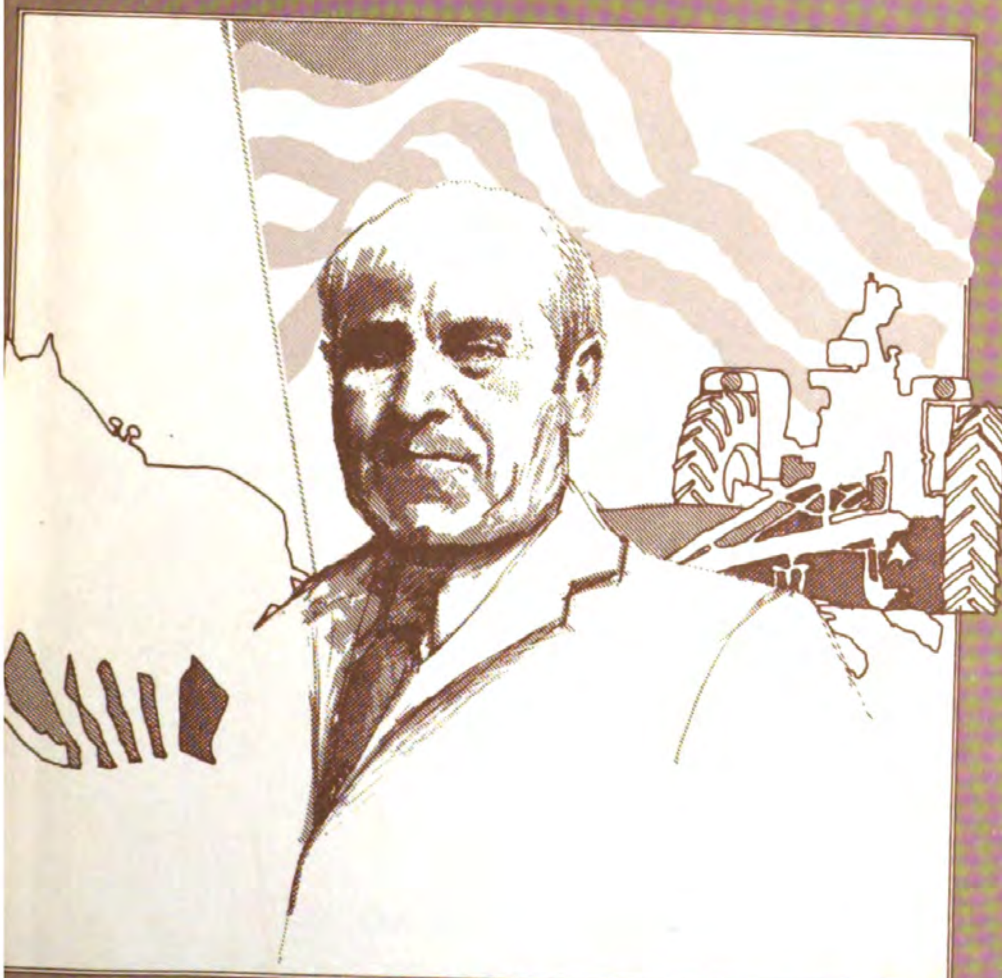
Another Revolution in U.S. Farming?

Lyle P. Schertz and Others



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FOREWORD

A principal purpose of Economics, Statistics, and Cooperatives Service is to provide objective information on important economic and social issues confronting our society. This was also true of its predecessor agencies. This book is in that tradition. It focuses on the structure of U.S. farming, a topic that gives rise to many issues and related policy questions. The issues, often complex, are sensitive because their resolution affects people's incomes and wealth.

I commend this book to you as a highly readable, objective presentation of many facets of the complex set of issues associated with this sensitive topic. It describes the changes in U.S. farming over the recent decades, points up the forces that have contributed to these changes, and anticipates the future.

Properly, we think, the authors do not offer policy prescriptions. These are correctly the responsibilities of private, as well as public, decisionmakers in our society.

KENNETH R. FARRELL
Administrator
Economics, Statistics, and Cooperatives Service

PREFACE

Farming in the United States is undergoing dramatic changes. These changes are reflected in headline topics such as: farm corporations, family farms, small farmers, control of agriculture, special valuations of farmland for tax purposes, tractorcades, foreign landownership, millionaires, and landed aristocracies.

