	2626.5	18,412	7.01	8202	44.6	1557

	Potatoes as % of Total	Concentrates 2/ Component of Total Feed Grain Units	Concentrates as % of Total	Milk Component 1000 tons Grain Units	Milk as % of Total	Other 3/ Feeds Component 1000 tons Grain Units	Other Feeds as % of Total
1954/55	28.9	N/A	N/A	N/A	N/A	N/A	N/A
1955/56	22.7	N/A	N/A	N/A	N/A	N/A	N/A
1956/57	25.8	N/A	N/A	N/A	N/A	N/A	N/A
1957/58	27.1	N/A	N/A	N/A	N/A	N/A	N/A
1958/59	22.6	N/A	N/A	N/A	N/A	N/A	N/A
1959/60	20.6	1678	14.6	1360	11.8	725	6.3
1960/61	22.1	1623	13.2	1292	10.5	1588	12.8
1961/62	18.9	2058	15.9	1393	10.8	1488	11.5
1962/63	21.0	2022	15.5	1346	10.3	1333	10.1
1963/64	22.7	2131	15.4	1345	9.7	1586	11.6
1964/65	18.1	2582	17.8	1524	10.5	1566	10.8
1970	11.7	3350	20.5	1716	10.5	1798	11.0
1975	8.4	4695	25.5	1933	10.5	2025	11.0

Source: *Statistisches Bundesamt, Agrarstatistische Arbeitsunterlagen*, Weisbaden (yearly)
BELF, Statistische Unterlagen zur Futterwirtschaft im Bundesgebiet, Bonn (yearly)
Own calculations

N/A - Not immediately available

[1] See Appendix B for Grain Unit Conversions

[2] Includes clover, legumes, tapioca meal, oil cakes, fish & meat meal, molasses, tailings

[3] Includes miscellaneous root crops, primarily sugar beet tailings.

provement in this factor over time would be a measure of the increase in efficiency of pigs in converting feed to pork. On the surface, it appears that this factor varies a great deal from year-to-year. Upon closer inspection, we find that the factor cycles with the pig cycle – when the pig cycle is at a peak so is the factor and when the pig cycle is at a low the factor corresponds. This phenomenon is perfectly logical when we consider that the pork production trend is increasing at a relatively constant rate, while the total number of pigs as shown by Figure 10 increase and then decrease and then increase again in a four year cycle. When the pig cycle is at a peak there are simply more mouths to feed for a given output of pork than when the pig cycle is in a trough. The question now becomes whether the feed-pork factor is cycling about a trend. A regression analysis relating the feed-pork ratio to time reveals a slight downward trend in the ratio. An extrapolation of the linear trend projects the feed-pork ratio to be 7.25 in 1970 and 7.01 in 1975. By multiplying the projected pork production for 1970 and 1975 from Table 73 by the feed-pork factor projected for 1970 and 1975, we find the projected total pig feed required in the projection years in grain unit equivalents. We project a pig feed requirement of 16,342 thousand tons of feed in grain units for 1970 and 18,412 thousand tons in 1975.

The next problem is to project the portion of the total feed requirement which will be feed grain. In Table 74, starting with column 4, we present the tonnage distribution in terms of grain units and the percentage distribution of the various courses of total pig feed by type. We find that the grain component has fluctuated between 40.6 and 46.7 percent of total feed during the 11 year period. The drop to 40.6 percent in 1963/64 was primarily caused by an abnormally high potato yield in 1963 resulting in a substitution of potatoes for grain in the total pig feed period. Concentrates are an increasing proportion of total feed while the milk conponent which is used primarily for piglet feeding remains quite constant in percentage terms. The other feed category also accounts for about 11 percent over the past five years.

In order to project the feed grain proportion of total feed, we will assume that other feeds primarily sugar beet tailings will account for 11 percent of total feeding in both 1970 and 1975. Since milk is used primarily in piglet feeding, we will assume the milk utilization to remain at 10.5 percent of total feed throughout the projection period. The trend in concentrate feeds is increasing and an extrapolation of this trend yields a 20.5 percent share of total feed in 1970 and a 25.5 percent share in 1975. Since the potatoes used as pig feed are essentially a residual after human consumption, industrial use, seed and waste are subtracted, we must make some assumptions about the potato supply-demand balance for 1970 and 1975. Table 75 presents our projections of potato surface yield and production in 1970 and 1975. Assuming the per capita consumption of feed and industrial potatoes to be 117

Kg. in 1970 and 106 Kg. in 1975, we find a total human consumption of 7,110 thousand tons in 1970 and 6,596 thousand tons in 1975. Seed use at the rate of 2500 Kg. per hectare amounts to 1,552 thousand tons in 1970 and 1,252 thousand tons in 1975. Waste at the rate of 5 percent production loss and 3 percent marketing loss accounts for another 1,083 thousand tons in 1970 and 949 thousand tons in 1975. This leaves a residual for feed purposes of 7,646 thousand tons in 1970 and 6,227 thousand tons in 1975. When this is converted to grain units by dividing by a factor of 4, we find the potato feed availability in terms of grain units to be 1,912 thousand tons in 1970 and 1,557 thousand tons in 1975.

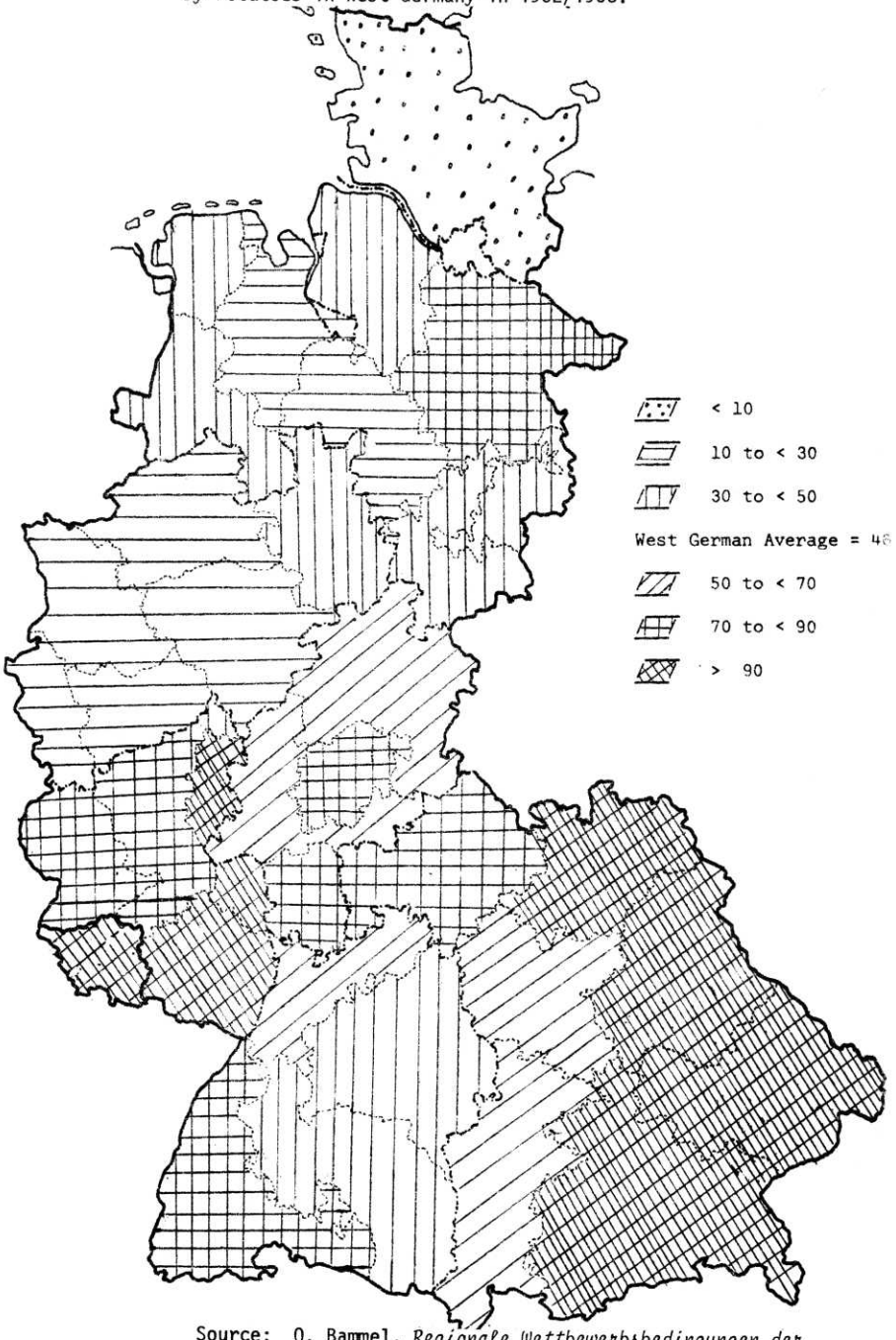
Table 75. Production and Utilization of Potatoes 1970, 1975 Projected.

	1970	1975
Hectares	621.1	500.8
Yield (100 Kilograms per Hectare)	280	300
Production (1000 tons)	17,391	15,024
Utilization		
Food and Industry (1000 tons)	7,110[1]	6,596[2]
Seed (1000 tons)	1,552	1,252
Waste 5 Percent Reduction Loss + 3 Percent Market Loss (1000 tons)	1,083	949
Feed (1000 tons)	7,646	6,227
Feed in Grain Units (1000 tons)	1,912	1,557

[1] At 117 Kilograms per Capita
[2] At 106 Kilograms per Capita

We will assume that pigs are the only users of potatoes as feed by 1970. On this basis going back to Table 74, we find that 11.7 percent of the total feed requirement is satisfied by potatoes in 1970 and 8.4 percent in 1975. By simple subtraction, we now find that the grain portion is projected at 46.3 percent in 1970 and 44.6 percent in 1975. The increasing utilization of concentrates between 1970 and 1975 account for the decreased portion of grain between the two periods. Thus, we project a pork production utilization of feed grains at 7,566 thousand tons in 1970 and 8,202 thousand tons in 1975. In these projections we are taking into account the fact that feed grain prices will decrease under the Common Agricultural Policy and that labor costs in all probability will continue to increase, thus sharply increasing the production cost for potatoes. Although the milk surplus is likely to increase, it is doubtful that pork producers could effectively utilize more. The difficult question is that of concentrates utilization. The best we can do at this point is to assume a trend extrapolation from historical utiliza-

Figure 11. Percentage of Total Pig Feed Tonnage Accounted for By Potatoes in West Germany in 1962/1963.



Source: O. Bammel, *Regionale Wettbewerbsbedingungen der Schweinehaltung in der Bundesrepublik Deutschland*, *Agrarwirtschaft Sonderheft* 19, 1965, p. 104.

tion but the whole concentrate question should be watched carefully during the next several years as its level of use and substitution for grain in livestock feeding will be very important in determining grain utilization levels.

While we were unable to obtain data necessary to accurately allocate the total grain requirement for pig production in West Germany to the individual states, we are able to make some generalized observations. Figure 11[7] shows the percentage of total pig feed tonnage accounted for by potatoes in various regions of West Germany. As we can see from the figure, the heaviest concentration of potato feeding of pigs is in Southern Germany while in the extreme northern areas grain is the primary feed. The portion of potato feeding is declining throughout the country, however, the big increase in grain feeding of pigs in the future will be in the south because they do such a relatively small amount of grain feeding presently. This means that the large expanding feed grain market for pork production in the future will be more difficult to reach with grains imported through the North Sea German ports.[8]

Since approximately 60 percent of the pork production is concentrated in the three northern states of Schleswig-Holstein, Niedersachsen and Nordrhein-Westfalen, a similar countrywide increase in the grain portion of the pig feed ration would increase total grain requirements in these three states to a larger extent than it would in the south. Thus, even though the potential for conversion to grain feeding is much greater in the southern states, there is still room for substantial increases in grain quantities required in the north.

Cattle

Two main breeds of cattle predominate in Germany -- the Holstein-Friesen in the north and the Simmentaler in the south. The Holstein-Friesen is a dual purpose breed providing both milk and meat while the Simmentaler is a triple purpose breed which, until the recent introduction of tractors was used extensively for draft.

Germany is presently facing on the one hand a certain milk surplus and on the other a potentially large beef deficit. In 1964/65 Germany was 100 percent self-sufficient in fluid milk, over 90 percent self-sufficient and increasing in milk products while at the same time only 82 percent self-sufficient in beef, the lowest in several years. Since German cattle are

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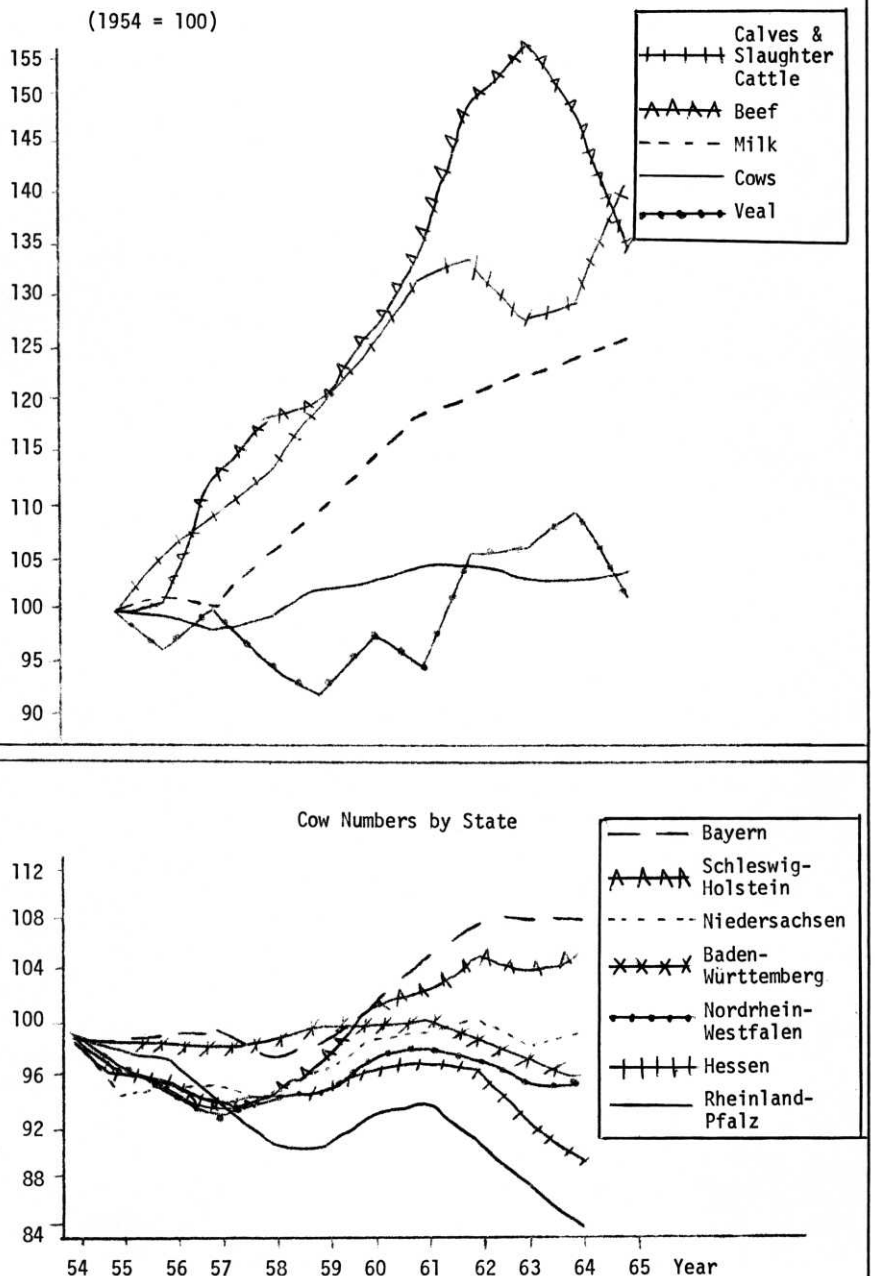
[7] Otto Bammel, "Regionale Wettbewerbsbedingungen der Schweinehaltung in der Bundesrepublik Deutschland" *Agrarwirtschaft Sonderheft* 19, 1965.

[8] Dr. Riecke of the Alfred G. Topfer Company in Hamburg indicated in an interview with the author that little, if any, grain shipments that arrive through Rotterdam or the German North Sea ports are destined for areas south of the Main River. (Interview in Hamburg, 7 December 1965).

Figure 12 Historical Trends in the Cattle Sector 1964/65, West Germany



Source: E. Reisch, *Betriebswirtschaftliche Aspekte der Rinderhaltung in der Bundesrepublik Deutschland*, *Zuchtungskunde*, Bd. November/December 1965.

traditionally dual-purpose, the problem is one of attempting to adjust production to diverging demands for milk and beef when they are joint products.

Figure 12a presents a historical perspective of the cattle sector over the past decade. Cow numbers have increased but slightly over the period with a definite cyclical variation in their numbers. At the same time, there has been a phenomenal increase in milk and beef production while veal production has remained relatively constant. Calf and slaughter cattle numbers have increased rapidly until 1961 when a short fodder situation caused an abnormally high rate of slaughterings for the following year. This, coupled with a downswinging cow numbers cycle, increased beef and veal production for 1962, 1963 and 1964 by a much greater extent than would normally have occurred. The cow numbers cycle appears to have hit a low in 1964 and began to increase again in 1965.

The aggregate picture, however, does not tell the whole story. Figure 12b presents the time series on cow numbers for each individual state between 1954 and 1964 in terms of index numbers based on 1954 as 100. A general downward trend is observed in every state except Bayern and Schleswig-Holstein. More specifically in the two areas of cow herd increase, we find increase concentrated in the Allgau region of the Alps in the south and on the shore of the North Sea in the northern area. Two separate situations present themselves in the north and south regions where cow numbers are increasing. In the south the farms are about 15 hectares with about 20-25 cows. They have almost no other livestock since in this region 65 out of every 100 animals are cows. The fodder crop areas are very good and yield enough fodder for up to 2 cows per hectare. These farms have expanded their cow herd to the maximum size that their land area and physical facilities will accommodate and their only possibility for increasing output is to get higher milk yields out of their cows.

On the North Sea shore the situation differs in that the dairy operations are primarily centered on farms with 30 to 40 hectares and also have about 20-25 cows. These farms still have additional capacity for expanding their herd size but for several reasons which we will explain below cannot expect as high an increase in milk yields in the future. Therefore, Reisch sees a further increase in cow numbers in the northern area but only a minimal increase in cow numbers in the southern area.[9]

Cow number projections are crucial to the projection of milk, beef and veal production. On the basis of past trends in cow numbers, we have projected cow numbers by state for 1970 and 1975 and they are presented in Table 77 as an adjunct to the milk production projections. Our aggregate to-

[9]Erwin Reisch, *Betriebswirtschaftliche Aspekte der Rinderhaltung in der Bundesrepublik Deutschland*. This was an article in the *Zuchtungskunde*. Bd. 37 November-December 1965 Heft 9-10, pp. 404-415.

tals of cow numbers for 1970 and 1975 are somewhat less than the trend extrapolation would provide. We show a relatively high increase in cow numbers in Schleswig-Holstein and Bayern as well as Niedersachsen which shares some of that North Sea coast where cow numbers have been increasing in the past. We show a slight increase in cow numbers in Nordrhein-Westfalen because of its proximity to a large and increasing fluid milk market in the Ruhr area. Even though some areas of Hessen will be converted to permanent grassland because of slopes too severe to mechanize as pointed out earlier in this report, we project a decrease in the cow population in Hessen and Rheinland-Pfalz because of many small farms in those areas switching to special crops to provide local markets in that heavily populated area; or where soil and climate are well adapted, they are switching to crops such as tobacco and vines.

Other small farms in these areas are without grassland and they are finding it more profitable to switch to pigs and poultry than to stay with the dairy operation. We project a decrease in Baden-Württemberg primarily because in this part of the country part-time farming has become a way of life due to the pull of jobs in industry and the part-time farmer simply does not have time to take care of his dairy herd. Also, with a rising level of living due to the outside wages, many farmers would rather be free on weekends than to be tied down to the chores associated with dairy farming. According to Reisch, in general, the number of herds with less than 8 cows as well as the number of herds with greater than 50 cows is declining. Reisch predicts that every two to three years this bracket will shift on the lower extreme by one cow. In other words, two to three years from now the number of herds with less than 10 cows will be declining. The decline in herds with over 50 cows is primarily due to a labor problem which is mentioned in more detail below.[10]

Since cow numbers are not projected to increase by any appreciable amount by 1975, we must look primarily to greater efficiency of production for increases in output of both milk and meat. Three possibilities exist for increases in milk yields per cow. A negative correlation exists between the use of cows for draft and the amount of milk produced. That is, with the decreasing use of these animals for draft as they are replaced by tractors, milk production per cow increases. Table 76 presents the draft cow distribution by state and shows the very rapid decline in draft cow numbers between 1955 and 1965. Since the rate of decline in use of draft animals has been so great in the past and the increase in tractor numbers, as discussed in earlier chapters, has been so rapid with no indication of a slow-down in the immediate future it appears that by 1970 no cows will be used for draft purposes in Germany. The greatest share of the increase in milk yields due to discon-

[10] Interview with Professor Reisch on 13 May 1966.

tinued use of the cow for draft purposes has already been observed. However, with a discontinuance of the necessity of using the Simmentaler breed for draft purposes, they can be replaced by a higher milk yielding breed. And in fact, the Holstein-Friesen breed has been moving south at a reasonably rapid pace. Replacing a Simmentaler cow with a Holstein-Friesen cow increases milk production by about 1000 Kg. per year. Some southern areas are being forced into replacing with the Holstein-Friesen breed because the number of young female Simmentaler stock has dropped within the last several years under the necessary replacement level due to lags in obtaining an effective tuberculosis eradication program. Thus, a strong flow of Holstein-Friesen stock into southern Germany to replace the Simmentaler is expected to continue.

Table 76. Cows Used for Draft by State 1955-1965 in 1000's

	1955	1960	1965
Schleswig-Holstein	0	0	0
Niedersachsen	46.5	12.3	1.6
Nordrhein-Westfalen	54.7	20.4	7.5
Hessen	186.7	108.9	31.9
Rheinland-Pfalz	170.6	89.6	13.5
Baden-Württemberg	419.4	165.1	31.4
Bayern	573.4	281.3	77.3
Saarland	22.4	12.5	3.2
West Germany	1473.7	690.1	166.4

Another way to increase milk production is through the increased feeding of grain and concentrates in the diet. A general rule of thumb is that on a straight fodder ration the milk yield per cow, will average about 2700 liters per year. Then for every 1 kg. of supplemental feed added to the daily ration output of milk will increase by approximately 2 liters per day or 640 liters per year.

Few farmers are presently feeding up to the optimum supplemental ration, but the tendency is toward more use of grains and concentrates in the milk herd diet. With a decrease in the feed grain price under the Common Agricultural Policy, and a milk price remaining approximately at its present level, additional incentive to feed more grain in the dairy operation is present.

Finally several agricultural experiment stations are engaged in programs essentially designed to "split the breed." That is, they are taking certain bloodlines within the Holstein or Simmentaler breeds which are particularly heavy milk producers and others which show particularly good beef characteristics and breeding these for milk and beef production respectively with less

regard for beef in the former or milk production levels in the latter. Proponents of these programs claim some success and indicate the results are beginning to be seen at the farm level as a slight amount of beef specialization and a more pronounced dairy specialization occurs. The result of these three trends -- less use of cows for draft, feeding more supplements in the dairy herd ration, and breeding for dairy specialization -- is the ability to produce more milk with the same number of cows or conversely the same amount of milk can be produced with fewer cows.

With a dual purpose breed of cattle, a rather inflexible technical ratio exists between milk and beef production. We say rather inflexible because within limits this ratio can change and in fact has been shifting. Assuming a constant milk output per cow, in order to achieve a given milk production level, simple mathematics tells us how many cows are needed. With this number of cows we can estimate with reasonable accuracy how many calves will be forthcoming. From the calf crop, we know a certain number of heifers must be held for dairy herd replacement. The rest are available for beef and veal production. And, of course, the dairy herd culls add to the total meat supply when slaughtered after their milk producing life is over.

Now one would expect that with price and demand conditions found in Germany in the past several years and guaranteed to continue under the CAP -- a constant milk price and an increasing beef price (milk-beef price ratio in 1964 at 1:5.8 and in 1965 at 1:6.4) brought about by an increasing demand -- farmers would react by increasing their cattle herds to take advantage of the higher price of the beef portion since they are not vulnerable to a price decrease in the milk portion of their joint production. But the problem is not so clear-cut and other factors must be considered.

The first is labor. Virtually all German farms with over 25 cows employ a dairy herdsman. The herdsman has an employment contract with the farmer stating his wage and benefits as well as the number of cows for which he is responsible. Well organized union backing along with the full employment situation throughout the economy places the herdsmen in a particularly strong position. The farmer can expand his herd only if the herdsman agrees to take on an additional work load. And if the herdsman agrees, he will most certainly require additional compensation probably at a higher level since wage rates are on the increase throughout the economy.