The changes are associated with many developments and government policies in our society—and in some cases, developments in other countries. Inflation, decisions in other countries, tax regulations, nonfarm employment opportunities, new technologies, support of farm prices, and availability of credit are involved.

U.S. farming has undergone dramatic changes in the past. In fact, the changes in two different periods have been called revolutions. In the first revolution, horses were substituted rapidly for hand power. In the second revolution, tractors were substituted for horses.[1]

The changes underway today in U.S. farming may be as far-reaching as the earlier revolutions. Principally involved is a transformation in the organization and management of U.S. farming. Changes in size of farms, form of ownership, use of capital goods, carrying risks, and using credit are of major importance in the dramatic adjustments taking place.

This book is based on two concepts: first, that the transformation underway in U.S. farming is giving rise to many issues generated by a variety of forces and, second, that the materials contained in this book can contribute to an enlightened dialog about the related issues. Additionally, it is based on the premise that increased public awareness of the changes and related issues will lead to more serious consideration and review of current and possible public policies which affect or could affect the way U.S. resources are organized and managed to produce food and fiber.

How Americans deal with these issues is important to wealthy, as well as poor, farm and ranch operators. The issues also have important implications for other Americans, including: (1) those who do not operate farms but own and supply land, labor, and capital for farming; (2) those who participate in the input and the product marketing, processing, and distribution subsectors of agriculture; and (3) those whose association with U.S. farming is limited to consumption. The issues are important to all these groups because the eventual social, economic, and political responses will impact income and wealth distributions among households and the economic growth of our Nation.

The specific purposes of this book are to assemble, refine, synthesize, and present available knowledge about:

[1]Wayne D. Rasmussen, "The Impact of Technological Change on American Agriculture, 1862-1962," *Journal of Economic History*, Volume 22, pages 578-591, December 1962.

- How U.S. production of livestock and crops is organized and managed.
- Why it is this way.
- How resources are likely to be organized and managed in the future, why, and with what results.

Research on the second and third of these purposes is extremely limited. We decided, however, we would express our best judgments despite the dearth of research information. Thus, the related discussions should be considered as a set of hypotheses to be discussed, criticized, revised, and researched.

The emphasis here is on the production subsector of agriculture. Changes in this subsector are influenced by many forces outside the subsector and have impacts beyond the subsector as well. Thus, information and knowledge about the input and the marketing and distribution subsectors of agriculture are encompassed, but only to the extent that they were considered by the individual authors to be important to accomplish the stated objectives. The same is true with respect to considerations such as communities, people, jobs, employment, and economic growth.

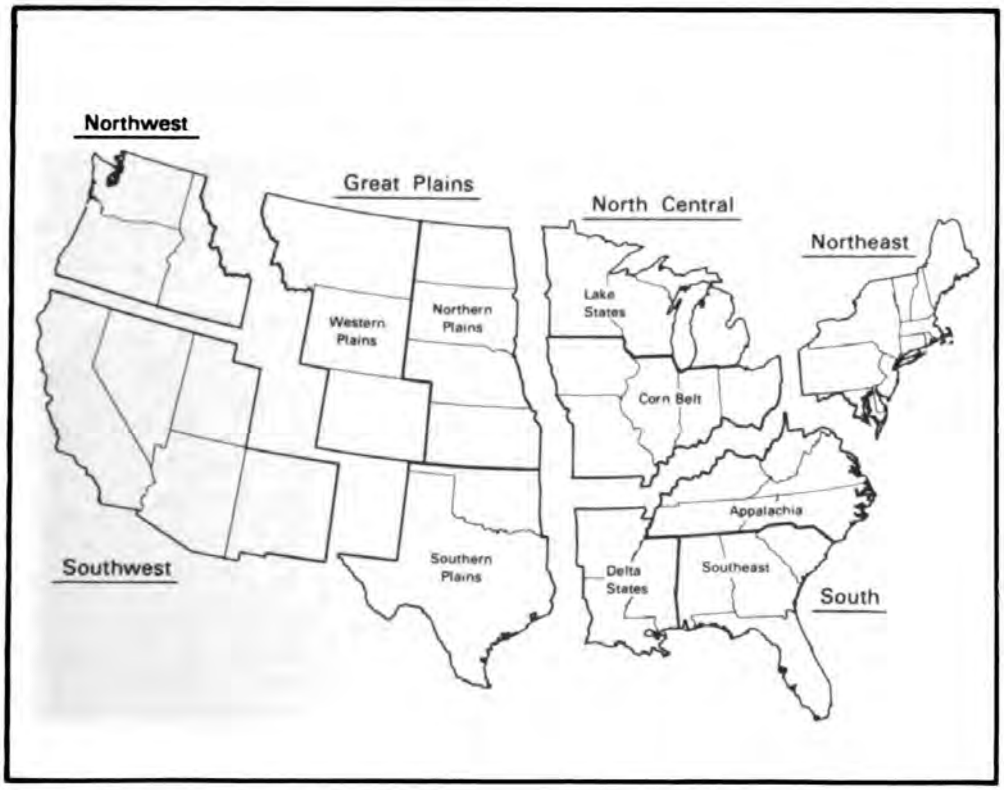
The Summary is followed by Part I, which focuses on developments in the United States as a whole. Part II contains four chapters on livestock: one each for beef, dairy, poultry and eggs, and pork. Part III includes chapters on six regions of the country to enhance readers' understanding of the great heterogeneity of U.S. farming.

Data presented in the text largely correspond to the regions shown in figure 1. Subregions of these regions are utilized in some cases. Also, in some instances, it was helpful to use data for other regional configurations such as the farm production regions utilized by ESCS for compilation of many data series. Data only for the continental United States are utilized.

The overwhelming majority of the data are taken from USDA and Census of Agriculture statistical series. Other sources are used occasionally, as indicated in the text.

The terms farms and ranches are used interchangeably in the text.

FIGURE 1
FARMING REGIONS



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Robert Reinsel
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CONTENTS

Another Revolution in U.S. Farming?

SUMMARY

PART I—A NATIONAL OVERVIEW

U.S. farming is changing dramatically and rapidly. Farms are fewer and larger, and production is concentrated among large operators. The largest 50,000 farms are fewer than 2 percent of the total . . . but they account for more than one-third of all farm sales.

Great heterogeneity in terms of size, ownership, and products continues, with owner-operated farms still the dominant tenure arrangement. However, the relative importance of the number of arrangements in which some land is owned and some is rented has increased significantly. And the corporate form of ownership has become more common.

Dramatic shifts in the mix and productivity of resources used in farming have been key aspects of the transformation. The substitution of capital goods incorporating new and different technologies for labor and land has been a prominent feature of this change. However, incentives to substitute capital inputs for labor have been lessened in recent years as price increases for land and capital goods have been greater than price increases for labor.

Significant changes in the distribution of income and wealth among farm people and substantial adjustments in the distribution of wealth among Americans have accompanied the increasing concentration of farming into larger units. Increases in farm income and wealth of landowners have given rise to higher returns on investments in farming over time in relation to returns on common stock of U.S. industry.

Many forces have affected the way U.S. farms are organized and managed. Seven, however, are especially important. They are:

- Inflation.
- Increases in farm product exports.
- Availability of capital-intensive new technologies.
- Nonfarm employment opportunities.
- Availability of institutional credit for the purchase of land and capital goods.
- Commodity programs supporting farm product prices.
- Tax rules applicable to incomes and estates.

Inflation increases: (1) the wealth of those who own land, (2) demand for land, and (3) input prices. And it strengthens the relative economic position of the wealthier and higher income people in buying land. Through these effects, inflation—compared with stable prices—leads to fewer farms and greater concentration of production, incomes, and wealth among those associated with the larger farms.

Exports were important to the: (1) sharp increase in farm earnings in the 1970's, (2) opportunity to realize politically acceptable prices and farm income with only modest restraints on production, and (3) relatively strong markets for soybeans and corn. Aside from the substantial effects of the higher incomes and wealth on the organization of U.S. farming, these developments led to greater specialization in the production of grain and soybeans in the Corn Belt.

One of the major results of new technologies used in farming has been to facilitate efforts by some individuals to control larger amounts of production resources. It is this control over a large amount of production resources (on large farms and ranches) that affords the opportunity to realize increased incomes and wealth. In crop production, the adoption of modern machinery means production systems that have extremely high unit costs at small volumes of production and low costs at large volumes. Similar production functions are associated with large-scale poultry, beef, drylot dairy, and confinement hog feeding units. The increased use of capital-intensive technologies in U.S. farming has meant decreased labor requirements.

The substitution of capital goods and land for labor has been facilitated greatly by the opportunity for farm people to migrate to the cities of our country and be better off than if they had stayed in rural areas.