This situation also has a negative effect upon the rate of modernization and technological innovation in the dairy plant. Since the herdsman's salary is fixed at least for the term of his contract, no labor cost reduction can be gained by the owner by bringing in labor saving innovations. The herdsman merely does less for the same wage in such cases while the owner has the additional cost of modernization. Therefore, modernization is usually delayed at least until a new contract must be negotiated with the herdsman. Some

owners at the point of contract negotiation decide not to renew their herdsman contract and quit the dairy enterprise substituting or increasing their other livestock enterprises. This decision is based on the relative profitability of dairy versus alternative enterprises, the cost of modernization in dairying as opposed to the others, and the extent to which the farm structure allows substitution of enterprises.

On large farms dairying is disappearing. The land base is large enough on these farms and the price ratios between cash crops, particularly grain and sugar beets, and the dairy enterprise favorable enough that the operator can maintain a satisfactory income without bothering with the time consuming and troublesome labor problems associated with the dairy enterprise. Many move out of dairying. Those who remain commit themselves wholeheartedly to dairying by building a large herd and building or remodeling to a very modern and efficient operation to include freestall housing, automatic feeding, herringbone milking parlors, pipeline milkers and bulk tank collection.

The small farms, those with more than 8 but less than 20 cows, remain engaged in the dairy enterprise. These farms normally do not employ herdsmen and do not have a land base large enough for an adequate income from a straight cash crop operation. Thus, they must have some type of livestock enterprise to meet their income requirements and to use the available operator and family labor. For small farms with adequate grassland, dairying is that enterprise. The land base, extent of grassland and availability of family labor set the limits of herd size.

So we see both large and small farms have limits to their ability to expand the dairy enterprise which in most cases have already been reached. Therefore, a more direct approach in attempting to increase income is to increase the production of milk per cow. With increased milk yields per cow there is relatively little additional burden placed on the family labor supply in the case of the small farm and the herdsman has no additional claim against the large farm. Thus, larger dairy herds as a source of more beef calves do not appear to be a solution to the increased demand for beef.

With the increasing beef prices farmers are adjusting production along other lines to attempt to increase the supply of beef moving into the market. One such method is an increase in slaughter weights. As a calf becomes heavier, more feed is needed for weight maintenance; so if slaughter weight increases are to be effected, larger rations are required. The marginal kilogram of gain becomes more expensive. When the marginal cost of the last kilogram of gain is equal to its marginal value at the market, the optimum sale weight has been reached. Thus, with increasing beef prices, *ceteris paribus*, the optimum sale weight increases. In the same vein, an increased interest in the use of more grain and protein concentrates for beef fattening is observed in Germany. And, here again, the decreased feed grain prices un-

der the CAP will create an even more favorable situation for increased grain feeding.

Another method of increasing beef supplies now used by some producers is to run beef heifers through one or two pregnancies before slaughter. By keeping the cow the additional time needed for her to calve, the farmer gets the additional weight on the cow, the milk she produces during the period, and another calf. This practice is supplemented by practices known as *Mutterkuhhaltung* and *Ammenkuhhaltung*. The first being simply the calf suckling from its own mother and the latter, one mother cow wet nursing two or three calves. Neither of these latter methods are practiced extensively but increased interest in them is evident.

One solution which appears to be the obvious answer at first glance is to break the joint milk-beef product tie by bringing in specialized beef breeds, running a cow-calf operation to supply the feeder calves needed and feed them out in feed lots using a high concentrate ration. A complex set of relationships preclude this type of beef production in Germany. The first can be summed up by pointing out that Germany has no area comparable to the Great Plains in the U.S. In certain areas of the Great Plains, the highest best use of the land is for range cattle purposes. In Germany, several more profitable land-use alternatives to range cattle present themselves on a return per hectare basis.

The second is concerned with existing farm structure. Even if the low-priced, low-return land could be found to support a cow-calf range operation, farm size is so small and fragmentation so extreme that few farm operators would have the land base to establish the volume operation large enough to provide their income expectations. In northern Hessen and in some areas of Baden-Württemberg and Bayern, land which cannot be mechanized is being returned to grass. This will eventually include virtually all the agricultural land with a slope greater than 20°. But, the average farm size in Hessen (for example) was 6.8 hectares in 1965. And the carrying capacity of grassland in Germany ranges approximately .7 to 1.5 hectares per animal unit (cow and calf). Taking the best figure (.7) and applying it to the average size farm, we find a carrying capacity of about 10 animal units -- hardly enough to make a living even with today's high beef prices. A dairy enterprise using supplemental fodder would certainly be more profitable from a total income standpoint. The point is that a range cow-calf operation as a separate enterprise is not feasible. The farmer must have the income from the milk production along with the calves in order to make the operation profitable.

While the supplying of calves cannot be accomplished without the dairy enterprise, a feeding enterprise can be sustained separate from dairying. The trend toward specialized feeding is discernible whereby larger farms are quitting the dairy enterprise, buying their calves from dairy farms normally

as eight-day-old, early-weaned feeders, and feeding them out to slaughter weights averaging 380-400 kilograms. The price of these feeder calves has increased sharply from about 120 DM in the early 1960's to as high as 350DM in 1965. As mentioned before, relatively little grain and concentrated feed is used for fattening purposes because the rate of gain is better with a milk and fodder ration and up to this point more profitable.

Another barrier to the use of grain and concentrate feeds to a large extent in beef fattening, and one which may not be nearly as high as some seem to think, is the fact that this type of feeding produces more fat during the gain period and as those who are pessimistic about grain feeding observe, this is contrary to the German consumers taste in beef. They prefer lean beef with little marbling and will continue to do so for some time to come, so the dissenters say. Inertia and resistance to change is stronger in Germany and probably throughout Europe than in the U.S. It is doubtful without a strong price incentive that the German housewife could be induced to try the result of full blown grain feeding and to make the radical changes from her customary cooking methods necessary to prepare the grain fed beef into tasty dishes that would have her going back for more. However, increased use of grain in the beef fattening diet will of necessity occur gradually thus allowing the housewife to adjust to any changes in the type of beef produced by grain feeding gradually over a relatively long time period. So we feel that the nonacceptance argument is invalid.

To summarize the factors which must be considered in making projections of milk, beef and veal production, we find the following to be particularly relevant: (1) Milk and beef are joint products on German farms and are likely to remain so. (2) Milk production per cow is increasing in the face of a surplus due primarily to decreased use of cows for draft purposes, increased rate of feeding grain and concentrates, and breeding for higher milk production. (3) Dairy cow herd numbers are increasing at somewhat less than the past trend rate and are concentrating to some extent in the Allgau region in the south and along the North Sea shore in the north primarily due to changes in farm size structure. (4) Beef calves for fattening purposes are in short supply and the main response to rising beef prices is in the form of feeding to higher slaughter weights, feeding out a higher portion of the calf crop for beef rather than slaughtering as veal, and to a lesser extent, running beef heifers through one or two pregnancies before slaughter. (5) Cow-calf operations are not feasible in Germany due to land use intensity and farm structure. (6) Feeding of grain and protein concentrates to beef animals has been at a very low level in the past but has been increasing slightly. Additional impetus to increase the rate of grain and concentrate feeding may be provided by a more favorable price relationship in the form of rising beef prices and a decline in grain prices under the Common Agricultural Policy.

Milk Production Projections

Table 77 presents cow numbers, milk yield per cow and total production projected for each state for 1970 and 1975 and the aggregate for West Germany. The basis for the cow numbers projections has been explained above as well as some of the factors to be considered for the milk yield per cow projections. For the milk yield projections,[11] we consider the historical developments as well as future changes in factors affecting yield such as the increased use of grain and protein concentrates in the dairy herd ration, the replacement of the low yielding Simmentaler breed by the higher yielding Holstein-Friesen breed in the south, and to a much lesser degree the emphasis on breeding for higher milk production. Our final milk projections show an increase from 21,344 thousand tons of milk produced in 1965 to 23,214 thousand tons and 26,206 thousand tons produced in 1970 and 1975, respectively. The milk yield figures for West Germany are production weighted and calculated by dividing the national production summed from each of the individual states by the total cow numbers.

Beef and Veal Production Projections

In order to project beef and veal production in West Germany for 1970 and 1975, we must look at the historical relationships between cow numbers and calves for slaughter on the one hand and total slaughterings and beef and veal production on the other. Table 78 presents the basic data used in projecting beef and veal production as well as the 1970 and 1975 projections for each state. Column 1 presents cow herd numbers by state with the 1970 and 1975 projections. Column 2 presents the calving rate for each year in the base period plus the 1970 and 1975 projections. The calving rate shows the number of calves born relative to the number of cows. The national rate is assumed for each of the states since data was not available. The rate appears unusually high but is not when we consider that a heifer is not counted as a cow until she has dropped her first calf. Therefore, in any given year none of the heifers pregnant for the first time are counted in the cow herd. For this reason along with the fact that we expect, as noted above, an increase in the practice of running beef heifers through one or two pregnancies before slaughter leads us to project a calving rate of over 100% in 1970 and 1975. With the number of cows and the calving rate, a simple multiplication brings us to the number of calves born each year in Column 3.

Assuming that each calf raised for dairy herd replacement will be offset in the total cattle available for slaughter by a dairy herd cull, the total number of slaughterings relative to calf births are affected only by increases or decreases in the cow herd. Therefore Column 4 of Table 78 pre-

[11] For historical data on milk yield by state see Appendix C.

Table 77. Projected Milk Production by State in West Germany 1965, 1970-1975.

	Cows in 1000's			Milk Yield in Kilograms			Total Production in 1000 Tons		
	1965	1970	1975	1965	1970	1975	1965	1970	1975
Schleswig-Holstein	510.8	536.5	565.7	4218	4433	4699	2154.6	2378.3	2658.2
Niedersachsen	1050.7	1071.4	1109.0	4205	4422	4687	4418.2	4737.7	5197.9
Nordrhein-Westfalen	797.2	802.2	808.2	4126	4272	4539	3289.2	3427.0	3668.4
Hessen	379.1	364.4	347.6	3606	3938	4436	1367.0	1435.0	1542.0
Rheinland-Pfalz	298.4	277.0	251.6	3262	3708	4223	973.4	1027.1	1062.5
Baden-Württemberg	828.0	807.8	790.7	3136	3433	3905	2596.6	2773.2	3087.7
Bayern	1956.5	2065.9	2197.2	3287	3550	4055	6431.0	7334.0	8909.6
Saarland	31.2	25.6	18.7	3661	3979	4184	114.2	101.9	78.2
West Germany	5851.9	5950.8	6088.7	3647	3901	4304	21,344.2	23,214.2	26,205.6

Table 78. Beef and Veal Production by State 1959-1965 with Projections to 1970 and 1975

State Year	Cows 1000 (1)	Calving Rate % (2)	Calves 1000 (3)	Cow Herd Trend Adjustment 1000 (4)	Calves Available for Slaughter 1000 (5)	Minus 4.7% Bias in Calves Available 1000 (6)	Total Slaughter Actual 1000 (7)	(6-7) Export(+) or Import (-) 1000 (8)
Schleswig-Holstein								
1959	448.6	94.4	423.5	15.9	407.6	388.4	375.7	12.7
1960	467.4	97.7	456.6	18.8	437.8	417.2	418.0	-.8
1961	473.2	95.4	451.4	5.8	445.6	424.7	443.3	-18.6
1962	484.2	95.7	463.4	11.0	452.4	431.1	463.0	-31.9
1963	478.3	97.2	464.9	-5.9	470.8	448.7	529.2	-80.5
1964	485.2	98.1	476.0	6.9	469.1	447.1	447.0	.1
1965	510.8	96.1	490.9	25.6	465.3	443.4	396.8	46.6
1970	536.5	100.2	537.6	5.7	531.9	506.9	518.6	-11.7
1975	565.7	100.8	570.2	5.8	564.4	537.9	550.3	-12.4

State Year	% of Calves Available for Slaughter X(+) or M(-)(8/6) % (9)	Beef Slaughter / Total Slaughter % (10)	Beef Slaughter 1000 (11)	Veal Slaughter 1000 (12)	Beef Slaughter Weight Kg (13)	Veal Slaughter Weight Kg (14)	Beef 1000 tons (15)	Veal 1000 tons (16)
Schleswig-Holstein								
1959	3.3	75.0	281.7	94.0	228	53	64.2	5.0
1960	-.2	74.4	311.2	106.8	222	53	69.1	5.7
1961	-4.4	78.9	349.7	93.6	232	54	81.1	5.1
1962	-7.4	82.1	380.1	82.9	238	55	90.5	4.6
1963	-17.9	80.2	424.5	104.7	232	55	98.5	5.8
1964	0	80.3	358.9	88.1	234	60	84.0	5.3
1965	10.5	82.0	325.5	71.3	240	68	78.1	4.8
1970	-2.3	84.0	435.6	83.0	239	74	104.1	6.1
1975	-2.3	86.0	473.3	77.0	243	86	115.0	6.6

Table 78. Beef & Veal continued

State Year	Cows	Calving Rate	Calves	Cow Herd Trend Adjustment	Calves Available for Slaughter	Minus 4.7% Bias in Calves Available	Total Slaughter Actual	(6-7) Export(+) or Import (-)
	1000 (1)	% (2)	1000 (3)	1000 (4)	1000 (5)	1000 (6)	1000 (7)	1000 (8)
Niedersachsen								
1959	1006.2	94.4	949.9	21.2	928.7	885.1	533.9	351.2
1960	1027.6	97.7	1004.0	21.4	982.6	936.4	568.9	367.5
1961	1032.6	95.4	985.1	5.0	980.1	934.0	579.1	354.9
1962	1041.1	95.7	996.3	8.5	987.8	941.4	607.5	333.9
1963	1019.5	97.2	991.0	-21.6	1012.6	965.0	664.9	300.1
1964	1029.2	98.1	1009.6	9.7	999.9	952.9	617.8	335.1
1965	1050.7	96.1	1009.7	21.0	988.7	942.2	581.0	361.2
1970	1071.4	100.2	1073.5	4.1	1069.4	1019.1	645.1	374.0
1975	1109.0	100.8	1117.9	3.7	1114.2	1061.8	672.1	389.7

State Year	% of Calves Available for Slaughter X(+) or M(-)(8/6)	Beef Slaughter / Total Slaughter	Beef Slaughter	Veal Slaughter	Beef Slaughter Weight	Veal Slaughter Weight	Beef	Veal
	% (9)	% (10)	1000 (11)	1000 (12)	Kg (13)	Kg (14)	1000 tons (15)	1000 tons (16)
Niedersachsen								
1959	39.7	70.8	377.8	156.1	250	46	94.5	7.2
1960	39.2	72.3	411.4	157.5	252	48	103.7	7.6
1961	38.0	75.7	438.1	141.0	259	51	113.5	7.2
1962	35.5	77.3	469.5	138.0	259	54	121.6	7.5
1963	31.1	74.5	495.5	169.4	257	53	127.3	9.0
1964	35.2	74.1	457.5	160.3	258	60	118.0	9.6
1965	38.3	83.1	430.5	150.5	263	67	113.2	10.1
1970	36.7	80.0	516.1	129.0	268	76	138.3	9.8
1975	36.7	83.0	557.8	114.3	276	92	154.0	10.5

Table 78. Beef & Veal continued

State Year	Cows 1000 (1)	Calving Rate % (2)	Calves 1000 (3)	Cow Herd Trend Adjustment 1000 (4)	Calves Available for Slaughter 1000 (5)	Minus 4.7% Bias in Calves Available 1000 (6)	Total Slaughter Actual 1000 (7)	(6-7) Export(+) or Import (-) 1000 (8)
Nordrhein-Westfalen								
1959	789.3	94.4	745.1	4.7	740.4	705.6	1027.4	-321.8
1960	810.8	97.7	792.2	21.5	770.7	734.5	1060.2	-325.7
1961	818.8	95.4	781.1	8.0	773.1	736.8	1061.5	-324.7
1962	810.1	95.7	775.3	-8.7	784.0	747.2	1129.7	-382.5
1963	793.2	97.2	771.0	-16.9	787.9	750.9	1201.7	-450.8
1964	795.1	98.1	780.0	1.9	778.1	741.5	1074.4	-332.9
1965	797.2	96.1	766.1	2.1	764.0	728.1	963.6	-235.5
1970	802.2	100.2	803.8	1.0	802.8	765.1	1117.8	-352.7
1975	808.2	100.8	814.7	1.2	813.5	775.3	1132.7	-357.4

State Year	% of Calves Available for Slaughter X(+) or M(-)(8/6) % (9)	Beef Slaughter / Total Slaughter % (10)	Beef Slaughter 1000 (11)	Veal Slaughter 1000 (12)	Beef Slaughter Weight Kg (13)	Veal Slaughter Weight Kg (14)	Beef 1000 tons (15)	Veal 1000 tons (16)
Nordrhein-Westfalen								
1959	-45.6	64.7	665.2	362.2	258	45	171.6	16.3
1960	-44.3	64.9	688.4	371.8	262	47	180.4	17.5
1961	-44.1	69.1	733.2	328.3	267	50	195.8	16.4
1962	-51.2	70.8	799.8	329.9	265	57	211.9	18.8
1963	-60.0	70.4	845.9	355.8	264	60	223.3	21.3
1964	-44.9	72.8	782.1	292.3	272	67	212.7	19.6
1965	-32.3	74.8	720.5	243.1	273	72	196.7	17.5
1970	-46.1	78.0	871.9	245.9	280	85	244.1	20.9
1975	-46.1	82.0	928.8	203.9	290	105	269.4	21.4

Table 78. Beef & Veal continued

State Year	Cows 1000 (1)	Calving Rate % (2)	Calves 1000 (3)	Cow Herd Trend Adjustment 1000 (4)	Calves Available for Slaughter 1000 (5)	Minus 4.7% Bias in Calves Available 1000 (6)	Total Slaughter Actual 1000 (7)	(6-7) Export(+) or Import (-) 1000 (8)
Hessen								
1959	399.2	94.4	376.8	2.0	374.8	357.2	468.7	-111.5
1960	406.7	97.7	397.3	7.5	389.8	371.5	475.0	-103.5
1961	409.4	95.4	390.6	2.7	387.9	369.7	470.0	-100.3
1962	398.4	95.7	381.3	-11.0	392.3	373.9	516.2	-142.3
1963	386.8	97.2	376.0	-11.6	387.6	369.4	531.3	-161.9
1964	377.5	98.1	370.3	-9.3	379.6	361.8	497.1	-135.3
1965	379.1	96.1	364.3	1.6	362.7	345.7	412.9	-67.2
1970	364.4	100.2	365.1	-2.9	368.0	350.7	463.3	-112.6
1975	347.6	100.8	350.4	-3.4	353.8	337.2	462.0	-108.2

State Year	% of Calves Available for Slaughter X(+) or M(-)(8/6) % (9)	Beef Slaughter / Total Slaughter % (10)	Beef Slaughter 1000 (11)	Veal Slaughter 1000 (12)	Beef Slaughter Weight Kg (13)	Veal Slaughter Weight Kg (14)	Beef 1000 tons (15)	Veal 1000 tons (16)
Hessen								
1959	-31.2	58.9	276.1	192.6	269	46	74.3	8.9
1960	-27.9	60.3	286.2	188.8	272	49	77.8	9.3
1961	-27.1	64.0	300.6	169.4	275	53	82.7	9.0
1962	-38.1	64.7	334.0	182.2	274	53	91.5	9.7
1963	-43.8	65.7	349.0	182.3	276	56	96.3	10.2
1964	-37.4	68.0	338.2	158.9	276	61	93.3	9.7
1965	-19.4	72.1	297.5	115.4	279	65	83.0	7.5
1970	-32.1	73.0	338.2	125.1	289	73	97.7	9.1
1975	-32.1	77.0	355.7	106.3	301	87	107.1	9.2

Table 78. Beef & Veal continued

State Year	Cows 1000 (1)	Calving Rate % (2)	Calves 1000 (3)	Cow Herd Trend Adjustment 1000 (4)	Calves Available for Slaughter 1000 (5)	Minus 4.7% Bias in Calves Available 1000 (6)	Total Slaughter Actual 1000 (7)	(6-7) Export(+) or Import (-) 1000 (8)
Rheinland-Pfalz								
1959	326.0	94.4	307.7	-.8	308.5	294.0	310.1	-16.1
1960	334.6	97.7	326.9	8.6	318.3	303.3	310.8	-7.5
1961	336.9	95.4	321.4	2.3	319.1	304.1	301.9	2.2
1962	326.7	95.7	312.7	-10.2	322.9	307.7	327.0	-19.3
1963	312.0	97.2	303.3	-14.7	318.0	303.1	320.0	-16.9
1964	302.3	98.1	296.6	-9.7	306.3	291.9	307.0	-15.1
1965	298.4	96.1	286.8	-3.9	290.7	277.0	265.2	11.8
1970	277.0	100.2	277.6	-4.3	281.9	268.7	276.5	-7.8
1975	251.6	100.8	253.6	-5.1	258.7	246.5	253.6	-7.1

State Year	% of Calves Available for Slaughter X(+) or M(-)(8/6) % (9)	Beef Slaughter / Total Slaughter % (10)	Beef Slaughter 1000 (11)	Veal Slaughter 1000 (12)	Beef Slaughter Weight Kg (13)	Veal Slaughter Weight Kg (14)	Beef 1000 tons (15)	Veal 1000 tons (16)
Rheinland-Pfalz								
1959	-5.5	65.8	203.9	106.2	250	43	51.0	4.6
1960	-2.5	66.5	206.8	104.0	252	46	52.1	4.8
1961	.7	69.7	210.4	91.5	265	48	55.8	4.4
1962	-6.3	70.7	231.3	95.7	263	49	60.8	4.7
1963	-5.6	73.2	234.1	85.9	266	53	62.3	4.6
1964	-5.2	75.6	231.6	75.4	266	55	61.6	4.1
1965	4.3	78.4	207.9	57.3	267	61	55.5	3.5
1970	-2.9	83.0	229.5	47.0	284	67	65.2	3.1
1975	-2.9	87.0	220.6	33.0	300	80	66.2	2.6

Table 78. Beef & Veal continued

State Year	Cows 1000 (1)	Calving Rate % (2)	Calves 1000 (3)	Cow Herd Trend Adjustment 1000 (4)	Calves Available for Slaughter 1000 (5)	Minus 4.7% Bias in Calves Available 1000 (6)	Total Slaughter Actual 1000 (7)	(6-7) Export(+) or Import (-) 1000 (8)
Bayern								
1959	1792.1	94.4	1691.7	21.4	1670.3	1591.8	1348.9	242.9
1960	1840.4	97.7	1798.1	48.3	1749.8	1667.6	1412.5	255.1
1961	1909.6	95.4	1821.8	69.2	1752.6	1670.2	1376.9	293.3
1962	1958.2	95.7	1874.0	48.6	1825.4	1739.6	1546.7	192.9
1963	1961.1	97.2	1906.2	2.9	1903.3	1813.8	1606.0	207.8
1964	1960.4	98.1	1923.2	-.7	1923.9	1833.5	1500.4	333.1
1965	1956.5	96.1	1880.2	3.9	1876.3	1788.1	1312.6	475.5
1970	2065.9	100.2	2070.0	21.9	2048.1	1951.8	1629.8	322.0
1975	2197.2	100.8	2214.8	26.3	2188.5	2085.6	1741.5	344.1

State Year	% of Calves Available for Slaughter X(+) or M(-)(8/6) % (9)	Beef Slaughter / Total Slaughter % (10)	Beef Slaughter 1000 (11)	Veal Slaughter 1000 (12)	Beef Slaughter Weight Kg (13)	Veal Slaughter Weight Kg (14)	Beef 1000 tons (15)	Veal 1000 tons (16)
Bayern								
1959	15.3	52.3	705.8	643.1	268	45	189.2	28.9
1960	15.3	52.1	735.8	676.7	268	45	197.2	30.5
1961	17.6	51.9	714.7	662.2	277	47	198.0	31.1
1962	11.1	50.8	786.0	760.7	278	48	218.5	36.5
1963	11.5	49.8	799.2	806.8	277	49	221.4	39.5
1964	18.2	52.8	792.4	708.0	279	50	221.1	35.4
1965	26.6	53.3	699.2	613.4	280	53	195.8	32.5
1970	16.5	56.0	912.7	717.1	290	57	264.7	40.9
1975	16.5	60.0	1044.9	696.6	301	63	314.5	43.9