A prominent feature of the transformation of U.S. farming has been the increased availability of institutional credit for purchases of farm real estate and capital goods. The rules applied by lenders in responding to demands for credit and for servicing loans have a substantial influence on who survives in farming. But probably of greater importance is the way economic forces associated with inflation affect potential borrowers differently, and thereby determine who obtains credit to buy land. People with sources of money other than the land being purchased have a clear competitive edge over people without such alternate sources.

U.S. commodity programs have accelerated the shift to large farms by supporting commodity prices and increasing the chances of significant price increases. In this way, commodity programs have enhanced the: (1) confidence of people aggressively willing to accumulate land and/or invest in capital goods that facilitate large-scale production of commodities, and (2) willingness of lenders to extend credit to these kinds of people. Modifications of commodity programs so there are greater risks of commodity price declines would discourage increased farm size and product specialization, and make farm resources less attractive as investment opportunities.

Several rules for income and estate taxes have a significant effect on farming. In total, they increase the attractiveness of owning farm assets and lead to: (1) larger investments by nonfarm people in farm assets, (2) larger farms owned and/or operated by those farmers who are able to exploit tax opportunities, and (3) more corporate farms.

The effects of any of these forces are influenced by the presence of other forces. For example, the full effects of increased farm exports on U.S. farming would have been significantly different if U.S. income tax rules had not allowed cash accounting by farmers and tax credits for investments. And the effect of inflation combined with increased availability of credit is significantly different than if either of these forces had acted without the other.

The sustained synergistic effects of the seven major forces suggest that in the future the United States will experience:

- Further declines in the number of farms, but at rates substantially less than in the 1950's and 1960's.
- Increasing concentration of production among the largest producers.
- Strong pressures for increased separation of ownership and use of resources.

Inflation, energy prices, and changes in tax rules have changed the prospective character and degree of influence of the major forces affecting farming. Both inflation and the changes in tax rules reinforce the trends toward fewer and larger farms and are likely to accelerate the separation of ownership and use of resources.

Prospective higher energy prices inject substantial uncertainties for the future organization of U.S. farming. The higher energy prices are bound to affect the mix of resources used in farming. There will be increased economic incentives to use energy-efficient systems of production, but the eventual effect on how U.S. production of livestock and crops is organized and managed is highly uncertain.

Regardless of the eventual scenario and whether the changes are described realistically as developments, transformation, or a "revolution," government policies and programs will influence and be challenged by the events.

In rare cases, new programs may be developed; in a few other situations, old programs may be discarded. The more likely outcome is that the objectives of individual programs and related policies which guide their implementation will be challenged and may be found wanting.

Policies and programs will be under increasing pressure to discriminate among recipients to dampen the potential regressiveness of their benefits. Consideration may be given to focusing on income problems of farmers on an individual need basis–an approach similar to the way our society relates to income problems of people who are not farmers. In this context, incomes from both farm and nonfarm activities would be considered. In turn, criteria used in deciding upon implementation of traditional farm-related programs, such as credit programs, would give central emphasis to general economic and social objectives of the country, such as price stability, employment, and balance of trade.

Thus, changes in the way programs are implemented may be as dramatic as changes in farming–and equally revolutionary.

PART II—LIVESTOCK PRODUCTION

Some of the most important aspects of and extensive changes related to the transformation of U.S. farming involve livestock production–especially cattle feeding, poultry and egg production, and hog raising. Changes in cattle raising, as distinct from cattle feeding, are considerably less. Changes in dairying are somewhat less, but an important question is whether the large dairy operations of up to 10,000 cows will be replicated in other parts of the country.

Cattle feeding and poultry and egg production have experienced phenomenal adjustments in the United States. Today, one-half of the cattle fed in this country are fed in 422 feedlots averaging over 30,000 head per year. In 1974, slightly more than 5,000 farms, each with 20,000 birds or more, accounted for nearly 70 percent of U.S. egg production. Sixteen to 17,000 farms, each selling 60,000 or more broilers, accounted for 90 percent of production.

The hog industry also has been experiencing significant changes, but the adjustments have not advanced as far as they have for beef feeding and poultry and eggs. The changes have accelerated, however. In 1974, 10,000 farms accounted for one-fourth of all hog sales. There are now at least 15 to 20 firms with annual marketings of

50,000 to 200,000 head. If these are successful, the number of such firms will increase.