Table 78. Beef & Veal continued

State Year	Cows	Calving Rate	Calves	Cow Herd Trend Adjustment	Calves Available for Slaughter	Minus 4.7% Bias in Calves Available	Total Slaughter Actual	(6-7) Export(+) or Import (-)
	1000 (1)	% (2)	1000 (3)	1000 (4)	1000 (5)	1000 (6)	1000 (7)	1000 (8)
Baden-Württemberg								
1959	873.2	94.4	824.3	9.0	815.3	777.0	920.8	-143.8
1960	875.0	97.7	954.9	1.8	853.1	813.0	960.6	-147.6
1961	879.0	95.4	838.6	4.0	834.6	795.4	929.6	-134.2
1962	866.7	95.7	829.4	-12.3	841.7	802.1	1025.6	-223.5
1963	849.1	97.2	825.3	-17.6	842.9	803.3	1042.2	-238.9
1964	832.6	98.1	816.8	-16.5	833.3	794.1	1012.1	-218.0
1965	828.0	96.1	795.7	-4.6	800.7	763.1	879.7	-116.6
1970	807.8	100.2	809.4	-4.0	813.4	775.2	945.7	-170.5
1975	790.7	100.8	797.0	-3.4	800.4	762.8	930.6	-167.8

State Year	% of Calves Available for Slaughter X(+) or M(-)(8/6)	Beef Slaughter / Total Slaughter	Beef Slaughter	Veal Slaughter	Beef Slaughter Weight	Veal Slaughter Weight	Beef	Veal
	% (9)	% (10)	1000 (11)	1000 (12)	Kg (13)	Kg (14)	1000 tons (15)	1000 tons (16)
Baden-Württemberg								
1959	-18.5	55.1	507.6	413.2	272	48	138.1	19.8
1960	-18.2	55.7	535.0	425.6	273	49	146.1	20.9
1961	-16.9	57.8	537.2	392.4	278	50	149.3	19.6
1962	-27.9	58.2	597.1	428.5	275	51	164.2	21.9
1963	-29.7	58.7	611.7	430.5	274	55	167.6	23.7
1964	-27.5	61.2	619.1	393.0	278	59	172.1	23.2
1965	-15.3	60.9	535.6	344.1	277	65	148.4	22.4
1970	-22.0	66.0	624.2	321.5	286	69	178.5	22.2
1975	-22.0	71.0	660.7	269.9	295	79	194.9	21.3

Table 78. Beef & Veal continued

State Year	Cows 1000 (1)	Calving Rate % (2)	Calves 1000 (3)	Cow Herd Trend Adjustment 1000 (4)	Calves Available for Slaughter 1000 (5)	Minus 4.7% Bias in Calves Available 1000 (6)	Total Slaughter Actual 1000 (7)	(6-7) Export(+) or Import (-) 1000 (8)
Saarland								
1959	35.2	94.4	33.2	-2.4	35.6	33.9	29.5	4.4
1960	35.3	97.7	34.5	.1	34.4	32.8	28.8	4.0
1961	34.8	95.4	33.2	-.5	33.7	32.1	28.0	4.1
1962	34.1	95.7	32.6	-.7	33.3	31.7	40.8	-9.1
1963	33.0	97.2	32.1	-1.1	33.2	31.6	44.2	-12.6
1964	31.8	98.1	31.2	-1.2	32.4	30.9	38.7	-7.8
1965	31.2	96.1	30.0	-.6	30.6	29.2	28.9	.3
1970	25.6	100.2	25.7	-1.1	26.8	25.5	27.5	-2.0
1975	18.7	100.8	18.8	-1.4	20.2	19.3	20.8	-1.5

State Year	% of Calves Available for Slaughter X(+) or M(-)(8/6) % (9)	Beef Slaughter / Total Slaughter % (10)	Beef Slaughter 1000 (11)	Veal Slaughter 1000 (12)	Beef Slaughter Weight Kg (13)	Veal Slaughter Weight Kg (14)	Beef 1000 tons (15)	Veal 1000 tons (16)
Saarland								
1959	13.0	44.7	13.2	16.3	245	36	3.2	.6
1960	12.2	43.4	12.5	16.3	240	35	3.0	.6
1961	12.8	52.1	14.6	13.4	248	35	3.6	.5
1962	-28.7	62.5	25.5	15.3	251	35	6.4	.5
1963	-39.9	67.4	29.8	14.4	253	43	7.5	.6
1964	-25.2	64.6	25.0	13.7	252	45	6.3	.6
1965	1.0	65.1	18.8	10.1	256	48	4.8	.5
1970	-7.8	71.0	19.5	8.0	262	48	5.1	.4
1975	-7.8	78.0	16.2	4.6	271	53	4.4	.2

sents the cow herd trend adjustment or the number of calves necessary beyond replacement to maintain the cow herd on the trend level. Subtracting Column 4 from Column 3 we arrive at the number of calves available for slaughter presented in Column 5. By relating the number of calves available for slaughter during the base period to the total number of slaughterings during the base period at the national level, we find an upward bias over the seven years from 1959 through 1965 in the number of calves available for slaughter of 4.7 percent. We assume this bias to be uniform throughout the eight states and apply a correction factor of 4.7 percent to compensate for disease and cattle deaths which do not result in increases in the meat supply. Column 6 then is the estimated number of cattle which are available for slaughter in each state and year based on the cow herd. Column 7 presents the actual number of slaughterings during the base years in each of the states. Column 8 presents the number of cattle exported or imported by subtracting Column 7 from Column 6. Column 9 shows the percent of cattle available for slaughter which are exported or imported by dividing Column 8 by Column 6. A simple average of this column for the base period is used for the 1970 and 1975 projection. The 1970 and 1975 percentages from Column 9 are then applied to the 1970 and 1975 projections in Column 6 to arrive at the total slaughter estimates for 1970 and 1975 in Column 7.

Beef and veal slaughterings are presented for the base period in Columns 11 and 12 and the beef slaughter proportion of total slaughterings is calculated by dividing Column 11 by Column 7 with the result shown in Column 10. Projections of the beef slaughterings as a percentage of total slaughterings for 1970 and 1975 are based on the trend shown in Column 10 during the 1959/65 base period. Beef and veal slaughterings for 1970 and 1975 are based on the projection of total slaughterings in Column 7 and the beef proportion of total slaughterings in Column 10. Beef and veal slaughterings are presented in Columns 13 and 14 with projections based on the historical data.

Finally, beef and veal production in thousands of tons are shown in Columns 15 and 16 by multiplying the number of slaughterings in Columns 11 and 12 by the slaughter weights in Columns 13 and 14 respectively.

Through our calculations we find that cattle are not necessarily slaughtered in the same state in which they are raised. Niedersachsen and Bayern are major exporting states for slaughter cattle, while Hessen, Nordrhein-Westfalen, and Baden-Württemberg are major importers. Schleswig-Holstein, Rheinland-Pfalz and Saarland are very minor importers of slaughter cattle.

We also find that as asserted above the beef cattle slaughterings proportion of total slaughterings increases over time. Not only are both beef and veal cattle being fed to heavier slaughter weights, a greater proportion of the total number of calves are being held over and fed out as beef cattle.

Table 79. Beef and Veal Production in West Germany 1959-1965 with Projections to 1970 and 1975[1]

State Year	Cows	Calving Rate	Calves	Cow Herd Trend Adjustment	Calves Available for Slaughter	Minus 4.7% Bias in Calves Available	Total Slaughter	% Imbalance Between Calves Available and Slaughterings
	1000	%	1000	1000	1000	1000	1000	%
West Germany	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1959	5669.8	94.4	5352.3	130.6	5221.7		5015.0	
1960	5800.4	97.7	5667.0	130.6	5536.4		5235.0	
1961	5896.9	95.4	5625.6	96.5	5529.1		5189.8	
1961	5922.1	95.7	5667.4	25.2	5642.2		5656.8	
1963	5835.2	97.2	5671.8	-89.9	5758.7		5939.4	
1964	5816.4	98.1	5705.9	-18.8	5724.7		5494.5	
1965	5853.5	96.1	5625.2	37.1	5588.1		4710.5	
1970	5950.8	100.2	5962.7	20.4	5942.3	5663.0	5624.3	.7
1975	6088.7	100.8	6137.4	23.7	6113.7	5826.4	5763.6	1.0

State Year	Beef Total	Beef Slaughter	Veal Slaughter	Beef Slaughter Weight	Veal Slaughter Weight	Beef	Veal	Difference as Percent of Calves Available
	%	1000	1000	Kg	Kg	1000 tons	1000 tons	
West Germany	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1959	60.4	3031.2	1983.8	259	46	785.1	91.3	5.0
1960	60.9	3187.3	2047.7	260	47	828.7	96.2	5.4
1961	63.6	3298.3	1891.5	267	49	880.6	92.7	6.1
1962	64.1	3623.5	2033.3	267	51	967.5	103.7	-.3
1963	63.8	3789.7	2149.7	265	53	1004.3	113.9	-3.2
1964	65.6	3604.9	1889.6	269	57	969.7	107.7	4.8
1965	68.7	3235.4	1475.1	271	62	876.8	91.5	15.6
1970	70.2	3947.7	1676.6	278	67	1097.7	112.5	4.7
1975	73.9	4258.0	1505.6	288	77	1225.5	115.7	4.7

[1] All 1970 and 1975 totals in Columns 1, 3-5, 7, 10, 11, 14, and 15 are sums of the corresponding state totals from Table 78.

Table 79 presents the 1959-1965 historical data on beef and veal production as well as the aggregates of the 1970 and 1975 projections for West Germany from the individual states. Columns 1 through 5 are similar to those in Table 78 for the individual states. The upward bias in cattle available for slaughter over total slaughterings is seen by comparing Columns 5 and 7. The percentage bias is calculated for each year in Column 16 and average at 4.7 percent for the projection period. Column 6 adjusts the number of calves available for slaughter in the projection period downward by 4.7 percent to account for this bias. We find .7 percent and 1.0 percent more calves available than slaughterings in 1970 and 1975 respectively. We might expect some difference as long as slaughter weights are increasing but a portion of this discrepancy must be considered a slight aggregation error. Beef slaughterings as a percent of total slaughterings and beef and veal slaughter weights are calculated from the aggregated totals from the states and can thus be considered as weighted averages of the state projections.

Our projections show beef production levels for West Germany of 1,097.7 thousand tons in 1970 and 1,225.5 thousand tons in 1975. Veal production is projected at 112.5 and 115.7 thousand tons in 1970 and 1975 respectively. Beef production increases 15.5 percent and 29.0 percent while veal production increases 7.8 percent and 10.8 percent from a 1963/65 base period in 1970 and 1975 respectively. Beef production increases at a higher rate than veal.

The steeper beef trend can be partially explained by changing price relationships. Epp projects the veal-beef price ratio to decrease by 5.5 percent between 1964 and 1970. On the production side the calf-milk price ratio is expected to increase by about 15 percent while the beef-barley price ratio increases about 41 percent.[12] Thus both the sale price relationships and the production cost relationships tend to favor a greater increase in beef production. Finally, structural change to 1975 will have a small influence in favor of greater increases in beef than in veal production. Some tendency toward specialization in beef production and movement of farmers out of crowded villages allowing greater barnyard and building capacity is more advantageous to beef than to veal production.

Feed Grain Requirements in Cattle Production

Grain utilization in cattle feeding and dairying has increased substantially during the past decade. German data reports cattle feed utilization by type of feed but does not make a distinction between that used by dairy cows on the one hand and that used for beef fattening on the other. For our projection period two sources of increased feed grain usage are present.

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[12]Donald J. Epp, *The Impact of Agricultural Policies on Regional Grain and Livestock Prices in the European Economic Community*, Unpublished Ph.D. dissertation, Michigan State University, 1967.

Table 80. Feed Grain and Other Feed Utilization in Grain Units [1] by Cattle in West Germany 1953/54 1964/65 with Grain Projections to 1970 and 1975.

	Feed Grain		Concentrates [2]		Total Feed	Feed Grain	Milk	
	1000 tons Grain Units	% of Total	1000 tons Grain Units	% of Total	1000 tons Grain Units	Fed/Year/Head Kg	1000 tons Grain Units	% of Total
1953/54	1108	5.1	N/A	N/A	21607	95	N/A	N/A
1954/55	1349	6.3	N/A	N/A	21373	117	N/A	N/A
1955/56	1244	5.7	N/A	N/A	21674	108	N/A	N/A
1956/57	1408	6.4	N/A	N/A	22086	119	N/A	N/A
1957/58	1436	6.2	N/A	N/A	23277	120	N/A	N/A
1958/59	1442	6.0	N/A	N/A	24207	120	N/A	N/A
1959/60	1795	7.1	2795	11.1	25114	144	2084	8.3
1960/61	1899	7.4	2537	9.8	25823	148	2302	8.9
1961/62	1771	6.6	2941	10.9	27038	133	2372	8.8
1962/63	1989	7.3	3190	11.7	27254	149	2396	8.8
1963/64	2155	7.9	3014	11.1	27263	166	2363	8.7
1964/65	2272	8.3	3640	13.3	27367	174	2253	8.2
1970	2896	-	-	-	-	-	-	-
1975	3695	-	-	-	-	-	-	-

N/A Not immediately available

[1] For grain unit conversions see Appendix B.

[2] Includes bran, legumes, tapioca meal, oil cake, fish and meat meal, molasses, and tailings.

Both the increase in cattle numbers and an increasing per head consumption contribute to higher levels of feed grain utilization in the cattle sector in the future. With the emphasis placed on increasing milk yields per cow in dairying and higher levels of beef production coupled with lowering feed grain prices under the CAP, an even higher trend increase in feed grain use may be expected in the future than in the past. One factor which may be expected to temper this increasing feed grain usage trend is an increase in the use of concentrates, particularly in dairying.

Table 80 shows feed grain, concentrates and milk utilization by the cattle sector in West Germany between 1953/54 and 1964/65. We find during this period feed grains and concentrates both increase as percentages of total feed utilization. Since we do not have the data with which to tie feed grain usage rates to milk, beef and veal production rates; we must arrive at our feed grain utilization estimates through a much more loosely knit process. The increased feed grain utilization through increased cattle numbers and higher consumption levels per head will be offset to some extent by substitution of concentrates for feed grains. The lower increase in cow numbers relative to the base period will also be offset by a higher proportion of calves being fed out for beef and the generally higher slaughter weights for both beef and veal. Adjusting the feed grain usage trend to compensate for these relationships, we project feed grain consumption in the cattle sector to be 2,896 thousand tons in 1970 and 3,695 thousand tons in 1975.

Allocation of the feed grain utilization among the states cannot be done in a meaningful way since data utilization as between dairy cattle and beef cattle are not available. By looking at the distribution of cattle numbers in Table 78, we can determine that slightly over 40 percent of the cows are concentrated in the northern three states of Schleswig-Holstein, Niedersachsen, and Nordrhein-Westfalen while about 49 percent are found in the southern two states of Baden-Württemberg and Bayern. From these figures we might roughly conclude that about 40 percent of the feed grain utilization in the cattle sector is found in the northern three states which are quite accessible to feed grain imports from third countries through the Netherlands and north German ports.

Grain Requirements for Industrial Purposes

In order to arrive at a grain balance we must project the industrial grain requirement. By far the largest industrial user of grain is the brewing industry. Table 81 shows that beer consumption in West Germany has risen at a very steady rate from 61.9 liters per capita in 1954/55 to 122.7 liters per capita in 1964/65. Total consumption has risen at an even faster rate due to population increase. By estimating per capita beer consumption to be 140 liters in 1970 and 155 liters in 1975 and by assuming that supply will

equal demand, we project beer production to equal 85,078 thousand hectaliters in 1970 and 96,453 thousand hectaliters in 1975. At a conversion rate of 25.6 kilograms of barley per 100 liters of beer produced, the barley requirement will be 2,178 thousand tons in 1970 and 2,469 thousand tons in 1975. Other industrial grain uses include coffee substitute mixtures, alcoholic distillations, starch, and glucose production. Grain usage for these purposes has increased at a lesser rate than for brewing as shown in Table 81 and we estimate grain utilization to be 535 thousand tons in 1970 and 620 thousand tons in 1975. Total industrial use of grains are projected to be 2,713 thousand tons in 1970 and 3,089 thousand tons in 1975.

Table 81. Demand for Brewing Barley and Other Industrial Grain In West Germany 1954/55-1964/65 With Projections to 1970,75.

	liters per capita	Total Consumption (1000 HL)	Total Production (1000 HL)	Barley Required[1] (1000 tons)	Other Industrial Grain Usage (1000 tons)	Total Industrial Use (1000 tons)
1954/55	61.9	31,643	32,543	840	N/C	N/C
1955/56	69.4	35,887	36,882	957	N/C	N/C
1956/57	77.3	40,484	41,454	1,082	N/C	N/C
1957/58	83.7	44,372	45,340	1,182	N/C	N/C
1958/59	87.0	46,658	47,638	1,227	323	1,550
1959/60	95.7	52,877	53,911	1,376	344	1,720
1960/61	96.8	54,222	55,275	1,410	339	1,749
1961/62	104.7	59,253	60,273	1,536	365	1,901
1962/63	109.8	62,706	63,663	1,621	394	2,015
1963/64	118.6	68,658	69,551	1,770	394	2,164
1964/65	122.7	71,936	72,887	1,827	448	2,275
1970	140.0	85,078	85,078	2,178	535	2,713
1975	155.0	96,453	96,453	2,469	620	3,089

[1] 100 L = 1 HL = 25.6 Kg Barley

N/C = Comparable data not available

Source: *Statistisches Jahrbuch über Ernährung, Landwirtschaft, und Forsten* 1960 Table 242, 312; 1965, Table 158, 320.

Chapter 8

SUMMARY AND CONCLUSIONS

Objectives

The objectives of this study were to describe past trends and the present state of German agriculture and to project grain and livestock production to 1975, in light of expected internal developments as well as changes resulting from adaptation to the Common Agricultural Policy of the European Economic Community. West Germany contains about 20% of the agricultural land of the EEC and about 32% of the population. In 1965 self-sufficiency in food production was 78% or 65% depending upon whether production from imported feed grains is counted. West Germany is one of the top ten cash markets for U. S. agricultural exports.

Method

The starting point for projection in all cases was extrapolation of the historic trend using regression analysis or graphic extrapolation of plotted time series data. Three main factors will have an impact on the level and mix of agricultural production in West Germany in the next decade. These are farm structure, technology, and relative prices. The analysis in the first five chapters of the study provide the basis for estimating future changes in production associated with changes in structure, technology and price. The impact of these factors was assessed on groups of commodities and individual products. This analysis provided the basis for adjusting projections from the initial approximations obtained by extrapolating historical trends.

Impact of Structure

Structure is the main limiting factor in the adjustment process. Within farm structure, we include such variables as farm size, extent of fragmentation, farmstead layout, building capacity, and both the internal and external transportation network for the farm. Since structure is composed of those physical factors on the farm which are normally considered quite fixed, it limits the number and magnitude of input recombination alternatives possible in response to changes in relative product prices or factor costs and new technology. While structure encompasses a large number of factors, we have chosen size in land area as a reasonably good proxy. Average farm size in 1965 in West Germany was about nine hectares, but one million of the 1.45 million farms were less than 10 hectares in size. Since virtually all German farms can be considered multienterprise units, most of them are too small to adequately innovate much of the higher level agricultural technology associated with large-scale commercial farming. Labor-saving technology, coupled with a low unemployment rate in the general economy, has produced a mass exodus of farm labor into industrial jobs. Along with this mass exodus of people, we also find a relatively high rate of farm consolidation so the struc-

ture of the remaining farms, particularly with regard to size, is improving. While some rather dramatic shifts are taking place, the structural situation, as measured by average farm size, changes quite slowly over time, and we project only a 1.5 hectare increase in average farm size to 10.5 hectares between 1965 and 1975. Some increase in the rate of structural change may be obtained through broader national programs but the structural situation is bad enough that even with full government program support, change can take place only very slowly over a long period of time. In Chapter Six, we projected the shifts in relative numbers of farms in various size categories. In the structural analysis we calculated that farm structure change as measured by hectare movement between farm size groups accounted for about 40% of the change in total grain acreage between 1960 and 1965. Further calculation revealed that the elasticity of change in total grain acreage with respect to change in farm numbers between 1960 and 1965 was -.18.

Impact of Technology

Technology affects production in several ways. Some technological innovations cut across several enterprises while others affect only one. In appraising the effect of cost-reducing or yield-increasing technologies on groups of commodities such as small grains, one must ascertain whether each crop will be affected similarly or whether some will be affected to a greater degree than others. Technologies which affect all grains equally will tend to shift production as between grains and other crops (i.e. row crops) while those that affect a single grain will shift production within the grain group as well as between grain and other crops. Introduction of combines, for example, will affect all grains, while a new hybrid seed will influence production of a single crop. Fertilizer will affect all crops but with a differential impact depending upon yield responses of individual crops.

Technology, both the labor-saving and the yield-increasing varieties, is being innovated on West German farms at a very rapid rate. Thus, higher production levels are being attained with fewer farms and a smaller farm population. But as we have pointed out, technological advances favor some types of production over others. Generally, grains are more easily mechanized than are other types of crops. And in the livestock sector, poultry and egg production are most easily mechanized followed by pork, dairying, and beef production in that order. Thus, with higher mechanization levels, we find some increase in total grains with relatively large increases in crop surface in wheat and barley and with less than proportionate decreases in rye, oats, and mixed grains. We also find large increases in poultry and egg production; increases in pig numbers for pork production, but only slight increases in cow numbers for milk, beef and veal production.

Structural change analysis indicated a decrease in numbers of all types of livestock studied as farm size increases. More than offsetting this phenomenon were other tendencies including new cost-reducing technological innovation; increased specialization; increased feed efficiency, particularly for grain-consuming livestock; increased use of grain and concentrates in feeding; improved methods of handling livestock for faster weight gains;higher birth and lower loss rates; and higher yield per animal. Thus livestock numbers increased despite the inverse correlation with structural change. Structure elasticity calculations for livestock were not made because of the overwhelming strength of these other factors in influencing the level and mix of livestock production.

Impact of Prices

The third variable of importance in determining production levels and mix in the agricultural sector of West Germany is the price structure of agricultural products. Under the Common Agricultural Policy grain prices in Germany will fall about 10%. Production theory tells us that the normal response of a farmer faced with a decrease in the price of the output from one of his enterprises, provided all other things remain constant, is to shift resources out of that enterprise and into their formerly next-best alternatives in other farm enterprises. Thus, the output level from the enterprise in which the price fell will decrease and the output from the alternative enterprises will increase. Under the CAP, prices of all grains, prices for certain other crops which compete for surface with grains, and prices of the products of certain grain-using livestock enterprises will change simultaneously.

When we look at historical price behavior of the various agricultural products, we find that the absolute as well as the relative price levels of grains have remained virtually constant since 1958. With the structural and technological considerations which have been discussed above, (and in the first five chapters of the text), it appears that a good case for the threshold argument with respect to price changes may be quite readily substantiated. That is, over a reasonably large range of price changes, farm organization will not be changed due to fixity of resources in certain enterprises, inflexibility in crop rotation, and difficulty of adapting specialized technology to the fixed plant in order to adjust the enterprise mix. Thus, we must look beyond the price structure of groups of commodities alone, internally, and *vis à vis* each other in order to explain the level and mix of agricultural production.

Our attempts to formulate statistical models to estimate supply response elasticities for grains with respect to price all showed statistically non-significant results. The main reason for this can be traced to the extreme constancy of the price structure for grains during the base period. The only

other research in this area for Germany is a study by Willms.[1] Willms postulated a great number of elasticity equations some of which showed significant results. His estimate of the elasticity of wheat surface with respect to real price ranges between .59 and .74 with a large grouping in the .65 to .69 range. The elasticity of wheat surface with respect to nominal price estimates range between .31 and .38. Willms reported only real price elasticities for rye ranging between .9 and 1.0. Barley price elasticities were reported at .18 for nominal price and .34 for real price. Finally, price elasticities for oats were estimated at .19 for nominal price and .08 for real price with the decline in the number of horses entered as a variable in both equations. No cross price elasticities for any of the grains were signifi - cantly different from zero in the estimating equations. While these elasticities were one of many variables considered in developing our projections, we tended to view these estimates as being on the high side.

The price decrease for grains is not uniform across the country because the new policy uses a different mechanism to set grain prices at the various market points than was formerly in effect. Our analysis indicates, however, that the relative profitabilities of the various grain enterprises after the price changes occurring under the CAP will remain in their former relative positions. The only discernible change was that barley will become somewhat more competitive with wheat on a gross hectare return basis. Relative to the grains, high labor costs and requirements work to the disadvantage of potatoes and other fodder crops.

With respect to livestock prices, poultry and egg prices will fall due to increases in the efficiency of commercial production of these products. Hog prices are expected to fall but the hog-barley price ratio is expected to improve between 1964 and 1970 and then decrease between 1970 and 1975 approximately offsetting increases in feeding efficiency. Milk prices will remain about the same to slightly higher than under national policy while beef and veal prices will increase. The net effect of the price changes in the feed livestock sector will be to enhance the trends already in evidence due to technology and slowly changing farm structure. Farm structure will continue to limit enterprise shifts in response to price changes. With fixed building capacity, limited credit availability and a rather rigid crop rotation; small farms do not have the flexibility to adjust in response to price changes. Therefore, the direct response to small price changes occurring under the Common Agricultural Policy will be very slight with respect either to production levels or production mix in West Germany in the next decade.

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[1] Enno F. Willms, *Versuch einer Quantifizierung von Getreideangebotsfunktionen in der Europäischen Wirtschaftsgemeinschaft*, Kiel, 1966.

The price changes along with other factors will have some indirect impact on long-run production adjustment. With increasing incomes in the general economy and lower incomes on the farm due to the lower prices and higher costs, the opportunity costs associated with farm labor moving to urban jobs is reduced while the opportunity in industry becomes greater. An increased rate of movement off farms will set the stage for those farmers remaining in agriculture to improve their structural situation and in turn, adopt more of the available technology. This will have an impact on the enterprise mix--primarily a shift toward more grain and more specialization in the livestock enterprises. Thus, the income effect of the lower price structure under the CAP, coupled with higher costs and higher non-farm incomes in the long-run view, has some relevance for U. S. export markets, particularly for grain.

Results of Production Analysis

We turn now to a more detailed product-by-product analysis of our results. Table 82 shows estimated percentage changes in total production of the various agriculture products of interest in the study for each of the five-year periods between 1960 and 1975. This total percentage change for each product in each five-year period is broken into two parts -- the percent change in total production associated with change in output per production unit and the percent change in production associated with change in production units--number of hectares, cows, etc.[2] For example, in the period 1965-1970, we project a 21.9% increase in total grain production. Of this increase, 21.6% is caused by increases in yields per hectare and .3% is caused by increases in number of hectares planted to grains. Total grain surface will tend to increase due to differential impacts of technology of grain versus other crops as well as in the grain conversion livestock sector which favors grain feeding. This latter phenomenon manifests itself primarily in the question of grains versus potatoes in pig production and the industrialization of broiler and egg production. Another causal factor tending to increase total grain surface is an expected increase in the number of grain converting livestock both absolutely and relative to other livestock.

Factors tending to limit the increase in grain hectares include a rather rigid crop rotation to preserve soil quality and maintain yields. Whether

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[2]For a discussion of the theoretical basis for this procedure see David H. Boyne, *Changes in the Real Wealth Position of Farm Operators 1940-1960*, Technical Bulletin Number 294, (Michigan State University, Agricultural Experiment Station, 1964) pp. 31-33 and 70-71. Essentially the procedure is based on the Taylor series expansion of a function. If Grain Output = Hectares planted times yield per hectare ($O = HY$) then change in output between two time periods can be allocated to H and Y as $O = H\Delta Y + \Delta H\Delta Y + Y\Delta H$. So $H\Delta Y + \frac{1}{2}(\Delta H\Delta Y)$ is an estimate of the change in grain output (ΔO) associated with change in yield and $Y\Delta H + \frac{1}{2}(\Delta H\Delta Y)$ is an estimate of the ΔO associated with change in hectares planted. Dividing through by base year output converts to percentages as used in Table 82.

Table 82. Percent Change in Production of Agricultural Products in West Germany by Five-Year Periods 1960 - 1975 and the Extent of Influence by Various Causal Factors

Product	Measure of		1960 - 1965			1965 - 1970			1970 - 1975		
	Production Unit	Output per Production Unit	% Δ in Prodn.	% Δ in Prodn. Associated with Change in Prodn. Unit	% Δ in Prodn. Associated with Change in Output/ Prodn. Unit	% Δ in Prodn.	% Δ in Prodn. Associated with Change in Prodn. Unit	% Δ in Prodn. Associated with Change in Output/ Prodn. Unit	% Δ in Prodn.	% Δ in Prodn. Associated with Change in Prodn. Unit	% Δ in Prodn. Associated with Change in Output/ Prodn. Unit
All Grains	Hectares	Yield/Ha.	-11.1	.5	-11.6	21.9	.3	21.6	8.1	.8	7.3
Wheat	Hectares	Yield/Ha.	-12.4	2.1	-14.5	26.9	6.7	20.2	11.2	4.2	7.0
Rye	Hectares	Yield/Ha.	-25.6	-13.4	-12.2	-2.9	-24.0	21.1	-12.2	-18.1	5.9
Winter Barley	Hectares	Yield/Ha.	25.2	27.7	-2.5	56.1	44.1	12.0	32.0	26.2	5.8
Summer Barley	Hectares	Yield/Ha.	-4.3	17.5	-21.8	54.1	20.6	33.5	20.3	13.8	6.5
Oats	Hectares	Yield/Ha.	-5.7	-2.7	-3.0	-1.0	-11.0	10.0	-4.0	-11.6	7.6
Mixed Grain	Hectares	Yield/Ha.	-11.0	-3.4	-7.6	3.6	-8.5	12.1	-10.1	-16.0	5.9
Potatoes	Hectares	Yield/Ha.	-26.3	-24.5	-1.8	2.5	-16.8	19.3	-13.9	-20.3	6.4
Sugar Beets	Hectares	Yield/Ha.	-11.2	.2	-11.4	21.0	7.2	13.8	8.9	4.1	4.8
Milk	Cow Numbers	Milk/cow	8.4	.9	7.5	8.8	1.7	7.1	12.9	2.4	10.5
Calves	Cow Numbers	Calving rate	-.7	.9	-1.6	6.0	1.7	4.3	2.9	2.3	.6
Beef Slaughterings	Total Slaug.	Beef Portion	1.5	-10.7	12.2	22.0	19.6	2.4	7.9	2.6	5.3
Veal Slaughterings	Total Slaug.	Veal Portion	-28.0	-9.1	-18.9	13.7	18.9	-5.2	-10.2	2.4	-12.6
Beef	Beef Slaug.	Slaughter Wt.	5.8	1.5	4.3	25.2	22.3	2.9	11.6	7.9	3.7
Veal	Veal Slaug.	Slaughter Wt.	-4.9	-32.4	27.5	23.0	14.3	8.7	2.8	-11.4	14.2
Pork	Pork Slaug.	Slaughter Wt.	31.6	30.7	0.0	22.9	29.7	-6.8	16.5	19.2	-2.7
Eggs	Hens	Eggs/Hen	51.1	28.8	22.3	30.5	13.5	17.0	13.6	2.0	11.6
Feed Grain (Poultry)	Poultry Meat	Feed Efficiency	N.A.	N.A.	N.A.	82.7	103.0	-20.3	38.4	51.1	-12.7
Feed Grain (Eggs)	Eggs	Feed Efficiency	N.A.	N.A.	N.A.	16.3	28.8	-12.5	6.8	13.3	-6.5
Total Pig Feed	Pork	Feed Efficiency	26.4	28.0	-1.6	12.8	16.8	-4.0	12.7	16.3	-3.6
Feed Grain (Pork)	Total Feed	Grain Portion of Total	15.7	25.1	-9.4	22.0	13.3	8.7	8.4	12.3	-3.9

N.A. - Not Available

such a rigid crop rotation need be adhered to is certainly questionable but German farmers and agricultural professionals, by and large, believe it is necessary. Finally, the increase in demand for beef causes a greater demand for forage since more calves are being fed for a longer time period to increase beef production. The net effect of the various opposing forces is such that a very slight increase in total grain hectares is expected to 1975.

The main factor influencing the increase in grain production is the rather rapid increase in yields. This will be brought about by increased use of fertilizer and better cultural practices and is largely independent of small price changes.

The data of Table 82 needs to be interpreted with care. The two base years, 1960 and 1965, were both unusual. On the one hand, 1960 was a relatively good agricultural year and grain production, in particular, was above trend. On the other hand, 1965 was a rather poor agricultural year with crop production below trend. Therefore, in the data, we find changes in crop production biased downward in the 1960-65 period and biased upward between 1965 and 1970. Thus, for comparison of changes in production over the period, the data is less than optimal. The main usefulness of the table is in pointing out the relative magnitudes of influence of the various causal factors listed. With these data limitations in mind, we shall proceed to a summary of results by commodity.

Summary by Commodity

While change in the number of hectares devoted to grain accounts for only .3 of the 21.9 percent increase in grain production, we find that this net result is based on widely ranging degrees of influence by hectares on production of individual grains. Large decreases in the number of hectares devoted to rye, oats, and mixed grain are slightly more than offset by increases in hectares of summer barley, winter barley, and wheat; thus accounting for the slight effect of changes in hectares on total increase in grain production. All grain yields are increasing although at slightly different rates. The increase in the total hectares of wheat can be explained by a slight differential increase in yield favoring wheat and a price advantage relative to rye and oats. Increases in barley hectares are accounted for by again a differential increase in yield favoring barley over other grains except wheat, increased demand for grain conversion livestock products, increased use of barley as a feed grain, and increased beer consumption which in combination have pushed the price of barley high relative to prices of other grains.

The decrease in oats hectares until about 1961 was highly correlated with the decline in the number of horses. After 1961, farmers realized that oats, a "healthy" crop in the rotation, could be used to help maintain soil fertility in the face of a larger portion of grains in the drop rotation

plan. Rye hectares decreased because of a price, yield, and nutritional value disadvantage relative to wheat. The decrease in mixed grain surface can be accounted for primarily by a lower yield increase and less adaptability to modern feeding practices relative to the other grains.

The principal factor in the increase in milk production is substantially increasing milk yield per cow since cow numbers remain relatively constant. Milk yield per cow increases rather rapidly due to an increase in feed grain, and concentrates fed, a decrease in the number of cows used for draft purposes, and to a lesser extent a replacement of the lower yielding Simmentaler breed in Southern Germany by the higher yielding Holstein Friesen. The increase in cow numbers is limited by increasing labor costs for dairy herdsmen, off-farm job opportunities and higher wages for both hired and operator labor, a relatively higher demand for leisure time particularly by part-time farmers, the limited availability of grassland and fodder, the relative profitability of pork production, and the small size of farm which in most cases does not allow innovation of labor-saving technology. Factors tending to maintain the cow herd without a decrease include a stable price for milk under the Common Agricultural Policy and increasing prices for beef and veal.

The increase in the number of calves is more than proportionate to the increase in the number of cows because of a more favorable calving rate. This is accomplished by better breeding herd management and a lower death loss.

Beef slaughterings increase due both to an increase in the number of calves and a greater number of these calves being fed out for beef rather than slaughtered as veal. Conversely, veal slaughterings are influenced by an increase in total slaughterings but decrease in the latter part of the projection period due to an overwhelming decrease in the veal portion of total slaughter. Beef production increases both due to increases in the number of beef slaughterings and an increase in the slaughter weight as a result of increasing demand and rising beef prices. Veal production also increases due to large increases in slaughter weight partially offset by a decrease in number of veal slaughterings.

Pork production increases during the projection period due to an increase in pork slaughterings slightly tempered by a decrease in slaughter weight. Slaughter weights decline both due to a slight shift in consumer taste for less fat and due to the economics of shifting from potato to grain feeding. Pork slaughterings increase due to specialization and commercialization of the pig feeding enterprise. Further, on many farms an increase in the size of the pig enterprise is a means of using labor freed by technological innovation.

Poultry and egg production is rapidly becoming centered in large scale industrial units which take advantage of the latest technology in environ-

mental control, labor-saving devices and feeding methods. The efficiencies of size gained through commercialization of production will virtually eliminate the farm flock by the end of the projection period. Demand for both poultry and eggs is greater than domestic supply and is increasing rapidly. The increase in egg production is due almost equally to increases in the number of eggs per hen and the number of hens. For the latter part of the projection period, however, the increase in the number of hens levels out at a more rapid rate than the increase in the egg yield per hen.

Feed grain utilization for production of poultry, eggs and pork increases throughout the projection period. The main factor in this increase, of course, is the increase in number of livestock units on feed. Only slightly offsetting this increase factor is an increase in feed efficiency for all grain converting livestock. Also we expect concentrates to supplement grain and to become a substantial part of the livestock feed mix by the end of the projection period. The increases in feed efficiency are prompted by the industrialization of the poultry and egg industries and by better housing and management in the pork industry.

Projection Results

Table 83 presents the summary of our grain and livestock product supply-demand balances for West Germany projected to 1970 and 1975. The demand projections were completed by V. Sorenson, Michigan State University. More detailed analysis of the basis for the supply projections are found in this study. The footnote for each item in the table refers to the projection tables in the study.

Total grain demand is projected to increase from 20,293 thousand tons in 1965 to 23,265 thousand tons in 1970, and 25,311 thousand tons in 1975. Domestic grain production is projected to increase from 13,790 thousand tons in 1965 to 16,799 thousand tons in 1970 and 18,152 thousand tons in 1975. This means that the total grain deficit which must be filled through import increases from 6,503 thousand tons in 1965 to 6,466 thousand tons in 1970 and 7,159 thousand tons in 1975. The mix of this grain import requirement will shift more heavily toward feed grain during the next decade. With both a declining demand for food grain during the period and an increase in production, particularly of quality wheat, import requirements will shift from food toward feed grains.

Output in the cattle sector will increase substantially. Milk production is expected to increase from 21,344 thousand tons in 1965 to 23,214 thousand tons in 1970 and 26,206 thousand tons in 1975. Milk demand will increase from 19,189 thousand tons in 1965 to 22,139 thousand tons in 1970 and 23,632 thousand tons in 1975. Thus, the milk surplus will stand at 1,075 thousand tons in 1970 and 2,574 thousand tons in 1975, if no change in the milk policy is forthcoming during the period. Beef and veal production will increase but will not be able to meet the rising demand. Demand will in-

Table 83. Supply-Demand Balance of Grain and Livestock Products in West Germany Projected to 1970 and 1975 in 1000 Metric Tons

	1965	1970	1975
Grain			
Demand by Source			
Cattle--Dairy, Veal, Beef Production[1]	2,272	2,896	3,695
Pork Production 2	6,201	7,566	8,202
Poultry Production[3]	336	614	850
Egg Production 3	2,516	2,927	3,125
Other--Horses, Sheep, Goats	165	100	100
Total Feed Demand	11,490	14,103	15,972
Grain for Brewing[4]	1,866	2,178	2,469
Other Industrial Grain[4]	448	535	620
Total Industrial Demand	2,314	2,713	3,089
Direct Human Demand 5	5,339	5,207	4,963
Seed (150 kg/ha)	736	738	742
Waste and Loss (3% of Production)	414	504	545
Total Grain Demand	20,293	23,265	25,311
Supply by Type			
Wheat 6/	4,348	5,509	6,128
Rye 6/	2,825	2,782	2,444
Food Grain 6/	7,173	8,291	8,572
Winter Barley[6]	1,193	1,866	2,464
Summer Barley[6]	2,171	3,359	4,042
Oats 6/	2,052	2,040	1,957
Mixed Grain[6]	1,201	1,243	1,117
Feed Grain 6	6,617	8,508	9,580
Total Grain Supply	13,790	16,799	18,152
Grain Deficit	6,503	6,466	7,159
Percent Self-Sufficiency	68%	72%	72%
Livestock Products			
Milk Supply 7/	21,344	23,214	26,206
Milk Demand 5/	19,189	22,139	23,632
Milk Surplus	2,155	1,075	2,574
Percent Self-Sufficiency	111%	105%	111%
Beef and Veal Demand[5]	1,220	1,373	1,630
Beef Supply 8	877	1,098	1,225
Veal Supply 8	92	113	116
Total Supply	969	1,211	1,341
Beef & Veal Deficit	251	162	289
Percent Self-Sufficiency	79%	88%	82%
Pork Supply[9, 12]	1,829	2,254	2,626
Pork Demand[5]	2,000	2,273	2,545
Pork Deficit or Surplus	171	19	81
Percent Self-Sufficiency	92%	100%	103%

Table 83 continued

	1965	1970	1975
Livestock Products cont.			
Poultry Demand[5][10]	350	511	629
Poultry Supply[10]	146	307	472
Poultry Deficit	204	204	157
Percent Self-Sufficiency	42%	60%	75%
Egg Demand[5][11]	785	997	1,120
Egg Supply[11]	628	887	1,008
Egg Deficit	157	110	112
Percent Self-Sufficiency	80%	88%	90%

[1]Table 80, p. 188. [2]Table 74, p.164. [3]Table 68, p.143. [4]Table 81, p.190. [5]Projection by Vernon Sorenson, Michigan State University. [6]Table 61, p.132. [7]Table 77, p.176. [8]Table 79, p.186. [9]Table 73, p.157. [10]Table 63, p.138. [11]Table 65, p.140. [12]12,000 tons added to pork supply in each time period to account for production in West Berlin.

crease from 1,220 thousand tons in 1965 to 1,373 thousand tons in 1970 and 1,630 thousand tons in 1975, related to production increases from 969 thousand tons in 1965 to 1,211 thousand tons and 1,341 thousand tons in 1970 and 1975 respectively. Thus, the beef and veal deficit will stand at 162 thousand tons in 1970 and 289 thousand tons in 1975.

We project an increase in pork supply from 1,829 thousand tons in 1965 to 2,254 thousand tons in 1970 and 2,626 thousand tons in 1975. This production increase is somewhat faster than the increase in demand causing the pork balance to go from a deficit to a slight surplus situation by 1975. Pork demand in 1965 was 2,000 thousand tons and increased to 2,273 thousand tons in 1970 and 2,545 thousand tons in 1975. Thus, the pork deficit closes from 171 thousand tons in 1965 to 19 thousand tons in 1970, and becomes a surplus of 81 thousand tons by 1975.

With the shift to large scale commercial enterprises, we expect an increase of poultry production from 146 thousand tons in 1965 to 307 thousand tons and 472 thousand tons in 1970 and 1975 respectively. Poultry demand will increase at a somewhat slower rate but is at a much higher level, beginning in 1965 at 350 thousand tons and increasing to 511 thousand tons and 629 thousand tons in 1970 and 1975 respectively. The poultry deficit will remain constant at 204 thousand tons between 1965 and 1970 and then decrease to 157 thousand tons in 1975.

Egg production will also be centered in large scale commercial establishments by 1975. Egg supplies will increase from 628 thousand tons in 1965 to 887 thousand tons in 1970 and 1,008 thousand tons in 1975, while egg de-

mand will increase from 785 thousand tons in 1965 to 997 thousand tons and 1,120 thousand tons in 1970 and 1975 respectively. The egg deficit will decrease from 157 thousand tons in 1965 to 110 thousand tons in 1970 and then remain at approximately the same absolute level, standing at 112 thousand tons in 1975.

The supply-demand balance projections are developed under certain assumptions as to levels and behavior of various exogenous variables during the next decade. Changes in any of these variables contrary to our assumptions can and most certainly will affect both the mix and the level of agricultural production. West Germany is only one of six countries involved in the European Economic Community and operating under the influence of the Common Agricultural Policy. As a member of the EEC what happens in the other countries with regard to changes in the level of the general economy, agricultural production, agricultural product demand, and national agricultural policies will have a much greater impact on the West German situation than formerly.

In summary, we show a deficit situation in grains, beef and veal, poultry meat and eggs and a surplus situation in milk and pork. The main stress point created by the West German situation on the Common Agricultural Policy will be in the milk, beef, and veal price relationships. Thus, we expect some changes in the CAP policy during the next decade in this area, unless West Germany can find a ready market within the EEC for their milk surpluses and a supply of beef and veal. This appears unlikely, and in fact, the situation may be aggravated by similar patterns in other EEC countries.

The pork surplus will probably create no particular problem, unless it continues to build after 1975. It will, however, cut into the export markets of those countries which formerly supplied Germany with pork to fill the deficit, primarily the Netherlands and Denmark.

The poultry meat and egg deficit in West Germany can quite readily be filled by imports from the Netherlands, and due to the heavy concentration of the population in the rural area next to the Dutch border probably at a lower cost than West Germany could fill it through domestic production.

The U.S. can expect to increase exports of feed grains to West Germany, but food grain and poultry exports will decrease. Due to differences in type of product demanded, transportation costs, institutional restrictions, and the internal U.S. supply-demand balances situation, the U.S. should not expect to fill any part of the beef and veal deficit in West Germany.

BIBLIOGRAPHY

References Cited

Abel, Wilhelm, *Agrarpolitik*. Göttingen, 1958.

Agra-Europe. Various Issues, London, Paris, Bonn, Rome.

Bammel, Otto. "Regionale Wettbewerbsbedingungen der Schweinehaltung in der Bundesrepublik Deutschland," *Agrarwirtschaft*, Hanover, Sonderheft 19, 1965.

Bostwick, Don. "Yield Probabilities As A Markov Process," *Agricultural Economics Research*, USDA, Vol. 14, Nr. 2, April, 1962.

Bothe, H. G. "Grundlagen der Agrarstruktur in der BRD," *Berichte über Landwirtschaft*. Hamburg and Berlin, Band 43, 1965.

Boyne, David H. "Changes in the Real Wealth Position of Farm Operators 1940-1960," Technical Bulletin No. 294, Michigan State University. Agricultural Experiment Station, 1964.

Brandkamp, F. "Struktur und Preisniveau des Landwirtschaftlichen Pachtwesens," *Berichte über Landwirtschaft* Heft 1. Hamburg and Berlin, 1965.

Bundesministerium für Ernährung, Landwirtschaft, und Forsten. *Bericht der Bundesregierung über die Lage der Landwirtschaft* (Grüner Bericht) Various issues 1956-1966. (Grüner Plan) Various issues 1956-1966.

_____. *Die Flurbereinigung in den Ländern der BRD*. Jahresbericht 1962, Bonn, 1962.

_____. *Die Verbesserung der Agrarstruktur in der BRD*. Bonn, 1964 and 1965.

_____. *Jahresberichte über die Düngemittelversorgung im Bundesgebiet*, Statistisches Bundesamt, Fachserie D, Industry und Handwerk, Reihe 6. Various issues, Wiesbaden.

_____. *Landwirtschaftliche Buchführungsergebnisse*. Various years, Bonn.

_____. *Statistisches Jahrbuch über Ernährung Landwirtschaft, und Forsten*, Various Issues 1955-1965, Hamburg and Berlin.

_____. *Statistische Uterlagen zür Futterwirtschaft im Bundesgebiet*. Various years, Bonn.

Deenen, B. van "Der Statistische und Soziologische Befund der landwirtschaftlichen Arbeitsverfassung und Arbeitskrafte nach 1945," *Wandl. der Landw. Arbeitsverf.* Berlin, 1961.

Deenen, B. van, Mrohs, E., Tiede, S., Vilmar, E. "Materialien zür Arbeitswirtschaft," *Forschungsstelle für Agrarpolitik und Agrarsoziologie* Heft 153, 1964.

"Die Zugkräfte der Landwirtschaft im Bundesgebiet." *Agrarwirtschaft*, 1965.

Dovring, F. "Forecasting the Move Away From the Land." *OECD Observer*. OECD, Paris, 22 January, 1964.

_____. *Problems of Manpower in Agriculture*. OECD, Paris, 1965.

Epp, Donald J. "The Impact of Agricultural Policies on Regional Grain and Livestock Prices in the EEC." unpublished Ph.D. dissertation, Michigan State University, 1967.

Fritzen, A. *Pacht*. Stuttgart, 1962.

Harder, Peter C. von. "Wirtschaftliche Voraussetzungen und Entwicklungslinien der Mechanisierung in der Landwirtschaft der BRD seit 1949." *Berichte über Landtechnik* Heft 85, Frankfurt, 1965.

IFO - Institute für Wirtschaftsforschung E.V. "Long-term Development of Demand and Supply for Agricultural Products in the Federal Republic of Germany," München, 1966.

Köhne, Manfred. "Die Landwirtschaftliche Einheitsbewertung." Unpublished paper. Göttingen, 1965.

_____. *Projektion von Verbrauch, Produktion, und Netteeinfurbedarf wichtiger Agrarprodukte für die BRD in 1970 und 1975 - ein Vergleich von drei Studien.* English translation - *Projection of Consumption, Production, and Net Import Demand of Important Agricultural Products for the Federal Republic of Germany in 1970 and 1975 - a Comparison of Three Studies.* Unpublished paper prepared for use by Michigan State University project leaders. Göttingen, 1966.

Kratzsch, K. "Verminderung des Arbeitskräftebestandes in der Westdeutschen Landwirtschaft," *Wirtwiss. Mitt.* Köln, 16.1963:1.

Krenz, Ronald D. "Projection of Farm Numbers for North Dakota With Markov Chains," *Agricultural Economics Research,* USDA, Vol. 16, Nr. 3, July, 1964.

Kuratorium für Technik in der Landwirtschaft. *Kalkulationsunterlagen,* Band 1 und 2.

Liesegang, F. "Der Naturliche Standort für den Anbau von Körner - und Silomais in Westdeutschland." Doctorate dissertation, München, 1965.

Lipinsky, E. E. "Agrarstrukturverbesserung und Bodenmobilität," *Agrarwirtschaft,* Jg. 12, Heft 10, Hanover, 1963, p. 321ff.

_____. "Die Bedentung der Landpacht in der BRD im Spiegel der Statistik," *Berichte über Landwirtschaft,* Heft 2. Hamburg und Berlin 1965.

Ministry of Agriculture and Fisheries, Netherlands. *Selected Agri-Figures of the EEC.* August, 1967.

Müller, Gerriet. *Die Entwicklung der Sektoralen und Regionalen Struktur der Erzeugung von Rindviehprodukten in der Bundesrepublik Deutschland.* Unpublished paper prepared for use by Michigan State University project leaders. Göttingen, 1966.

Müller, H. J. "Fremdkapital und Guthaben in landwirtschaftlichen Betrieben zum Stichtag 1-7-1964," *Berichte über Landwirtschaft.* Hamburg and Berlin, 1965.

Organization for Economic Cooperation and Development. *Low Incomes in Agriculture,* Agricultural Policy Report. Paris, 1964.

Plate, R. "Marktwirtschaftliche Aspekte der Rindviehhaltung in der BRD," *Züchtungskunde,* Heft 9/10, 1965.

Rämer, H. *Die Westdeutsche Landwirtschaft,* München, 1964.

Reisch, E. "Betriebswirtschaftliche Aspekte der Rindviehhaltung in der BRD," *Züchtungskunde,* Heft 9/10, 1965.

Röhm, H. "Die Landpacht im Südwestdeutschen Raum," *Berichte über Landwirtschaft,* Band 43, Hamburg und Berlin, 1965.

Rühmann, H. "Die Erschwerungmotorischer Arbeiten am Hang," *Bayerisches Landwirtschaftliches Jahrbuch,* Jg. 40, Sonderheft 4. München, Basel, Wien, 1963.

_____. "Landmaschineneinsatz im Hanggelände," *Agrarjahr 1965.* Würtzburg, 1965.

Ruhr Stickstoff Aktiengesellschaft. *Agrarstatistische Zusammenstellungen des Bundesgebietes,* Bochum.

Sabbarth, S. *Gegenwärtige und Zukünftige Richtbetriebsgrössen und - Organizationen landwirtschaftlichen Familienbetriebe in Hessen.* AVA in Hessen, Sonderheft 17, Wiesbaden, 1965.

Sandfort, A. "Steuerfragen der Geflügelhaltung," *Mitt. der DLG, Nr. 44,* 1965.

Schiever-Ahrens, W. *Über die Wettbewerbsfähigkeit des Zuckerrübenbaus in der Bundesrepublik Deutschland nach der Einführung einer gemeinsamen Marktordnung für Zucker.* Unpublished paper prepared for use by Michigan State University project leaders. Göttingen, 1966.

Schmidt, W. "Wandlungen im Arbeitskräftebestand der landwirtschaftlichen Betriebe von 1949 bis 1960," *Wirtschaft und Statistik,* WF 13, 1961:5.

Statistisches Bundesamt. *Agrarstatistische Arbeitsunterlagen.* Wiesbaden, Various years 1955-1965.

_____. Wiesbaden. "Besitzverhältnisse in den Land-und Forstwirtschaftliche Betrieben," *Landwirtschaft Zählung, 1960,* Heft 3. Stuttgart und Mainz, 1964.

_____. *Ergebnisse der Landwirtschaftszählung 1960* Vorbericht 12, 15, 17, 18 Wiesbaden.

_____. Fachserie B, Land und Forstwirtschaft, Reihel, *Bodennutzung und Ernte.* Wiesbaden, Various years 1955-1965.

_____. *Statistisches Jahrbuch für die Bundesrepublik Deutschland.* Wiesbaden, Various years.

_____. *Wirtschaft und Statistik.* Wiesbaden, Various years.

Statistische Monatshefte Schleswig-Holstein. *Die Gebäude in der Landwirtschaft Schleswig-Holstein,* 17 Jg., Heft 11, 1965.

Thimm, H. U. "Regionale Differenzierung der fachlichen Vorbildung landwirtschaftlicher Betriebsleiter," *Agrarwirtschaft.* Hanover, 1963.

U. S. Department of Agriculture, Economic Research Service. *Foreign Agricultural Trade of the United States.* November, 1966.

Vogel, G. "Abgrenzung und Umfang von tierbeständen im Rähmen des landwirtschaftlichen Vermögens," *Betriebswirtschaft Mitt. Nr. 133,* Kiel, 1965.

Wagner, H. "Die Verbreitung Resonanz u. Wirksamkeit von Informations - u. Beratungsmitteln bei den Landwirten Nordrhein-Westfalens." Unpublished doctorate dissertation. Bonn, 1964.

Weinschenk, G., Meinhold, K. *Vorschläge zür Künftigen Agrarpolitik in der BRD.* (Gutachten erstellt im Auftrage de Wirtschaftsrats der CDU.) Stuttgart-Höhenheim, 1965.

Willms, Enno F. *Versuch einer Quantifizierung von Getreideangebotsfunktion in der Europäischen Wirtschaftsgemeinschaft.* Kiel, 1966.

Other References

Beckmann, R. "Intensive tierhaltung erfordert Mischfutter," *Kraftfutter,* Hanover, January, 1966.

Bundesministerium für Ernährung, Landwirtschaft, und Forsten. *Bericht über Die Auswirkungen der EWG - Marktorganisationen auf dem Agrargebiet.* Bonn, 9 November, 1965.

DeLeeuw, A. *Einige Gesichtspunkte der Verbesserung der Agrarstruktur in der Bundesrepublik Deutschland,* Die Agrastruktur in der EWG - Interne Informationen 25, EWG, Brüssel, 1963.

DLG *Rindfleischproduktion Zwischen Nachfragesteigerung und Kälbermangel* Vorträge der Herbsttagung, Nürnberg, 30 8. bis 1. 9. 1965 Archiv der DLG Band 36, Frankfurt (Main), 1965.

Europäische Wirtschaftsgemeinschaft. *Die grossen Agrarregionen in der EWG.* Reihe Landwirtschaft 1, Brüssel, 1960.

Europäische Wirtschaftsgemeinschaft. *Der Mineraldünger verbrauch in den Ländern der EWG*. Reihe Landwirtschaft 8, Brüssel, 1962.

_____. *Der gemeinsame Markt für landwirtschaftliche Erzeugnisse - Vorausschau "1970"*. Reihe Landwirtschaft 10, Brüssel, 1963.

_____. *Economic Development Prospects in the EEC from 1960 to 1970*, Brüssel, 1962.

_____. *The Effect on Farm Incomes in Federal Germany of Lower Prices Within the Framework of the EEC's Common Agricultural Policy*. Agricultural Series 11, Brüssel, 1962.

_____. *Food Aid from the EEC to Developing Countries*. Agricultural Series 14, Brüssel, 1965.

Europäische Wirtschaftsgemeinschaft. *Die Erwerbstätigkeit in der Landwirtschaft in den Mitgliedstaaten der EWG*. Tiel I, Die Struktur der Erwerbstätigkeit, Reihe Sozialpolitik 7, Brüssel, 1964.

_____. Teil II, *Entwicklung und Aussichten*, Reihe Sozialpolitik 8, Brüssel, 1964.

FAO *Animal Feedstuffs: Regulations Governing Their Manufacture and Sale in European Countries*, Rome, 1963.

Friedman, K., Farnsworth, H. *The West German Grain Economy and the Common Market: Policies, Prices, and Production, 1925-1975*. Food Research Institute, Stanford University, 1966.

Heidhues, Theodor. "Entwicklungsmöglichkeiten landwirtschaftlicher Betriebe unter verschiedenen Preisannahmen," *Berichte über Landwirtschaft* Sonderheft 181, Hamburg und Berlin, 1966.

_____. "A Recursive Programming Model of Farm Growth in Northern Germany," *Journal of Farm Economics*, Vol. 48, Nr. 3, Pt. 1, August, 1966.

Kraal, A. *Changes in the Location of Cereal-Growing Areas in the Grouping of Compound Feed Industries in the EEC*. (EEC) Paper Presented at the 5th European Convention of Animal Feed Industries, Knokke, 7-10 June 1966.

Klemm, H., Marlin P.v. *Die EWG - Marktordnungen für Agrarprodukte und die Entwicklungsländer* IFO, München, 1965.

Kolt, Walter. *Untersuchungen über landwirtschaftliche Betriebstypen in Hessen - 1964*. A.V.A., Wiesbaden, 1965.

Krohn, H. B. "Die Versorgung der Europäischen Wirtschaftsgemeinschaft mit Erzeugnissen der Rindviehhaltung," *Agrarwirtschaft*, Hanover, September, 1964.

Lösch, Rolf, *Die Kostenstruktur landwirtschaftlichen Betriebe in der Bundesrepublik Deutschland, Frankreich, und den Niederlanden*. IFO, München, 1965.

Neander, Eckhart. "Produktionsverfahren der Rindfleischerzeugung und ihre betriebswirtschaftliche Beurteilung," *Agrarwirtschaft* Sonderheft 17. Hanover, 1965.

OECD. *Agriculture and Economic Growth*, Paris, 1964.

Plate, R., Woermann, E., Grupe, D. "Landwirtschaft im Strukturwandel der Volkswirtschaft," *Agrarwirtschaft* Sonderheft 14, Hanover, 1962.

Reisch, E. "Betriebswirtschaftliche Entwicklungstendenzen in der BRD," *Lichtungskunde* Heft 9, 1965.

_____. "Voraussetzungen und Möglichkeiten der Schwerpunktbildung in der Tierischen Produktion," *Bayrischen Landwirtschaftlichen Jahrbuch* Sonderheft 2, München, 1964.

Roemer, T., Scheibe, A., Schmidt, J., Woermann, E. *Handbuch der Landwirtschaft*. Berlin und Hamburg, 1954.

Schmidt, Helmut. *Standorte der tierischen Vered lungsproduktion und Absatzmoglichkeiten für Mischfutter*, Paper presented at 5 Europäischer Kongress der Futermittelindustrien, Knokke, 7. bis 10. June, 1966.

Schulze, Harmut (Ed.) *Materialgrundlagen zur regionalen landwirtschaftlichen Produktion in den Ländern der Europäischen Wirtschaftsgemeinschaft.* IFO München, 1965.

Sinzinger, E. *Die Auswirkungen veränderter Preis - Kostin - Verhältnisse auf Organisation und Rentabilität landwirtschaftlicher Betriebe in bayerischen Lösslehmgebieten.* München, 1963.

Statistisches Bundesamt, Wiesbaden. "Bodennutzung in den land - und Forstwirtschaftlichen Betrieben," *Landwirtschaftzählung 1960* Heft 4 Stuttgart und Mainz, 1964.

_____. "Viehhaltung in den land - und forstwirtschaftlichen Betrieben" *Landwirtschaftzählung 1960* Heft 5. Stuttgart und Mainz, 1963.

_____. "Maschinenverwendung in den land - und Forstwirtschaftlichen Betrieben," *Landwirtschaftzählung 1960* Heft 6. Stuttgart und Mainz, 1964.

_____. "Arbeitsverhältnisse in den land - und forstwirtschaftlichen Betrieben," *Landwirtschaftzählung 1960* Heft 7. Stuttgart und Mainz, 1966.

Steffen, G., *Produktions -- und Investitionsplanung in der tierischen Erzengung* Sonderdruck aus der Vortragsreihe der 19 Hochschultagung der Landwirtschaftlichen Fakultät der Universität Bonn, 5 und 6 Oktober 1965.

Urff, W.v., Baader, E., Schmidt, W. *Grundsätzliche Probleme bei der Errechnung des Betriebserfolges im Raumen eines Berichtes über die Einkommenslave landwirtschaftlicher Betriebe in den Mitgliedsländern der EWG*, Frankfurt, 1965.

U.S. Department of Agriculture, Economic Research Service. *Statistics on the European Economic Community*, Vol. 1, 1962, Vol. 2, 1963.

Weil, Gordon L. *A Handbook on the European Economic Community.* Frederick A. Praeger, New York, Washington, London (in cooperation with the European Community Information Service, Washington, D.C.) 1965.

Yates, P. Lamartine. *Food, Land and Manpower in Western Europe.* MacMillian and Co. Ltd., London, (St. Martins Press, New York), 1960.

APPENDIXES

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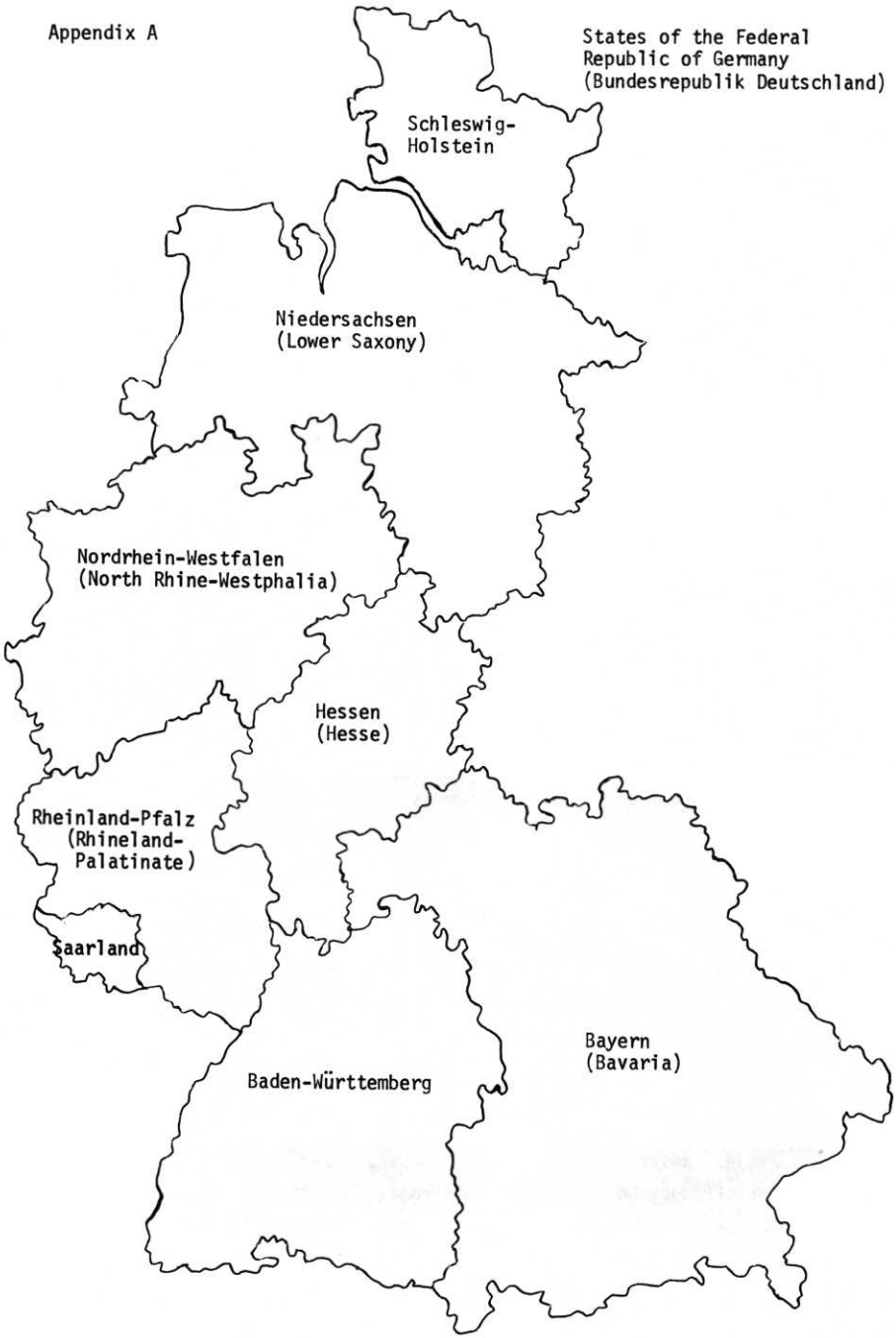
FOR THE APPENDIXES

Appendix A

States of the Federal Republic of Germany (Bundesrepublik Deutschland)



Appendix B

Conversion Tables and Abbreviations

Abbreviations

CAP - Common Agricultural Policy

DM - Deutsch Mark

EEC - European Economic Community

Ha - Hectare

Kg - Kilogram

OECD - Organization for Economic Cooperation and Development

tons - Metric Tons

For Quintals (100 Kg) per hectare to bushels per acre multiply by --

Wheat	- 1.4870
Corn, Rye, Sorghum, Flax	- 1.5932
Barley	- 1.8587
Oats 32 lb/bu.	- 2.7881
38 lb/bu.	- 2.3479
Hundredweights	- 2.2046

For Deutsch Marks per Quintal (100 Kg) to dollars per bushel divide by --

Wheat	- 14.697
Corn, Rye, Sorghum, Flax	- 15.747
Barley	- 18.372
Oats 32 lb/bu.	- 27.558
38 lb/bu.	- 23.206
Hundredweights	- 8.818

Grain Unit Conversion Table

Crop	Grain Unit
1 Kg. Grain	1.00 Kg.
1 Kg. Oilseed	2.00 Kg.
1 Kg. Oilcake	1.40 Kg.
1 Kg. Potatoes	.25 Kg.
1 Kg. Sugar Beets	.25 Kg.
1 Kg. Fodder Beets	.10 Kg.
1 Kg. Fluid Milk	.70 Kg.
1 Kg. Skimmed Milk	.30 Kg.
1 Kg. Fishmeal, meatmeal	1.60 Kg.

Source: *1965 Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten*, Table 189.

Metric System and Currency Unit Conversion Table

1 Deutsch Mark	= $.25
1 Dollar	= 4 Deutsch Marks
1 Acre	= .4047 Hectares
1 Gallon	= 3.785 Liters
1 Hectare	= 2.471 Acres
1 Hectoliter	= 100 Liters
1 Horsepower (metric)	= .986 Horsepower, U.S.
1 Kilogram	= 2.2046 Pounds
100 Kilograms	= 1 Quintal
1000 Kilograms	= 1 Metric Ton
1 Kilometer	= 1000 meters
1 Kilometer	= .6214 Miles
1 Kilometer (square)	= .3861 Square Miles
1 Kilometer (square)	= 100 Hectares
1 Liter	= 1.057 Liquid Quarts
1 Pound	= .4536 Kilograms
1 Meter	= 1.094 Yards
1 Square Meter	= 1.196 Square Yards
1 Mile	= 1.609 Kilometers
1 Square Mile	= 2.59 Square Kilometers
1 Quintal	= 100 Kilograms
1 Metric Ton	= 1000 Kilograms
1 Metric Ton	= 2204 Pounds
1 Ton, Long (2240 lbs.)	= 1016 Kilograms
1 Ton, Short (2000 lbs.)	= 907.2 Kilograms
1 Yard	= .9144 Meters

Livestock Unit Conversion Table

Animal	Livestock Unit
Horse, under 3 years	.70
Horse, 3 years and older	1.10
Calves, under 1 year	.30
Cattle, 1 to 2 years	.70
Breeding bulls	1.20
Draft oxen	1.20
Cows, heifers, feeder cattle	1.00
Sheep under 1 year	.05
Sheep, 1 year and older	.10
Goats	.08
Piglets	.02
Young pig	.06
Breeding pig	.30
Slaughter pig	.16
Chicken	.004

Source: *1965 Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten*, Table 171.

Appendix C

Method of Projection of Farm Numbers and Farm Hectares
By Farm Size Group by State in West Germany

The procedure used for these projections is an adaptation of the Markov chain technique as explained in some detail by Bostwick[1] and Krenz.[2] Essentially the Markov process assumes that a finite population can be divided into a specific number of subgroups or classes and that movement of the elements of the population from one class to another are predictable in a probability sense. Certainly the primary advantage of this technique is that it incorporates the assumption of interdependence of the outcomes within the subgroups or classes. The main disadvantage in projecting with this technique is that reliability tests have not yet been devised.

Ideally, the data used in the Markov chain technique to predict farm numbers by farm size group should include the movements of individual farm units among size groups over time. Since this type of data is unavailable, census data on number of farms in different size groups at different moments in time are utilized by making certain assumptions regarding the movement of farms between groups during the time periods covered. By converting movement flows in a base period to probabilities, it is possible to use the probability matrix thus formed as a predictive tool for making projections. Assumptions necessary for using census data include the following:[3] (1) Farms in all size groups will become larger if possible. This is certainly true of the farms in the size groups which are larger than the strictly part-time sizes. The government policy in Germany has been somewhat unfavorable to the expansion of farms in the over 100 hectare class but by grouping the 50-100 hectare and over 100 hectare groups together, the assumption becomes valid for the combined size group of 50 hectares and over. As will be seen for the part-time size group (under ten hectares) the technique is somewhat self-correcting even if the assumption is not entirely valid for these size groups. (2) The expansion of farm size is likely to occur gradually due to the limited amount of land and/or financing available for expanding any given farm. Thus, expanding farms are most likely to move through larger size group rather than jumping any size group on their way to becoming larger. (3) Decreases in farm sizes are not likely to occur. Because of the normal econom-

[1] Don Bostwick, "Yield Probabilities as a Markov Process," Agricultural Economics Research, USDA, Volume 14, No. 2, April 1962, pages 49-56.

[2] Ronald D. Krenz, "Projection of Farm Numbers for North Dakota with Markov Chains," Agricultural Economics Research, USDA, Volume 16, No. 3, July 1964, pages 77-83.

[3] *Ibid.*, page 78.

ics of size, voluntary decreases in farm size are much less likely than disappearance of the farm unit entirely through sale or rental to another farm unit. Again this assumption is not entirely valid in Germany in the case of the part-time farming size group. But again, the technique corrects for this situation in the net result by using an absorbing class into which farms move when they go out of business and a creating class from which farms come when they initially go into business. In the actual projection, the creating class was not necessary and was never used.

With these assumptions, the following rules can be established: (1) Farms in the largest size group remain there, (2) increases in farm numbers in any size group come from the next lower size group and, (3) decreases in farm numbers in any size group beyond those accounted for by rule 2 above are assumed to go out of business and are moved to the "out of business" absorbing group.

German statistics report farm numbers by farm size group for each of the eight states for the years 1955, 1960, and 1965. Statistics for intermediate years are also presented, but they are only interpolated estimates while the five year statistics are based on census results. To bring the German definition of the farm in line with EEC requirements, certain *Forstwirtschaftbetriebe*, or farms whose primary source of income is their forest products, had to be omitted from the statistics. The 1966 Green Report carried data conforming to the new definition for 1965 and revised figures for 1960. So we have data for 1955 under the old definition, for 1965 under the new, and for 1960 under both. By using the data for the two five-year periods, 1955-60 and 1960-65, a Markov probability matrix was constructed for the movement of farms between size groups based on the 1960-65 period and an adjustment matrix based on a comparison of the differential rates of change between the 1955-60 period and the 1960-65 period was also constructed. In light of the change in farm definition, the procedure calls for calculating the Markov probability matrix for the 1955-60 period using the 1960 numbers under the old farm definition and the 1960-65 matrix using the revised 1960 numbers.

Table C-1 presents the basic data needed to find the probability matrix used for the projection based on 1960-65 for the state of Niedersachsen. Census data is used to fill in the column labeled "total" with the number of farms in each size group in 1960 and the row labeled "total" with the corresponding data for 1965. The matrix cells are filled in accordance with our rules so that the row and column totals are satisfied starting in the lower right hand corner. The 6042 farms of 50 hectares and over in 1960 stay in the 50 hectare and over group in 1965. In addition 553 farms must be moved to the 50 hectare and over group from the 20-<50 hectare group to satisfy the 1965 total of 6595 farms in the 50 hectare and over group. This leaves

Table C-1. Flows of Farm Numbers Between Farm Size Groups in Niedersachsen 1960-1965

Size Group in Hectares 1960	out	Size Group in Hectares 1965						
		.5-<1	2-<5	5-<10	10-<20	20-<50	50-over	Total 1960
In	0	0	0	0	0	0	0	0
.5 - <2	10,145	55,245	0	0	0	0	0	65,390
2 - <5	7,236	0	38,401	0	0	0	0	45,637
5 - <10	7,125	0	0	33,814	668	0	0	41,607
10 - <20	0	0	0	0	49,697	4,002	0	53,699
20 - <50	0	0	0	0	0	34,364	553	34,917
50 - over	0	0	0	0	0	0	6,042	6,042
Total (1965)	24,506	55,245	38,401	33,814	50,365	38,366	6,595	247,292
Total farms 1965	222,786							
1960	247,292							

34,364 farms which were originally in the 20-<50 hectare group remaining there in 1965. But in 1965 there are 38,366 farms in that group so 4002 farms must be moved in from the 10-<20 hectare group to satisfy the 1965 total. In turn, this leaves only 49,697 farms in the 10-<20 hectare group when 50,365 are needed, so 668 farms must be moved from the 5-<10 hectare group. Now, remaining in the 5-<10 hectare group are 40,939 farms while only 33,814 farms are needed to satisfy the 1965 total. Thus, 7,125 farms are moved into the "out of business" column. The procedure continues until the total matrix is filled in and the totals satisfied for all size groups. In this case we find that the total number of farms decreased by 24,506 from 247,292 in 1960 to 222,786 in 1965 while the 20 hectare and over size groups increased and the less than 20 hectare size groups decreased.

Next the probability matrix is formed by calculating the proportional value of each cell in Table C-1 to the values in the column headed "total." That is, using the distribution of farms by size in 1960 as the base, calculate the proportion of each size group which stay in that size group, which move up to the next size group, and which go out of business. This matrix is presented as Table C-2.

A farm in the 5 -<10 hectare group in 1960 had a .1712 probability of going out of business, a .8127 probability of staying in the 5 -<10 hectare group, and a .0161 probability of moving to the 10 -<20 hectare group by 1965. The other probabilities can be read from table C-2 in a similar manner. This probability matrix can now be used to project the number of farms in each size group at the end of future 5 year periods. The implicit assumption made for the projection is that all factors affecting farm size will

Table C-2. Probability Matrix of Farm Movement Among Farm Size Groups Based on 1960-65 Period

Size Group in Hectares 1960	out	Size Group in Hectares 1965					
		.5-<2	2-<5	5-<10	10-<20	20-<50	50-over
In	0	0	0	0	0	0	0
.5-<2	.1551	.8449	0	0	0	0	0
2-<5	.1586	0	.8414	0	0	0	0
5-<10	.1712	0	0	.8127	.0161	0	0
10-<20	0	0	0	0	.9255	.0745	0
20-<50	0	0	0	0	0	.9842	.0158
50-over	0	0	0	0	0	0	1

change at a constant percentage rate during each of the five year intervals for which projections are made. That is, we assume a linear trend development in percentage terms of the number of farms in each farm size group based on the 1960-1965 development. Table C-3 presents the projection of farm numbers by farm size group for 1970 in Niedersachsen. The known data are the farm numbers distributed by size group in 1965, located in the column labeled "total" in Table C-3. By multiplying each 1965 farm size group total

Table C-3. Projection of Farm Numbers By Farm Size Group in 1970 Using 1960-65 As A Base

Size Group in Hectares 1965	Out	Size Group in Hectares 1970						1965 total
		.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	
In	0	0	0	0	0	0	0	0
5-<2	8,568	46,677	0	0	0	0	0	55,245
2-<5	6,090	0	32,311	0	0	0	0	38,401
5-<10	5,789	0	0	27,481	544	0	0	33,814
10-<20	0	0	0	0	46,613	3,752	0	50,365
20-<50	0	0	0	0	0	37,760	606	38,366
50-over	0	0	0	0	0	0	6,595	6,595
Total 1970	20,447	46,677	32,311	27,481	47,157	41,512	7,201	222,786

Total Farms
1970 202,339
1965 222,786

by the individual probabilities from the probability matrix of Table C-2 and entering the results in the corresponding cells in Table C-3, we get the projected shifts in farm numbers between size groups during the 1965-70 period. By adding the columns we find the projected number of farms in each size group in 1970. Further, we project 20,447 less farms in 1970 for a total of

202,339 farms as opposed to 222,786 farms in 1965.

These 1970 projections, as stated above assume a linear percentage trend in farm size numbers. Since we have more data than we have used, namely the census data for 1955, we can introduce the possibility of percentage change nonlinearity into our model. The nonlinearity innovation in the model may operate in either direction from the straight linear construct; but once the nonlinear coefficients are established, the deviation from the linear is assumed to proceed at a constant rate. Thus in effect we are saying that the factors affecting change in farm size are not necessarily changing at a constant percentage rate, but if this rate changes over time it must itself change at a constant percentage rate. While still abstracting from reality this assumption is probably more valid than the linearity assumption.[4]

In order to incorporate the percentage change nonlinearity assumption into our projections, the differential in the rates of adjustment between farm size groups during two known time periods must be established. Thus, Tables C-4 and C-5 establish the farm size flows and probability matrix respectively for the period 1955-1960 in the same manner as Tables C-1 and C-2 did for the 1960-1965 period.

Table C-4. Flows of Farm Numbers Between Farm Size Groups in Niedersachsen 1955-60

Size Group in Hectares 1955	out	Size Group in Hectares 1960						
		.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	1955 total
In	0	0	0	0	0	0	0	0
.5-< 2	15,061	65,859	0	0	0	0	0	80,920
2-<5	12,734	0	45,752	0	0	0	0	58,486
5-<10	3,515	0	0	41,654	6,022	0	0	51,191
10-<20	0	0	0	0	47,709	4,068	0	51,777
20-<50	0	0	0	0	0	30,875	838	31,713
50-over	0	0	0	0	0	0	5,215	5,215
Total 1960	31,310	65,859	45,752	41,654	53,731	34,943	6,053	279,302

Total Farms
1960 247,992
1955 279,302

We see by comparing Tables C-2 and C-5, that the probabilities of farm movement have changed between the two 5 year periods. To establish the rate of change between the two periods each size group cell in Table C-2 is divided by its counterpart in Table C-5 and the result entered into the corresponding cell in Table C-6.

[4]No adjustment was possible for Saarland since data for 1955 was not available. Bias caused was minimal due to Saarland's relatively small size.

Table C-5. Probability Matrix of Farm Movement
Among Farm Size Groups Based on 1955-1960 Period

Size Group in Hectares 1955	out	Size Group in Hectares 1960					
		.5-<2	2-<5	5-<10	10-<20	20-<50	50-over
In	0	0	0	0	0	0	0
.5-<2	.1861	.8139	0	0	0	0	0
2-<5	.2177	0	.7823	0	0	0	0
5-<10	.0687	0	0	.8137	.1176	0	0
10-<20	0	0	0	0	.9214	.0786	0
20-<50	0	0	0	0	0	.9736	.0264
50-over	0	0	0	0	0	0	1

Table C-6. Rate of Change in the Probabilities
Matrices Between 1955-1960 and 1960-1965 Matrix

Size Group in Hectares 1955-1960	out	Size Group in Hectares 1960-65					
		.5-<2	2-<5	5-<10	10-<20	20-<50	50-over
.5-<2	0	1.0381	0	0	0	0	0
2-<5	0	0	1.0755	0	0	0	0
5-<10	0	0	0	.9988	.1369	0	0
10-<20	0	0	0	0	1.0044	.9478	0
20-<50	0	0	0	0	0	1.0109	.5985
50-over	0	0	0	0	0	0	1

The rates of change in probabilities in the "out of business" columns are not calculated because at this point we no longer have a closed system where the rate of change adjustments add to 1 (one). That is, in comparing rates of change in the probabilities between the two 5 year intervals we are operating from two entirely different bases. The within group rates are being adjusted on the basis of 2 separate sets of probabilities and therefore do not necessarily need to cancel each other. The number of farms moving to the "out of business" column becomes in this case a net residual to be determined merely by subtraction after the adjustment is performed.

Table C-7 shows the adjusted estimates of farm numbers in each size group for 1970.

It is compiled by multiplying the cells of Table C-3 by corresponding cells of Table C-6 and entering the results in the proper cells of Table C-7. The columns are then added to estimate the farm numbers in each size group. To determine out movement the sum of the size groups is subtracted from the 1965 total number of farms. In this case, the projected number of farms in 1970 is 206,231 and out movement between 1965 and 1970 is estimated at 16,555 farms. That is, 20,447 farms projected as moving out in Table C-3

adjusted downward by 3,892 farms in Table C-7.

The projection of farm numbers by farm size group in 1975 proceeds in the same manner as the 1970 projection, but using the 1970 figures as a

Table C-7 Projection of Farm Numbers by Farm Size Group in 1970 Using 1960-1965 Base With Adjustments for Change in Rate Between 1955-1960 and 1960-1965, in Niedersachsen

Size Group in Hectares 1970	out	Size Group in Hectares 1970 adjusted						
		.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	total 1970
.5-<2		48,455	0	0	0	0	0	
2-<5		0	34,750	0	0	0	0	
5-<10		0	0	27,448	74	0	0	
10-<20		0	0	0	46,818	3,556	0	
20-<50		0	0	0	0	38,172	363	
50-over		0	0	0	0	0	6,595	
Adjusted Total 1970	-3,892	48,455	34,750	27,448	46,892	41,728	6,958	202,339
Total Farms Adjusted	1970 206,231 1970 202,339							

starting point. Certainly the 1975 projection is less reliable than the 1970 projection since (1) it is farther into the future allowing even more time for the underlying parameters to change and (2) any basic error in the 1970 projection is compounded into the 1975 projection since the 1970 figures are used as a base for the 1975 projection. Table C-8 is the first step in the 1975 projection corresponding to Table C-3 for the 1970 projection.

Table C-8. Projection of Farm Numbers by Farm Size Group In 1975 Using 1960-1965 As a Base For Probabilities and 1970 Projections As a Base For Farm Numbers

Size Group in Hectares 1970	out	Size Group in Hectares 1975						1970 total
		.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	
In	0	0	0	0	0	0	0	0
.5-<2	7,515	40,940	0	0	0	0	0	48,455
2-<5	5,511	0	29,239	0	0	0	0	34,750
5-<10	4,699	0	0	22,307	442	0	0	27,448
10-<20	0	0	0	0	43,399	3,493	0	46,892
20-<50	0	0	0	0	0	41,069	659	41,728
50-over	0	0	0	0	0	0	6,958	6,958
Total 1975	17,725	40,940	29,239	22,307	43,841	44,562	7,617	206,231
Total Farms	1975 188,506 1970 206,231							

Table C-9 presents the 1975 adjusted projection corresponding to Table C-7 for the 1970 projections. That is the farm size group cells in Table C-8 are adjusted by the rate of change matrix found in Table C-6.

Table C-9. Projection of Farm Numbers by Farm Size Group in 1975 Using 1960-65 Probabilities Base, 1970 Projections of Farm Numbers Base, and Adjustments For Rate of Change Based on 1955-1960 and 1960-1965

Size Group in Hectares 1975 Adjusted	out	Size Group in Hectares 1975 Adjusted						
		.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	total 1975
In		0	0	0	0	0	0	
.5-<2		42,500	0	0	0	0	0	
2-<5		0	31,447	0	0	0	0	
5-<10		0	0	22,280	61	0	0	
10-<20		0	0	0	43,590	3,311	0	
20-<50		0	0	0	0	41,517	394	
50-over		0	0	0	0	0	6,958	
Adjusted Total 1975	-3,552	42,500	31,447	22,280	43,651	44,828	7,352	188,506
Total Farms Adjusted 1975	192,058							
1975	188,506							

Table C-10 presents the development of farm numbers by farm size group for Niedersachsen including the adjusted projections for 1970 and 1975.

Table C-10 Farm Numbers by Farm Size Group in Niedersachsen 1955-1965 and Projections to 1975

Year	Size Group in Hectares						
	.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	Total
1955	80,920	58,486	51,191	51,777	31,713	5,215	279,302
1960 1/	65,859	45,752	41,654	53,731	34,943	6,053	247,992
1960 2/	65,390	45,637	41,607	53,699	34,917	6,042	247,292
1965	55,245	38,401	33,814	50,365	38,366	6,595	222,786
1970	48,455	34,750	27,448	46,892	41,728	6,958	206,231
1975	42,500	31,447	22,280	43,651	44,828	7,352	192,058

[1] 1960 data under old farm definition.
[2] 1960 data under new farm definition.

The same procedure was used to estimate farm numbers for each of the remaining 7 states and totals aggregated to yield farm numbers projections by farm size group on a national level.

The technique for projection of farm hectares deviated from that used on the farm numbers only in the handling of decreases or increases in the total number of hectares in farms between 5 year periods. On the assumption that the decreases in farm land reported are primarily caused by urbanization and that hectares in all size groups are equally vulnerable to urbanization the total decrease between two time periods was allocated to the size groups on the basis of the beginning period percentage distribution by farm size group. Likewise, increases in total hectares through reclamation programs were assumed to be equally available to all hectares regardless of the farm size group in which they were located so the increases were also distributed on the basis of the beginning percentage distribution of hectares in the farm size groups. Finally, for the final projections an urbanization adjustment factor was applied to each farm size group after the Markov process projection was completed. This factor was calculated directly from the rate of change in the total number of hectares between 1960 and 1965.

Table C-11 presents the results of the hectare distribution projections

Table C-11. Number of Hectares by Farm Size Group in Niedersachsen 1955-1965 With Projections to 1975

Land	Farm Size Group in Hectares						
Year	.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	total
Niedersachsen							
1955	86.8	192.6	370.3	723.3	949.2	421.2	2743.4
1960 1/	69.5	150.3	305.7	765.1	1046.5	476.3	2813.4
1960 2/	69.1	149.9	305.3	764.7	1045.6	474.9	2809.5
1965	58.1	125.2	247.7	731.4	1145.1	514.1	2821.6
1970	51.9	115.7	209.0	657.7	1245.2	542.2	2821.7
1975	45.9	105.7	176.5	582.2	1316.0	567.3	2793.6

[1] Old definition of a farm.

[2] New definition of a farm.

Source: Green Reports and own calculations.

by farm size group for Niedersachsen along with the 1955-1965 comparative data. Projections were made in the same way for the other 7 states and an aggregate compiled for West Germany. A reasonable check on consistency of the method between the farm numbers and farm hectares projections is to calculate the average farm size in each size group and compare these calculations with data from 1955-1965. Table C-12 presents the average farm size by farm size group in Niedersachsen for 1955-1965 and projections for 1970 and 1975. The projections appear consistent with the base data.

Table C-12. Average Farm Size by Farm Size Group in Niedersachsen 1955-1965 With Projections to 1975

Land	Farm Size Group in Hectares						
Year	5-<2	2-<5	5-<10	10-<20	20-<50	50-over	Total
Niedersachsen							
1955	1.1	3.3	7.2	14.0	30.0	80.8	9.8
1960	1.1	3.3	7.3	14.2	30.0	78.7	11.3
1965	1.1	3.3	7.3	14.5	29.8	78.0	12.7
1970	1.1	3.3	7.6	14.0	30.0	77.9	13.7
1975	1.1	3.4	7.9	13.1	29.4	77.2	14.5

APPENDIX D

Table D-1. Percentage Distribution of Farm Numbers by Farm Size Group by State in West Germany, 1955-1965, with Projections to 1975.

Land	Farm Size Group in Hectares						
Year	.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	Total
Schleswig-Holstein							
1955	18.9	15.9	12.9	21.7	25.4	5.2	100
1960	17.5	14.1	11.4	21.9	29.2	5.9	100
1965	17.9	12.6	9.9	20.5	32.6	6.5	100
1970	18.4	11.7	8.4	18.2	36.0	7.3	100
1975	19.0	10.7	7.2	16.0	39.3	7.8	100
Niedersachsen							
1955	29.0	20.9	18.3	18.5	11.4	1.9	100
1960	26.6	18.4	16.8	21.7	14.1	2.4	100
1965	24.8	17.2	15.2	22.6	17.2	3.0	100
1970	23.5	16.9	13.3	22.7	20.2	3.4	100
1975	22.2	16.4	11.6	22.7	23.3	3.8	100
Nordrhein-Westfalen							
1955	33.8	23.4	18.0	15.3	8.3	1.2	100
1960	30.4	21.8	17.8	18.5	10.2	1.3	100
1965	27.4	20.5	16.9	21.1	12.5	1.6	100
1970	25.0	19.5	15.2	23.3	15.1	1.9	100
1975	22.5	18.4	13.5	25.4	17.9	2.3	100
Hessen							
1955	40.2	29.3	17.6	10.5	2.1	0.3	100
1960	36.3	27.9	18.0	14.6	2.8	0.4	100
1965	31.3	27.3	17.8	18.4	4.7	0.5	100
1970	25.2	26.7	16.5	21.3	9.7	0.6	100
1975	19.7	25.3	14.8	23.6	15.8	0.8	100
Rheinland-Pfalz							
1955	38.5	32.9	20.1	7.3	1.1	0.1	100
1960	36.8	28.7	20.9	11.5	1.9	0.2	100
1965	35.1	25.8	20.0	15.4	3.5	0.2	100
1970	33.3	23.8	18.0	17.9	6.8	0.2	100
1975	31.2	21.6	16.1	19.9	10.9	0.3	100
Baden-Württemberg							
1955	36.7	31.5	20.3	9.1	2.2	0.2	100
1960	35.6	27.8	21.8	12.0	2.6	0.2	100
1965	36.6	25.7	20.4	13.9	3.1	0.3	100
1970	36.8	26.2	17.6	15.2	3.9	0.3	100
1975	37.5	26.6	15.2	15.6	4.6	0.5	100
Bayern							
1955	19.1	26.4	27.8	19.5	6.7	0.5	100
1960	17.7	23.3	28.2	22.8	7.4	0.6	100
1965	16.0	21.4	27.3	26.1	8.6	0.6	100
1970	14.8	20.6	25.2	28.9	9.8	0.7	100
1975	13.6	19.6	23.1	31.7	11.2	0.8	100
Saarland							
1955	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1960	61.6	22.4	7.9	6.3	1.6	0.2	100
1965	59.5	21.8	8.0	6.9	3.6	0.2	100
1970	57.1	21.2	8.1	7.3	5.9	0.4	100
1975	54.5	20.7	7.9	7.6	8.6	0.7	100
West Germany							
1955	30.5	26.8	21.0	14.5	6.3	0.9	100
1960	28.8	23.9	21.1	17.7	7.5	1.0	100
1965	27.1	22.2	20.1	20.1	9.3	1.2	100
1970	25.6	21.5	18.2	21.8	11.5	1.4	100
1975	24.3	20.8	16.2	23.3	13.8	1.6	100

Table D-2. Percentage Distribution of Farm Hectares by Farm Size Group by State in West Germany, 1955-1965, with Projections to 1975

Land	Farm Size Group in Hectares						
Year	.5-<2	2-<5	5-<10	10-<20	20-<50	50-over	Total
Schleswig-Holstein							
1955	1.3	3.0	5.4	18.5	45.3	26.5	100
1960	1.0	2.4	4.5	17.5	47.4	27.2	100
1965	1.0	2.0	3.6	15.6	49.8	28.0	100
1970	0.9	1.9	3.1	13.2	52.2	28.7	100
1975	0.9	1.8	2.5	11.1	54.2	29.5	100
Niedersachsen							
1955	3.2	7.0	13.5	26.4	34.6	15.4	100
1960	2.5	5.3	10.9	27.2	37.2	16.9	100
1965	2.1	4.4	8.8	25.9	40.6	18.2	100
1970	1.8	4.1	7.5	23.2	44.2	19.2	100
1975	1.6	3.8	6.4	20.8	47.1	20.3	100
Nordrhein-Westfalen							
1955	4.7	9.6	16.4	27.1	30.7	11.5	100
1960	3.7	7.9	14.5	29.3	33.0	11.6	100
1965	2.9	6.6	12.4	30.1	35.9	12.1	100
1970	2.3	5.5	9.6	30.0	39.5	13.1	100
1975	1.8	4.6	7.6	30.2	41.7	14.1	100
Hessen							
1955	8.3	19.3	25.4	28.8	11.2	7.0	100
1960	6.7	15.9	22.8	34.9	13.2	6.5	100
1965	4.9	13.2	18.9	38.3	18.1	6.6	100
1970	3.1	9.9	13.3	35.0	31.7	7.0	100
1975	2.0	7.4	9.8	30.5	42.6	7.9	100
Rheinland-Pfalz							
1955	10.2	27.1	33.2	20.4	6.6	2.5	100
1960	8.0	18.8	30.0	30.8	9.9	2.7	100
1965	6.4	14.5	24.6	36.2	15.6	2.7	100
1970	5.3	12.3	19.9	36.3	23.5	2.7	100
1975	4.4	10.4	16.3	34.8	31.3	2.8	100
Baden-Württemberg							
1955	8.1	21.3	28.7	25.2	12.0	4.7	100
1960	7.1	17.2	29.0	30.4	12.8	3.5	100
1965	6.8	15.1	26.0	33.9	14.6	3.6	100
1970	6.6	14.4	21.6	35.3	16.9	5.2	100
1975	6.5	13.8	18.1	35.3	9.1	7.2	100
Bayern							
1955	2.6	11.2	24.3	33.1	22.7	6.1	100
1960	2.2	9.3	23.5	36.2	23.3	5.5	100
1965	1.9	7.9	21.3	38.7	24.9	5.3	100
1970	1.6	7.0	18.2	40.2	26.9	6.1	100
1975	1.4	6.2	15.5	40.8	29.1	7.0	100
Saarland							
1955	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1960	19.1	20.7	17.0	26.1	12.4	4.7	100
1965	15.2	16.7	23.9	24.3	24.5	5.4	100
1970	11.9	13.2	11.2	21.1	34.9	7.7	100
1975	9.3	10.6	8.8	17.7	42.8	10.8	100
West Germany							
1955	4.6	12.5	20.6	27.3	24.8	10.2	100
1960	3.8	9.8	18.9	30.5	26.7	10.3	100
1965	3.2	8.3	16.4	31.8	29.6	10.7	100
1970	2.8	7.3	13.4	31.3	33.5	11.7	100
1975	2.4	6.4	11.2	30.3	36.9	12.8	100

Table D-3. Total Egg Production by State in West Germany (in Million Eggs), 1960-1965

	1960	1961	1962	1963	1964	1965
Schleswig-Holstein	580	630	686	680	754	753
Niedersachsen	1974	2191	2437	2672	3021	3198
Nordrhein-Westfalen	1794	1865	2083	2792	2441	2658
Hessen	528	556	582	631	713	764
Rheinland-Pfalz	431	446	479	543	603	658
Baden-Württemberg	894	942	1012	1110	1293	1423
Bayern	1594	1690	1744	1949	2209	2305
Saarland	100	101	110	120	131	137
West Germany	7895	8421	9133	9997	11194	11930

Source: *Bundesministerium für Ernährung, Landwirtschaft und Forsten.*

Table D-4. Average Slaughter Weight of Veal Calves Under Three Months By State in West Germany, 1955-1965, in Kilograms[1]

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Schleswig-Holstein	41	44	47	52	53	53	54	55	55	60	68
Niedersachsen	37	39	41	45	46	48	51	54	53	60	67
Nordrhein-Westfalen	38	39	41	44	45	47	50	57	60	67	72
Hessen	42	43	43	45	46	49	53	53	56	61	65
Rheinland-Pfalz	39	41	40	42	43	46	48	49	53	55	61
Baden-Württemberg	45	45	45	47	48	49	50	51	55	59	65
Bayern	41	43	44	44	45	45	47	48	49	50	53
Saarland	NA	38	36	37	36	35	35	35	43	45	48
West Germany	41	42	43	45	46	47	49	51	53	57	62

NA = Not Available

[1]Without offal and fat.

Source: *Statistisches Bundesamt, Agrarstatistische Arbeitsunterlagen*, Wiesbaden (annually).

Table D-5. Average Slaughter Weight of Beef Cattle By State in West Germany, 1955-1965, in Kilograms[1]

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Schleswig-Holstein	230	231	233	231	228	222	232	238	232	234	240
Niedersachsen	250	248	246	258	250	252	259	259	257	258	263
Nordrhein-Westfalen	257	257	255	261	258	262	267	265	264	272	273
Hessen	262	263	258	266	269	272	275	274	276	276	279
Rheinland-Pfalz	240	247	248	251	250	252	265	263	266	266	267
Baden-Württemberg	265	264	265	271	272	273	278	275	274	278	277
Bayern	264	267	263	265	268	268	277	278	277	279	280
Saarland	NA	240	245	245	245	240	248	251	253	252	256
West Germany	256	257	255	261	259	260	267	267	265	269	271

NA = Not Available

[1]Without offal and fat.

Source: *Statistisches Bundesamt, Agrarstattistische Arbeitsunterlagen*, Wiesbaden (annually).

Table D-6. Veal Production By State In West Germany, 1955-1965, in Tons[1]

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Schleswig-Holstein	6980	6156	6249	5526	5026	5670	5070	4605	5772	5359	4813
Niedersachsen	9099	8664	8531	7605	7164	7500	7211	7388	9056	9671	10085
Nordrhein-Westfalen	18323	17924	18055	16841	16392	17477	16345	18934	21192	19538	17460
Hessen	9429	9132	9540	8921	8892	9262	8987	9707	10177	9709	7552
Rheinland-Pfalz	5370	5046	5098	4892	4524	4774	4389	4691	4579	4171	3507
Baden-Württemberg	20872	20053	20390	20478	19862	20789	19660	21922	23652	23098	22519
Bayern	28997	28842	31206	29841	28749	30505	31225	36545	39353	35663	32733
Saarland	NA	818	722	644	584	575	468	540	622	613	486
West Germany	99070	95817	99069	94104	91193	96704	93479	104449	114545	107967	99266

NA = Not Available

[1]Without offal and fat.

Table D-7. Beef Production by State in West Germany, 1955-1965, in Tons[1,2]

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Schleswig-Holstein	50180	46266	61555	59949	64387	68961	81257	90716	98468	84095	78271
Niedersachsen	80126	80310	88591	93114	94551	103606	113299	121598	127262	117949	112944
Nordrhein-Westfalen	151435	155036	167807	172767	171348	180053	195527	211896	223225	212415	196515
Hessen	60489	64428	70805	71969	74217	77798	82464	91283	96305	93209	82846
Rheinland-Pfalz	42678	44680	48458	50035	50929	52138	55591	60669	62036	61336	55235
Baden-Württemberg	128372	116486	128372	139001	138552	145769	149214	164443	167457	172100	148407
Bayern	154118	153662	176665	188546	188958	197379	197806	218584	221462	221231	195601
Saarland	NA	2862	3365	3193	3242	2989	3610	6385	7532	6287	4806
West Germany	656480	663640	745618	778574	786184	828693	878768	974021	1011446	975417	881334

NA = Not Available

[1]Without offal and fat.

[2]Commercial and home slaughtering.

Source: *Statistisches Bundesamt, Agrarstatistische Arbeitsunterlagen*, Wiesbaden (annually).

Table D-8. Average Milk Yield Per Cow and Year by State in West Germany in Kilograms [1954/55 - 1958/59 economic year (July-June); 1960-1965 calendar year]

	1954/ 1955	1955/ 1956	1956/ 1957	1957/ 1958	1958/ 1959	1960	1961	1962	1963	1964	1965
Schleswig-Holstein	3511	3656	3830	3059	3945	3958	3976	4078	3984	4082	4218
Niedersachsen	3441	3597	3543	3838	3796	3909	3951	3983	4009	4120	4205
Nordrhein-Westfalen	3617	3730	3539	3769	3813	3916	3938	3921	4031	4102	4126
Hessen	2674	2784	2702	2912	3148	3185	3291	3190	3400	3491	3606
Rheinland-Pfalz	2115	2253	2327	2452	2616	2780	2854	2855	2968	3176	3262
Baden-Württemberg	2444	2516	2496	2664	2887	2938	2920	2962	3042	3052	3136
Bayern	2564	2629	2684	2788	3023	3118	3147	3169	3193	3249	3287
Saarland	NA	NA	NA	2702	2796	3374	3512	3424	3502	3647	3661
West Germany	2910	3006	2996	3169	3303	3395	3428	3444	3498	3572	3642

NA = Not Available

Source: *Statistisches Bundesamt, Agrarstatistische Arbeitsunterlagen,* Wiesbaden (annually).

Table D-9. Total Milk Production by State in West Germany, 1955-1965, in 1000 Tons[1]

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Schleswig-Holstein	1611.4	1605.4	1666.0	1733.2	1707.3	1775.8	1858.6	1928.4	1929.4	1952.8	2047.9
Niedersachsen	3571.9	3614.4	3536.5	3760.7	3739.1	3933.1	4057.7	4112.7	4173.9	4200.1	4307.0
Nordrhein-Westfalen	3012.1	3008.9	2823.4	2951.3	2991.3	3091.5	3192.6	3210.8	3265.5	3253.3	3280.7
Hessen	1127.8	1153.0	1111.4	1172.1	1250.5	1271.4	1338.3	1305.9	1354.7	1350.4	1361.1
Rheinland-Pfalz	762.8	785.1	805.3	834.3	854.9	906.5	954.7	962.1	969.5	990.9	986.3
Baden-Württemberg	2127.1	2176.8	2153.1	2294.6	2494.5	2565.1	2555.1	2603.8	2636.6	2591.6	2610.9
Bayern	4634.6	4762.9	4828.1	5023.7	5352.6	5587.3	5791.4	6052.0	6253.4	6370.7	6443.7
Saarland	------	------	------	112.4	106.8	118.7	123.8	119.2	119.5	120.3	116.6
West Germany	16847.7	17106.5	16923.7	17769.5	18496.9	19249.6	19872.2	20307.3	20713.9	20840.5	21183.3

[1] Includes Berlin

Source: *Agrarstatistische Arbeitsunterlagen, Statistisches Bundesamt*, Wiesbaden (annually).

Table D-10. Use of Commercial Fertilizer 1955-1965 in 1000 tons.

Country Fertilizer	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	Kilograms Per Hectare Cultivated Land 1964/65
Belgium												
Nitrogen N	93.3	85.3	86.9	79.1	97.5	98.6	100.3	104.5	109.0	156.4	162.6	130.1
Phosphate P_2O_5	92.0	96.7	104.9	97.4	91.7	94.0	88.7	95.0	115.0	76.6	119.3	137.6
Lime K_2O	135.7	148.5	152.3	146.4	152.3	155.5	152.2	171.6	184.6	186.6	178.1	189.7
Luxembourg												
Nitrogen N	3.7	3.7	3.7	3.7	3.9	4.5	4.8	4.7	5.6	5.3	4.9	69.0
Phosphate P_2O_5	5.2	5.3	4.6	6.1	5.4	6.4	6.1	5.8	6.3	6.2	6.8	95.8
Lime K_2O	4.8	5.4	5.1	5.6	6.0	6.2	6.1	5.8	5.9	7.1	7.0	98.6
Netherlands												
Nitrogen N	187.0	184.3	193.7	208.3	209.1	212.1	223.6	242.9	294.0	289.7	293.7	293.7
Phosphate P_2O_5	108.4	110.9	112.2	110.6	111.5	110.9	112.1	100.9	101.5	120.8	111.2	111.2
Lime K_2O	146.1	165.4	151.6	151.3	146.2	152.6	138.2	126.3	124.0	146.6	139.1	139.1

Source: *FAO Production Yearbook*, Vol. 4-19.

Appendix E. Grain-Livestock Economy Projections for the Benelux Countries 1970 and 1975.

Introduction

In order to complete the northern EEC grain and livestock supply response picture for 1970 and 1975, we must develop projections for Belgium, Luxembourg and The Netherlands. As Table E-1 shows, these countries account for 12.1 percent of the total EEC population but only 5.7 percent of the total EEC agricultural land. Due to their relative weight in the total EEC agricultural sector, we will neither attempt to describe their agriculture in as great a detail as has been done for Germany (and France and Italy in separate reports in this series), nor will we for the most part attempt to develop our own projections from raw data. Our primary data source will be the USDA contract studies in Belgium and The Netherlands concerned with supply and demand for agricultural products in 1970 and 1975. In some cases, we will disagree with the projections contained in those studies and for those cases we will adjust the projections.[1]

While these countries together contain only 5.7 percent of the EEC agricultural land area due to a very heavy orientation toward livestock, they accounted for 9.7 percent of the gross agricultural product of the EEC (Table E-2a). According to Table E-2c, the livestock sector in Luxembourg contributed 82.5 percent of the total agricultural product in 1963 while The Netherlands and Belgium livestock sectors contributed 63.5 and 63.1 percent, re-

Table E-1. Population and Agricultural Land in the Benelux Countries Compared To the Total EEC 1963/64.

	EEC	Belgium	Luxembourg	Netherlands	Total Low Countries
Population (in 1000's)	178,460	9,328	327	12,042	21,697
Percent of Total EEC Pop.	100	5.2	.2	6.7	12.1
Total Land (1000 Hectares)	116,774	3,051	259	3,354	6,664
Percent of Total EEC Land	100	2.6	.2	2.9	5.7
Agricultural Land (1000 Ha)	71,684	1,671	135	2,281	4,087
Percent of Total EEC Agricultural Land	100	2.3	.2	3.2	5.7
Persons Per Square Kilometer of Total Land	153	306	126	359	326
Persons Per Square Kilometer Of Agricultural Land	249	558	242	528	531
Square Meters Agricultural Land Per Person	4,017	1,791	4,128	1,894	1,884

[1] Landbouw Economisch Instituut. *Supply and Demand, Imports and Exports of Agricultural Products in The Netherlands, Projections for 1970 and 1975*, 'S-Gravenhage, 1966; Studiecentrum voor Economisch on Sociaal Onderzoek, *Long Term Development of Supply and Demand for Agricultural Products in Belgium 1970 1975*. Antwerp, 1966.

Table E-2a. Percentage of Gross Agricultural Product of the EEC Contributed by the Benelux Countries 1956, 1960, 1963.					
Year				EEC GADP (REAL)	
				Units of Account	
	Belgium	Luxembourg	Netherlands	Percent	Billion
1956	4.0	.2	5.4	100	14.5
1960	4.2	.2	6.0	100	15.9
1963	4.2	.1	5.4	100	19.1

Table E-2b. Agricultural Sector Percentage Share of Gross National Product in the Benelux Countries - 1955, 1960, 1964. (Factor cost basis in nominal terms).			
Year			
	Belgium	Luxembourg	Netherlands
1955	7.4	8.6	11.0
1960	6.8	7.3	10.1
1964	6.2	N/A	9.0

N/A = Not Available. Last Data Available 1962 = 7.2%.

Table E-2c. Total Agricultural Product and Percentage Contributed by the Crop and Livestock Sectors - 1963.				
	EEC	Belgium	Luxembourg	Netherlands
Crop	41.6	36.9	17.5	36.5
Livestock	58.4	63.1	82.5	63.5
Total Agricultural Product 1963 in Billion Dollars	26.4	1.23	.05	1.90

Source: *Statistisches Jahrbuch über Ernährung Landwirtschaft und Forsten 1965.*

spectively. As in the other developed economies of the EEC, western Europe, and elsewhere; the agricultural contribution to Gross National Product in each country is decreasing over time. In 1964 agricultural contribution in Belgium was 6.2 percent and in The Netherlands 9.0 percent (Table E-2b) The figure for Luxembourg in 1964 is unavailable but in 1960 it was 7.3 percent. Thus, we can see that these countries are highly industrialized with an agriculture weighted very heavily toward livestock and livestock products due at least in part to the limited agricultural land area and a high population density.

Farm Structure, Technology, and Agricultural Policy

Table E-3 presents the number of farms and number of hectares by farm size group along with the average farm size in 1959 and 1965. Except for

Belgium in 1965, where only the total number of farms was available, we see a shift of farms from the small to the large size groups. But even by 1965 the heavy concentration of farms is in the 1-<10 hectare farm size category and the largest single category with respect to number of hectares is the 10-<20 hectare size group. In 1965, Belgium has the smallest average size farms with 9.4 hectares followed by the Netherlands with 10.7 and Luxembourg with 16.0. The extent of fragmentation varies considerably in the Benelux countries. Luxembourg has the most serious fragmentation problem with an average farm consisting of 17.1 land parcels averaging .88 hectares in size in 1960. In 1959, the average Belgian farm had 4.9 parcels of 1.3 hectares each and The Netherlands had 3.8 parcels per farm of 2.6 hectares.[2] Therefore, the same generalizations with regard to level of mechanization and the innovation of new technology that we made with respect to Germany apply to farms in these countries.[3]

As we can see from Table E-4, mechanization has proceeded at a rapid rate since 1950 even with the limitations imposed by the farm structure situation. By 1964, Luxembourg had 100.1 tractors per thousand hectares of cultivated land while The Netherlands had 94.2 and Belgium had 64.4. Also, by 1964 Luxembourg led in number of combines per 10,000 hectares of grain land with 221.1 followed by The Netherlands with 108.9 and Belgium with 102.4. The number of milking machines also increased rapidly and once again Luxembourg led with 90.2 milking machines per thousand milk cows in 1964 while Belgium had 42.5 and The Netherlands 41.9. Increases in fertilizer use were rapid and substantial as shown in Table D-10 of the statistical appendix.

In an interview with the SESO group,[4] we found that the enterprise organization on Belgian farms is quite uniform throughout the country and is a mixed enterprise system with similar organizational patterns and problems. The northern portion of the country is better off in terms of both productivity and structure than the southern areas, but regionalization on this basis would not be worthwhile for production response study purposes. According to survey results from some 220 Belgian farms compiled by the Station d'Economie Rurale at Ghent over the period 1958-1962, gross output per hectare on farms of less than 7 hectares was more than twice that on farms larger than 35 hectares. The small farms maintain a highly intensified livestock production based primarily on purchased feed in order to utilize available family labor.[5]

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[2]Organization for Economic Cooperation and Development (OECD) *Low Incomes in Agriculture*, Paris, 1964.

[3]For a detailed discussion of these impacts see Chapters 2,3, and 5.

[4]Interview with Emil van Broekhaven, Mr. DeSalyen, and Miss Stuych, Studiecentrum voor Economisch en Sociaal Onderzoek, Antwerp, 30 June 1966.

[5]OECD, *op. cit.*, pp. 97-114.

Table E-3. Number of Farms by Farm Size Group 1959 and 1965 in 1000's.

Country / Year	Farm Size Group in Hectares						
	1-<5	5-<10	10-<20	20-<50	50-<100	100-over	Total
Belgium							
1959	93.2	52.7	35.2	12.3	1.9	.3	195.5
1965	59.2	41.6	35.4	15.0	2.0	.3	153.7
Luxembourg							
1959	3.1	2.0	2.8	2.2	.2	.0	10.3
1965	2.1	1.4	2.2	2.5	.2	.0	8.4
Netherlands							
1959	87.7	62.2	53.9	24.5	1.9	.2	230.3
1965	74.2	52.5	55.2	25.3	1.9	.2	209.3

Number of Hectares by Farm Size Group in the Low Countries 1959 and 1965. (in 1000's)

Belgium							
1959	252.7	374.9	437.8	347.8	126.1	39.8	1628.8
1965	160.4	301.5	495.3	422.7	136.0	44.6	1570.6
Luxembourg							
1959	8.3	14.6	41.3	62.8	9.7	1.2	137.9
1965	5.8	10.4	32.4	72.3	12.6	1.2	134.7
Netherlands							
1959	223.0	456.7	749.8	702.0	116.1	35.7	2283.3
1965	186.0	387.2	770.0	723.1	121.8	48.1	2236.2

Average Farm Size in the Low Countries 1959 and 1965 in Hectares.

	Belgium	Luxembourg	Netherlands
1959	8.3	13.4	9.9
1965	10.2	16.0	10.7

The tight labor situation similar to that found in Germany has caused a rapid rate of off-farm migration and a smaller number of new entrants as well as an increase in the number of part-time farms. The Belgian agricultural population decreased by about 39 percent between 1950 and 1962. The result has been that cattle numbers have stabilized to some extent due to the fact that many farmers now want more leisure time and do not want to be bothered with livestock on a part-time farming basis. The SESO group indicated that in their opinion very little production response would be attributable to the Common Agricultural Policy because 1) the prices in Belgium lie somewhat near the center of the compromise between the different countries and, thus, prices will not change very much and, 2) their evidence indicates a very inelastic response to price by farmers, therefore, they indicate very little production or organizational shift due to changes in price.

Due to the predominance of a powerful iron and steel industry in Luxembourg and a small national market for agricultural products, the agricultural

Table E-4. Farm Mechanization in the Benelux Countries

	Year	Belgium	Luxembourg	Netherlands
Tractors	1950	8,059	997	21,050
	1955	24,500	4,289	39,155
	1960	44,188	6,387	81,733
	1964	61,377	7,107	111,701
Per 1000 Hectares Cultivated Land	1964	64.4	100.1	94.2
Combines	1958	1,881	260	3,000
	1964	5,133	1,068	5,240
Per 10,000 Hectares Grain Land	1964	102.4	221.1	108.9
Milking Machines	1958	26,858	4,216	22,678
	1964	42,438	4,960	70,519
Per 1000 Milk Cows	1964	42.5	90.2	41.9

Source: FAO *Production Yearbook*, various issues; *Statistisches Jahrbuch über Ernährung, Landwirtschaft, und Forsten*, 1965, Table 450.

industry is of limited significance. Contrary to the pattern in the other northern EEC countries, farm size decreases from south to north. In the northern cantons the largest portion of farms over 2 hectares falls in the 5-<20 hectare group while in the south farms of over 20 hectares predominate. Agricultural policy is aimed at maintaining an agricultural industry since it is viewed as being in the national interest.

During the period between 1947 and 1962 the agricultural labor force fell by one third and in 1962 stood at 15 percent of the total active population. The decline is continuing along with a substantial shift to part-time farming. Families on about 30 percent of Luxembourg farms have outside sources of income.[6]

According to van den Noort,[7] the Netherlands can be divided into two main areas for agricultural production purposes by a line running from southwest to northeast. The first area is the west and north portion noted for rather large dairy and arable farms as well as horticultural crops. This area has the highest agricultural productivity in the country. The south and east areas have mainly sandy soils and here we find the mixed farming and livestock enterprises which tend to be heavily oriented toward pig and poultry production. A study by the Agricultural Economics Institute in Wageningen shows a very high rate of increase in productivity is closely correlated to farm size until about 20 hectares is reached. Beyond the 20 hectare size, the productivity

[6] OECD, *op. cit.*, pp. 283-293.

[7] The following section is based on an interview with Peter C. van den Noort; See also van den Noort's "Agricultural Productivity in Western Europe" *Netherlands Journal of Agricultural Science*, 1967.

still increases but at a much slower rate. It appears, therefore, that a much stronger impetus to reach a farm size of 20 hectares is present than to move on to farm sizes greater than 20 hectares.

The lower productivity areas in the south and east were historically feudal or communal. This means that the area had rather small individual holdings and was not set up on a commercial agricultural basis. It essentially had to come from behind in relation to the other areas but has progressed rather rapidly and is now quite commercial.

Along with the communal and feudal aspect in the east, forests and moorland were necessary for agricultural production in that the organic material from these areas was taken by the farmers and spread on the arable land as a means of increasing production. The ratio during the time that this was done was 1 hectare of arable land to 10 hectares of forest and moorland. With this type of labor intensive fertilization the farms tended to be rather small. Finally, these farms were located a long distance from the cities in The Netherlands and therefore were operated on a subsistence agricultural basis with little thought to becoming commercially organized to supply the city with agricultural products. After commercial fertilizers were introduced, the picture changed quite rapidly. The forest and moorland was no longer needed as a fertilizer source and was therefore reclaimed for agricultural purposes. The new area thus reclaimed provided an important outlet for the population pressure at the time. During the same period, relatively cheap U.S. feed grain became available. So it was only logical to increase production of livestock products in the new areas to the almost total exclusion of grain production. The industrial expansion, particularly in the Ruhr area, intensified the demand for livestock products. These old areas in the east still need a great deal of fertilizer to build up the soil and are still the smallest and most irregularly shaped in the country. Little opportunity for farm size expansion exists unless one farmer rents or sells to another.

In the north and west, we find the large commercial type farms. Since these farms are near the large population centers and thus the urban markets, they have a large history of commercial operation. Another very important reason though is the opportunity for expansion in these areas and in fact expansion can happen with very little effort on the part of the farmer. Drainage in The Netherlands runs north and west to the sea. The drainage as with most rivers of the world, carries with it a great deal of silt and soil which is deposited in the sea which in turn has currents which deposit it on the northern coastline. This builds up new land which can be claimed by the farmers who border the sea at those points. This, over several generations has caused very long, narrow farms but has increased the size of many of these farms several times over their original area. New polders are also being opened for settlement and generally the size of the farms in these pol-

ders are much larger than the average size for the country. Even so, they are certainly the minimum in family farm size for political reasons. Governmental policy is aimed at putting as many people as possible onto the land in these new polder regions without sacrificing too much in economies of size and efficiency.

General wage and price level rises increased prices paid by farmers for production inputs by 90-100 percent (labor alone by 200 percent) in the 1953-1966 period while prices received increased only 20 percent. This cost-price squeeze has been eased by a high rate of technological innovation to achieve more efficient productivity relationships. Adjustments include: 1) a decrease in the agricultural population by about 35% from 1950 to 1964, 2) a decrease in number of farms by 5% during the same period, 3) heavy movement toward mechanization, and 4) intensification of production, particularly by small farms and in the livestock sector.[8]

The labor situation in the Netherlands, as throughout Europe, was tight until 1967 at which time unemployment increased rapidly. The opportunity for large off-farm migration is great even though it has slumped slightly from its 1965/66 peak and government policy encourages off-farm movement by buying out old farmers, pensioning them, and selling the land to younger farmers for expansion purposes. Provisions are also made to train people for off-farm jobs. In 1966, approximately 88 thousand part-time farmers were counted in the Netherlands and the number has been increasing rapidly.

After World War II, governmental policy in The Netherlands encouraged more self-sufficiency in feed and fodder in order to depend less on imports. The disrupting influence of the war on trade dealt some severe blows to the livestock sector of Netherlands agriculture when they could not ship feed grains in from outside sources. They were convinced after the war that the other countries would not be able to supply the feed grain requirements for a heavy livestock production orientation in The Netherlands. The past several years have proven otherwise and more grains are again available on an import basis. This means that the policy is shifting toward a more intensive livestock industry again which will rely to a great extent on imported grains.

The principal aim of the national agricultural policies in the Benelux countries has been to maintain a reasonable level of living for farm families relative to the nonfarm economy. In past years, this aim was implemented mainly through price support programs. In more recent years emphasis in political discussions has shifted toward programs designed to improve the competitive position of agriculture within the framework of the EEC and in anticipation of the adaptation of the Common Agricultural Policy. These include structural improvement programs as well as vocational training programs to

[8] OECD, *op. cit.*, pp. 295-324.

provide farm labor with the skills necessary for nonfarm employment.[9] Nevertheless the price and income policy of the EEC will remain the most important.

Price Relationship Changes Under the Common Agricultural Policy

Quantification of technology and farm structure effects on the mix and level of agricultural production in the Benelux countries was impossible with the data available. We can, however, make the generalization from our study in Germany that similar relationships exist and changes are taking place which indicate the general directions will be the same. That is, as farms become larger and more capable of innovating the technology, the enterprise mix will shift toward production of those agricultural products which are most easily mechanized and away from labor intensive production. Since structure and technology have been evolving over time, the logical way to begin our projections is to extrapolate time trends. Adjustments can then be made to correct for the influences of various factors which are not highly correlated with time.

One of these factors includes the changes in the price structure of agricultural products through the implementation of the Common Agricultural Policy. The absolute level of individual product prices is much less important than the relative price structure of agricultural products which are competing for the same scarce resources. Epp projects all grain and livestock product prices except broilers and eggs to increase over the next decade in the Benelux countries.[10] The changes in the price ratios depicted by Epp indicate a favoring of feed over food grain production in the next ten years. Beef production is favored over veal production both through a decline in the calf-beef price ratio and also a decline in the calf-milk price ratio. More extensive grain feeding of beef is indicated in all the Benelux countries while grain feeding to dairy cows is favored in The Netherlands but not in Belgium. Substitution of grain by concentrates however may become quite important. Pork, poultry and egg prices deteriorate relative to feed grain costs but probable increases in production efficiency and feed conversion rates will about offset the effect of the relative price changes.

Projections

Projections of the various types of grain surface, yield, and production are presented in Table E-5 along with historical data for 1955-1964. We show a relatively large increase in surface as well as total production of feed grains while food grain production increases come primarily through increased yields. As the primary source for our Netherlands grain projections, we used

[9] OECD, *op. cit.*, pp. 295-324.

[10] Donald J. Epp, *The Impact of Agricultural Policies on Regional Grain and Livestock Prices in the European Economic Community*, Unpub. Ph.D. dissertation, Michigan State University, 1967.

Table E-5. Surface Yield and Production of Grain Crops 1955-64 With Projections to 1970 and 1975.

Crop Year	Surface 1000 Ha	Yield 100 Kg Per Ha	Prod. 1000 tons	Surface 1000 Ha	Yield 100 Kg Per Ha	Prod. 1000 tons	Surface 1000 Ha	Yield 100 Kg Per Ha	Prod. 1000 tons
Wheat	Belgium			Luxembourg			Netherlands		
1955	197	37.1	731	18	23.0	41	89	39.3	350
1956	191	31.6	603	16	23.0	36	86	35.9	309
1957	214	35.8	766	21	23.0	48	99	39.7	393
1958	226	35.3	797	23	23.0	53	111	36.2	402
1959	207	38.9	809	20	25.0	50	120	41.0	494
1960	210	37.7	790	20	25.0	51	126	46.6	590
1961	212	34.8	738	20	25.0	49	123	39.3	482
1962	212	39.8	844	18	24.0	44	133	45.5	603
1963	204	37.7	770	22	22.8	50	126	42.0	530
1964	220	41.5	911	22	17.5	39	151	47.1	712
1970	214	42.3	905	23	25.8	59	143	48.0	686
1975	214	44.8	959	23	28.2	65	143	51.0	729
Rye									
1955	74	24.7	220	4	20.0	8	154	30.2	465
1956	68	28.8	196	4	20.5	9	171	28.8	492
1957	66	28.8	190	4	22.2	9	157	29.2	458
1958	69	29.1	200	4	22.0	10	145	29.4	427
1959	59	29.6	176	4	23.1	9	144	26.8	386
1960	63	29.9	188	4	23.0	9	152	30.3	460
1961	44	27.4	119	4	23.0	8	119	25.2	301
1962	39	30.8	121	2	22.0	5	107	31.8	339
1963	41	30.0	123	3	23.0	7	105	29.7	313
1964	42	32.6	136	3	21.0	6	106	33.7	356
1970	23	34.1	78	2	23.1	5	69	31.0	214
1975	19	36.2	69	2	23.7	5	61	32.0	195
Barley									
1955	82	34.3	280	7	24.0	16	70	37.7	264
1956	91	31.6	288	8	24.2	21	74	36.9	273
1957	86	34.4	296	6	24.0	16	72	40.6	292
1958	95	33.5	318	6	26.0	16	82	38.5	315
1959	110	36.3	382	7	27.0	18	72	37.1	268
1960	105	36.3	382	7	28.0	19	69	42.3	291
1961	121	33.8	409	7	26.0	19	103	37.6	385
1962	128	39.0	499	9	25.9	23	101	43.0	431
1963	134	35.8	482	8	26.9	23	101	38.4	387
1964	128	40.2	516	9	20.5	18	87	43.2	376
1970	168	41.7	701	11	30.3	33	163	45.0	734
1975	182	44.5	810	12	32.7	39	175	49.0	858
Oats									
1955	149	32.3	481	20	21.0	42	171	34.0	582
1956	158	30.6	484	20	23.0	46	153	31.6	483
1957	148	30.7	454	17	24.0	40	159	31.8	505
1958	142	31.2	443	16	25.0	40	137	32.4	446
1959	141	30.1	423	17	27.0	45	125	25.5	319
1960	141	31.8	450	16	28.0	46	114	33.9	387
1961	136	32.6	444	16	29.0	46	123	35.1	431
1962	125	34.1	427	16	26.0	43	119	39.0	465
1963	115	34.3	395	15	27.1	42	112	37.8	424
1964	105	35.5	373	15	20.0	30	103	40.8	420
1970	82	37.1	304	13	32.1	42	88	42.0	370
1975	64	38.6	247	11	35.7	39	76	44.0	334

Table E-5 Continued.

Crop Year	Surface 1000 Ha	Yield 100 Kg Per Ha	Prod. 1000 tons	Surface 1000 Ha	Yield 100 Kg Per Ha	Prod. 1000 tons	Surface 1000 Ha	Yield 100 Kg Per Ha	Prod. 1000 tons
Mixed Grain	Belgium			Luxembourg			Netherlands		
1955	1	----	2	2	20.0	4	29	32.5	95
1956	1	27.7	4	3	23.0	6	34	30.3	103
1957	1	27.7	2	2	24.1	5	37	30.3	111
1958	1	26.9	2	2	24.3	6	41	32.9	136
1959	1	29.5	2	3	26.3	7	43	21.8	94
1960	1	30.5	2	3	27.1	8	45	30.3	135
1961	1	29.9	2	2	27.9	7	53	30.7	162
1962	1	30.9	2	2	25.7	6	48	34.6	167
1963	1	31.7	2	2	23.1	6	42	34.2	145
1964	1	34.1	2	2	21.0	5	34	36.5	125
1970	1	36.2	2	1	29.7	3	30	36.0	108
1975	1	38.1	2	1	31.2	3	30	38.0	114

the study completed for the USDA by the Landbouw Economisch Instituut (LEI), but for our final projections we adjusted the food grain production upward from their figures primarily due to the fact that human consumption of food grains, even after our adjustment, will be greater than domestic supplies.[11] Thus, the price relationships for domestic production will be based totally on food usage since no surplus exists which must be diverted to feed grain channels.

Wheat surface under our adjustments increased more than in the LEI study, but a partially offsetting downward adjustment of the rye surface was also made. We projected a faster decline in oats surface offset by a faster increase in barley surface on the assumption that barley is a more nutritious feed and can generally be grown at a similar cost. Belgian grain surface was projected on the basis of past trends and adjusted in light of technological progress and changing price relationships under the CAP. Compared to the SESO projections, ours are slightly higher for wheat, rye and barley and lower for oats. For Luxembourg, our surface projections consisted mainly of trend extrapolations and we have no external check on our results.

Yields in the Benelux countries were projected independently and then checked against the LEI and SESO studies. Our final yield projections are in all cases quite consistent with results in these studies. With these adjustments, our projected grain production is both larger in total and more heavily weighted toward food grains than projected by LEI and SESO.

Turning to milk production, we use the SESO figures for Belgium almost intact after running our own analysis and deciding we had no basis for questioning their results. The Netherlands was quite a different story. We

[11] Landbouw Economisch Instituut, *op. cit.*,

disagree with the rapidity of milk cow herd increases projected by LEI because: 1) milk will be in surplus during the period, 2) additional beef and veal production in response to higher prices can be achieved at least in part through means other than cow herd increases (i.e. heavier slaughter weights) and 3) cow numbers can increase only as fast as the forage base expands either through greater forage surface or higher yields on existing surface. With increases in grain prices, we expect no large shift to forage crops so increased cow carrying capacity must come from increased forage yields which are unlikely. More than offsetting our conservative estimate of the cow herd is our projected increase in milk yield per cow which is significantly larger than the yields projected in the LEI study. An important factor in this increase is the rapidly increasing use of feed for concentrates. The net result is a larger Netherlands milk production in both 1970 and 1975 than projected by LEI. Based on past trends, the cow herd in Luxembourg is assumed to have stabilized at the mid-1960's level and yields are projected to increase only modestly. Table E-6 presents the cow herd numbers, milk yield, and milk production for the three countries during the historical period 1955-1964 and projections to 1970 and 1975.

Table E-6. Number of Cows, Milk Yield, and Milk Production 1955-1964 with Projections to 1970 and 1975.

Year	Cows 1000's	Yield Kg Per Cow Per Year	Prod. 1000 tons	Cows 1000's	Yield Kg Per Cow Per Year	Prod. 1000 tons	Cows 1000's	Yield Kg Per Cow Per Year	Prod. 1000 tons
	Belgium			Luxembourg			Netherlands		
1955	985	3760	3704	54	3245	175	1487	3915	5823
1956	974	3760	3662	53	3399	180	1472	4040	5943
1957	977	3811	3722	53	3399	180	1476	4065	6002
1958	996	3760	3743	52	3225	168	1503	4152	6240
1959	1013	3708	3762	52	3200	166	1544	4152	6411
1960	1021	3811	3903	56	3400	191	1599	4275	6838
1961	1025	3811	3907	55	3500	192	1648	4216	6953
1962	1051	3811	4005	55	3300	181	1720	4226	7269
1963	1043	3814	3978	55	3300	182	1720	4076	7011
1964	1003	3811	3822	55	3310	182	1666	4177	6956
1970	1052	3950	4155	55	3500	192	1872	4220	7900
1975	1061	4100	4350	55	3550	195	1930	4360	8415

Sources: FAO, *Production Yearbook*, various issues.
EEC, *Agristatistik*, No. 3, Brussels 1966.

Table E-7. Beef and Veal Production 1956-1964 with Projections to 1970 and 1975.

	Cows 1000's	Tot. Slau. 1000's	Slau/ Cows	Beef Slau. 1000	Veal Slau. 1000	Beef Slau/ Tot. Slau. %	Veal Slau/ Tot. Slau. %	Beef Slau.wt. Kg	Veal Slau.wt. Kg	Beef Prodn 1000 tons	Veal Prodn 1000 tons
							Belgium				
1956	974	892	.916	617	275	.692	.308	262	69	160	19
1957	977	856	.876	610	246	.713	.287	266	74	161	18
1958	996	941	.945	671	270	.713	.287	271	74	181	20
1959	1013	980	.975	691	297	.699	.301	267	76	183	23
1960	1021	995	.975	692	303	.695	.305	263	73	181	22
1961	1025	938	.915	672	266	.716	.284	272	74	182	20
1962	1051	995	.947	702	293	.706	.294	270	76	189	22
1963	1043	1106	1.060	760	346	.687	.313	267	78	202	27
1964	1003	947	.944	684	263	.722	.278	270	80	184	21
1970	1052	1010	.960	732	278	.725	.275	275	86	201	24
1975	1061	1029	.970	761	268	.740	.260	280	93	213	25
							Luxembourg				
1956	53	47	.887	26	21	.553	.447	262	52	7	1
1957	53	44	.830	26	18	.591	.309	265	53	8	1
1958	52	44	.846	26	18	.591	.309	262	53	8	1
1959	52	41	.788	26	15	.634	.366	257	53	8	1
1960	56	42	.750	28	14	.667	.333	254	51	8	1
1961	55	49	.891	37	12	.755	.345	259	53	10	1
1962	55	52	.945	39	13	.750	.250	260	55	10	1
1963	55	52	.945	40	12	.769	.231	254	57	10	1
1964	55	53	.964	40	13	.755	.245	252	65	10	1
1970	55	53	.970	41	12	.765	.235	270	75	11	1
1975	55	53	.970	41	12	.775	.225	275	82	11	1

Table E-7 Continued.

	Cows 1000's	Tot. Slau. 1000's	Slau/ Cows	Beef Slau. 1000	Veal Slau. 1000	Beef Slau/ Tot. Slau. %	Veal Slau/ Tot. Slau. %	Beef Slau. wt. Kg	Veal Slau. wt. Kg	Beef Prodn 1000 tons	Veal Prodn 1000 tons
							Netherlands				
1956	1472	1348	.916	603	745	.447	.553	287	39	173	29
1957	1476	1320	.894	616	704	.467	.533	290	49	179	34
1958	1503	1324	.881	631	693	.477	.523	289	46	182	32
1959	1544	1320	.855	648	672	.491	.509	285	51	185	34
1960	1590	1437	.899	702	735	.489	.511	285	57	201	42
1961	1648	1315	.798	721	594	.548	.452	287	56	207	33
1962	1720	1542	.897	817	725	.530	.470	281	67	230	50
1963	1720	1897	1.103	992	905	.577	.423	266	67	264	60
1964	1666	1502	.902	786	716	.477	.523	273	82	215	59
1970	1872	1704	.910	1073	631	.630	.370	280	94	300[1]	59[1]
1975	1930	1756	.910	1194	562	.680	.320	286	103	342[1]	58[1]

Source: EEC *Agrarstatistik* No. 7, 1965 Brussels.

[1]With an average yearly import of live slaughter cattle included in the slaughter statistics accounting for approximately 16 tons of beef and veal the 1970 and 1975 projections need to be adjusted downward for production from domestic cattle. After this adjustment, we project for 1970 beef production at 290 thousand tons and veal production at 53 thousand tons. For 1975 we project beef production at 331 thousand tons and veal production at 52 thousand tons.

Table E-7 presents the historical basis for our calculations of beef and veal production to 1970 and 1975 along with these projections. Starting with cow numbers and total slaughterings during the base period and projected cow numbers, we establish a relationship between the size of the cow herd and the number of slaughterings for the projected period. Apportioning the total slaughterings between beef and veal during the base period, we establish a beef-veal slaughter ratio which is projected to 1970 and 1975. Then by extrapolating beef and veal slaughter weights and multiplying these times the projected slaughterings, we calculate beef and veal production. Since The Netherlands has a relatively high import of live slaughter cattle included in the slaughter statistics, we have adjusted the final projections to account for only domestically produced slaughter cattle. Our results are slightly higher than those of LEI for The Netherlands and very similar to SESO results in Belgium. Again, we had no independent check of our results for Luxembourg.

For the projection of poultry meat production to 1970 and 1975, we used the LEI analysis intact. This, for The Netherlands, yields a surplus over domestic consumption about equal to that in the base period. Commercial poultry meat production adjusts relatively easy to changes in demand. Due to the fact that the demand projections being used in this study are considerably higher than those projected by SESO, we assume poultry meat prices to remain relatively strong. Thus, we have increased the projected output of poultry meat for Belgium over the SESO figures. Table E-8 presents the poultry meat production in Belgium and The Netherlands during the base period 1955 through 1964 and projected output for 1970 and 1975. No data on poultry meat production was available for Luxembourg.

Table E-8. Poultry Meat Production 1955-65 with Projections to 1970-75 in 1000 tons.

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1970	1975
Netherlands	29.3	35.0	41.6	49.2	61.6	77.4	83.3	98.8	104.8	128.0	227.0	282.0
Belgium	31.6	34.4	39.5	41.8	46.2	56.8	69.8	77.9	88.7	N/A	140.0	160.0

N/A = not immediately available

Source: EEC, *Agrarstatistik*, No. 7, Brussels, 1965.

Again on the assumption that production can be adjusted rather quickly to meet changing demand situations and that a strong demand will keep producer prices relatively high, we have projected a larger increase in egg production in the Benelux countries than is found in the LEI or the SESO studies. The fact that the demand estimates we are using are considerably higher

Table E-9. Laying Hens, Egg Yield and Egg Production 1955-64 with Projections to 1970 and 1975.

Year	Belgium				Luxembourg				Netherlands			
	Laying Hens 1000	Eggs Per Year Per Hen	Egg Prodn. Millions	Eggs in 1000 Tons	Laying Hens 1000	Eggs Per Year Per Hen	Egg Prodn. Millions	Eggs in 1000 Tons	Laying Hens 1000	Eggs Per Year Per Hen	Egg Prodn. Millions	Eggs in 1000 Tons
1955	15,361	138	2,120	120.8	361	122	44	2.5	19,189	219	4,195	239.1
1956	16,393	141	2,307	131.5	361	122	44	2.5	22,479	204	4,590	261.6
1957	16,926	146	2,473	141.0	361	122	44	2.5	20,709	241	5,000	285.0
1958	16,915	152	2,576	146.8	361	122	44	2.5	23,084	222	5,128	292.3
1959	16,994	164	2,781	158.5	361	122	44	2.5	25,352	230	5,825	332.0
1960	15,328	178	2,725	155.3	311	135	42	2.4	24,695	236	5,825	332.0
1961	17,382	178	3,102	176.8	300	120	36	2.1	28,633	210	5,999	341.9
1962	15,569	188	2,920	166.4	415	140	58	3.3	27,098	224	6,061	345.5
1963	15,585	191	2,980	169.9	415	147	61	3.5	24,957	214	5,340	304.4
1964	14,500	216	3,129	178.4	415	147	61	3.5	21,510	237	5,095	290.4
1970	14,035	230	3,228	184.0	450	170	76	4.3	22,582	240	5,420	309.0
1975	14,094	244	3,439	196.0	450	192	86	4.9	23,786	248	5,899	336.0

Sources: FAO, *Production Yearbook*, various issues.

EEC, *Agristatistik*, No. 3, Brussels 1966.

coupled with the assumption that due to locational advantages both Belgium and the Netherlands will have an opportunity to share in the egg market of Germany's heavily populated Ruhr area led us to project relatively high egg output levels. Table E-9 presents base data for 1955-1964 and projections to 1970 and 1975 which include the size of the laying flock, egg yields and egg production.

Table E-10 presents the basic data and calculations for projections of pork production to 1970 and 1975. For The Netherlands, our projection

Table E-10. Pork Production 1955-64 with Projections to 1970 and 1975.

Year	Sows in 1000's	Slaughterings 1000's	Slaughterings per Sow	Slaughter Weight Kg	Pork Production 1000 tons
			Belgium		
1955	N/A	2224	N/C	81	199
1956	189	2533	13.40	81	234
1957	169	2575	15.24	81	235
1958	181	2427	13.41	81	223
1959	196	2521	12.86	79	226
1960	218	2750	12.61	78	238
1961	223	2760	12.38	77	236
1962	246	3048	12.39	78	260
1963	207	2742	13.25	79	238
1964	232	2675	11.53	78	231
1970	262	3487	13.31	77	268
1975	276	3729	13.51	77	287
			Luxembourg		
1955	N/A	116	N/C	78	12
1956	12	119	9.92	76	13
1957	11	122	11.09	77	13
1958	12	122	10.17	75	12
1959	11	128	11.64	75	11
1960	11	130	11.82	77	11
1961	11	151	13.73	79	12
1962	12	164	13.67	81	13
1963	10	133	13.30	81	11
1964	12	147	12.25	81	12
1970	12	164	13.70	80	13
1975	12	168	14.00	80	13
			Netherlands		
1955	N/A	3703	N/C	90	332
1956	351	3879	11.05	88	343
1957	373	4121	11.04	88	363
1958	353	4015	11.37	87	350
1959	415	3955	9.53	90	356
1960	453	5116	11.29	85	435
1961	436	4706	10.79	85	400
1962	494	4961	10.04	84	418
1963	434	5034	11.60	83	420
1964	528	5174	9.80	84	432
1970	638	7018	11.00	82	575
1975	662	7475	11.30	80	598

N/A = Not immediately available
N/C = Not Calculated
Source: EEC *Agrarstatistik*, No. 7, 1965, No. 5, 1964 Brussels.

for 1970 is quite similar to that of the LEI study, but for 1975 we project a much lower rate of increase. The strong possibility of a community-wide surplus of pork coupled with a declining hog-barley price ratio throughout the projection period leads us to project the lower output for 1975. For Belgium our 1970 projection falls between the two estimates in the SESO study and it is slightly above their estimates for 1975. For Luxembourg, we had no independent check on our projections but we assumed a stable sow herd with a slight increase in breeding efficiency to arrive at the pork production in the projection period. In all cases our method began by projecting sow numbers and establishing a relationship between slaughterings and sow numbers during the base period which was then projected to 1970 and 1975. Slaughter weights in all cases tended to decline through the base period and we projected this decline on into the next decade. Once the number of slaughterings and the slaughter weight were projected a simple multiplication yielded the projected production.

Feed grain utilization projections are, of course, dependent upon the level of production in the livestock sector. The LEI study states "the estimate of the feed requirement in 1970 and 1975 is based on: 1) an assumption with regard to the future composition of the ration, 2) the forecast of the size of the stock populations, and 3) an expectation with respect to improvement of feed conversions." The summary report does not detail the analysis used to derive the feed grain projections. Further, no data from other sources are readily available with respect to feed grain - livestock conversion factors. Therefore, we adjusted the LEI feed grain utilization projections for The Netherlands on the basis of the feed grain-meat conversion factors derived for northern Germany applied to the difference between the LEI livestock product projections and ours. While some differences in these conversion factors between northern Germany and The Netherlands probably exist, the error is minimized by applying the German factors only to the difference in projection.

The SESO study presents feed grain requirement projections in value terms and in starch units but not in tons of grain. By establishing the relationship between tons and starch units in a base period using the SESO starch units and EEC statistics on tonnage fed, we were able to convert the SESO projections to tons. Since all grains are not equal in starch unit equivalents, some error enters with a change in the grain mix used in the projection period. But, this method is probably more accurate than building the projections from livestock production levels since we do not have Belgian conversion factors. Adjustments in the SESO projections converted to tons were made in a similar manner to those in the Netherlands again using German conversion factors. Feed grain requirements in Luxembourg were also found by applying the German conversion factors to the Luxembourg livestock product projection levels.

Summary

Table E-11 presents the supply-demand and trade balance data for the Netherlands and for the combined area of Belgium and Luxembourg. In looking at the balances for Belgium-Luxembourg first, we find the grain deficit growing from 1,618 thousand tons in 1964 to 2,129 thousand tons in 1970 and 2,325 thousand tons in 1975. Milk production increases faster than consumption going from a deficit of 156 thousand tons in 1964 to a surplus of 277 thousand tons in 1970 and 218 thousand tons in 1975. The base year comparison in this instance is a poor one, however, because milk production in 1964 dropped to its lowest level since 1959. Except for 1964, Belgium-Luxembourg was a surplus milk area at least as far back as 1960. The beef and veal deficit grows from 54 thousand tons in 1964 to 83 thousand tons in 1970 and 134 thousand tons in 1975. The pork surplus increases from 40 thousand tons in the base period to 52 thousand tons in 1970 and then decreases to 40 thousand tons again by 1975. A rather substantial jump in consumption between 1970 and 1975 coupled with a leveling off of production accounts for the decrease in surplus during that period. For poultry meat, we find little change in the surplus situation over the projected period. Poultry meat surpluses which stood at 4 thousand tons in 1964, increase to 11 thousand tons in 1970 and then taper back to 7 thousand tons in 1975. Egg production remains in substantial surplus throughout the period owing to the available market in Germany. The surplus was 59 thousand tons in 1964 declining to 49 thousand tons in 1970 and 46 thousand tons in 1975.

Turning to balances in The Netherlands, we find similar situations to those in Belgium-Luxembourg. The grain deficit increases from 3,336 thousand tons in 1964 to 4,145 thousand tons in 1970 and 4,335 thousand tons in 1975. The milk surplus increases from a base of 3,191 thousand tons in 1964 to 3,652 thousand tons in 1970 and by 1975 to a level of 3,668 thousand tons. The beef and veal balance indicates a 6 thousand ton surplus in 1964 rising to a 45 thousand ton surplus in 1970 and then becoming only a 4 thousand ton surplus by 1975. The pork surplus stands at 120 thousand tons in 1964 and declines to 119 thousand tons and 81 thousand tons in 1970 and 1975 respectively. The poultry meat surplus increases from 75 thousand tons in 1964 to 141 thousand tons and 146 thousand tons in 1970 and 1975 respectively. Finally, the egg surplus declines throughout the period starting at 132 thousand tons in 1964 and standing at 109 thousand tons in 1970 and 97 thousand tons in 1975.

In looking at the results of our projections for the northern EEC area composed of Germany, Netherlands and Belgium-Luxembourg, we find a similar pattern emerging. The grain deficit, the milk surplus, the beef deficit and the pork surplus all tend to increase in magnitude throughout the projection period. The poultry meat and egg surpluses in The Netherlands and Belgium-Luxembourg tend to partially offset the deficits in Germany.

Table E-11. Supply-Demand Balance Projections for Grains and Livestock Products - 1970 and 1975 in 1000 tons.

	Belgium-Luxembourg			Netherlands		
	1964	1970	1975	1964	1970	1975
Grain Production	2036	2132	2238	1908	2112	2230
Demand by Source						
Direct human use	1066	1007	931	1166	1159	1146
Feed	2157	2809	3166	3644	4597	4879
Seed 150 Kg/Ha	82	81	79	67	74	74
Waste 3% of Production	61	64	67	57	62	66
Industrial use	288	300	320	310	365	400
Total Demand	3654	4261	4563	5244	6257	6565
Grain Deficit	1618	2129	2325	3336	4145	4335
% Self-sufficiency	56%	50%	49%	36%	34%	34%
Milk Production	4004	4347	4545	6956	7900	8415
Milk Demand	4160	4070	4327	3765	4248	4747
Milk Surplus or Deficit	-156	+277	+218	+3191	+3652	+3668
% Self-sufficiency	96%	107%	105%	185%	186%	177%
Beef Production	194	212	224	194	290	331
Veal Production	22	25	26	40	53	52
Total Beef & Veal Production	216	237	250	234	343	383
Beef & Veal Demand	270	320	384	228	298	379
Surplus or Deficit	-54	-83	-134	+6	+45	+4
% Self-sufficiency	80%	74%	65%	103%	115%	101%
Pork Supply	243	281	300	432	523	570
Pork Demand	203	229	260	312	404	489
Surplus	40	52	40	120	119	81
% Self-sufficiency	120%	123%	115%	138%	129%	116%
Poultry Meat Supply	89	140	160	122	227	282
Poultry Meat Demand	85	129	153	47	86	136
Surplus	4	11	7	75	141	146
% Self-sufficiency	105%	109%	105%	260%	264%	207%
Egg Supply	182	188	201	290	309	336
Egg Demand	123	139	155	158	200	239
Egg Surplus	59	49	46	132	109	97
% Self-sufficiency	148%	135%	130%	184%	155%	141%

Source: Demand Projections by Vernon Sorenson, Michigan State University.
Supply projections own calculations.

The Benelux countries must compete in an export market framework for their agricultural products and must rely in large measure on imported feedstuffs. Greater intensification in the livestock sector means even more dependence on external sources for feedstuffs. So their economic situation in agriculture is determined largely by external economic forces and trends as well as trade policies of other countries. With the adoption of the CAP and the process of general economic integration under the EEC a greater sense of political and economic stability with respect to their export market hopefully will be achieved.

BIBLIOGRAPHY OF THE APPENDIXES

Agra-Europe, various issues. London, Paris, Bonn, Rome.

Bundesministerium für Ernährung, Landwirtschaft, und Forsten. *Statistisches Jahrbuch über Ernährung, Landwirtschaft, und Forsten 1960 and 1965*, Hamburg and Berlin.

Engel, Botho. *Aufbau und Tätigkeit der vertikalen Marktverbände für Agrarprodukte in den Niederlanden*, IFO-Institut für Wirtschaftsforschung e.V., München, 1964.

Epp, Donald J. *The Impact of Agricultural Policies on Regional Grain and Livestock Prices in the European Economic Community*, Unpublished Ph.D. Dissertation, Michigan State University, 1967.

European Economic Community. *Agrarstatistik*, various issues, 1963 - 1966, Brussels.

Food and Agriculture Organization of the United Nations (FAO). *Production Yearbook*, various issues, 1955-1965, Rome.

Landbouw Economisch Instituut. *Landbouweijfers* 'S-Gravenhagen, 1966.

_____. *Supply and Demand, Imports and Exports of Agricultural Products in the Netherlands, Projections for 1970 and 1975*. 'S-Gravenhagen 1966.

Economique Agricole (I.E.A.). *Evolution de L'Economie Agricole et Horticole 1964-1965*. Bruxelles, 1966.

Organization for Economic Cooperation and Development (OECD). *Low Incomes in Agriculture*, Paris, 1964.

Studiecentrum voor Economisch en Sociaal Onderzoek. *Long Term Development of Supply and Demand for Agricultural Products in Belgium, 1970-1975*. Antwerp, 1966.