Two-thirds of U.S. beef production come from cattle raising activities and dairy cattle. There is some concentration of cattle raising, but the changes have been much more limited than for hogs, poultry, or eggs. In 1974, farms and ranches with 200 and more beef cows accounted for 3 percent of farms and ranches with beef cows and 28 percent of the beef cows in the United States. Future changes are expected to occur slowly.

Dairying has become a specialized farm activity of commercial farming. The number of commercial dairy farms now is about 200,000, one-third the number in 1950. While adjustments in dairying have been much more limited than in some of the other livestock areas, large-scale production units are being operated successfully in California and Arizona—and a big question is whether their number will increase.

Beef

Cattle feeding has shifted away from small feedlots to very large commercial feedlot operations which utilize industrialized approaches to management, financing, and marketing. As a result, half the cattle fed in this country are fed in 422 feedlots averaging over 30,000 head per year. The other half are fed in more than 130,000 feedlots averaging 90 head per year.

Cattle feeding has increased in importance. But fed beef is still only one-third of all beef produced in the United States. The rest comes from cattle raising activities and dairy cattle.

The South has led all regions in growth of cattle raising since 1950 and has more cows than any other region. The average size of beef cow herds is small—40 head. And there is a large number of farms with beef cows—in 1974, over 1 million. At the same time, there is some concentration of production. In 1964, farms and ranches with 200 and more beef cows accounted for 1 percent of farms and ranches with beef cows and 24 percent of the beef cows in the United States. The respective percentages were 3 percent and 28 percent in 1974.

Further changes are expected in cattle feeding. However, the size of the larger feedlots may not increase much. The more dramatic changes in the coming years likely will involve changes in ownership and organizational arrangements which could facilitate higher utilization rates, lower production costs, and better production control.

Depletion of irrigation water in the Southern Plains and higher energy costs create great uncertainty about the continual concentration of beef feeding lots in this area.

In contrast to beef feeding, changes in cattle raising will occur slowly.

Dairy

Changes in dairying also have been substantial. Milk production, which once was almost universal on farms in the United States, has become a specialized form of commercial farming. Dairying to produce milk for home use has disappeared.

The number of commercial dairy farms today is about 200,000, one-third the number in 1950. They average over 50 cows per dairy farm. U.S. production continues to be concentrated in the Northeast (20 percent) and the North-Central (40 percent) regions. The South and the Southwest each account for about 13 percent.

Technological advances have been paramount in causing changes in dairy farming. These advances have been the principal reason why total farm labor requirements for dairying are now no more than one-fifth of the requirements in 1960. The most dramatic changes in dairying are illustrated by the large-scale drylot dairy operations in California, Arizona, and Florida—with herds of as many as 10,000 cows. The size question is closely related to technology and mechanization. But it also involves attitudes of operators and availability of credit. Obvious questions are: Why have producers in California, Arizona, and Florida found it profitable to organize dairying into drylot enterprises involving as many as 10,000 cows, while producers in the Northeast and Lake States have not developed enterprises of comparable size? Will entrepreneurs develop 5,000- to 10,000-cow dairies in the Northeast and Lake States? Or might such dairies develop in other regions in association with acceptance of newer techniques of product handling, such as reconstitution and sterilization?

Poultry and Eggs

Commercial poultry farms are large. Relatively few of these very large farms produce the bulk of poultry and egg supplies. In 1974, slightly more than 5,000 farms, each with 20,000 birds or more, accounted for nearly 70 percent of U.S. egg production. Sixteen to 17,000 farms, each selling 60,000 or more broilers, accounted for 90 percent of production. Slightly more than 5,000 farms, each raising 3,200 or more turkeys, accounted for 90 percent of production.

Today's poultry and egg industries involve an extensive network of linkages among production units and input-supplying and marketing functions. Coordinating systems cover virtually all commercial broiler production and four-fifths or more of all egg and turkey production. In these systems, much production is under contract to marketing firms or is only one phase within vertically integrated firms.

Extensive coordination of production, input-supplying, and marketing are likely to continue in the future. Further growth of typical production unit sizes is expected. The number of farms producing eggs may decline the most. Little change is expected in numbers of farms producing broilers and turkeys.

Pork

Changes in the hog industry have been especially rapid in the last 10 to 15 years. Total annual production of pork has varied between 12 billion and 15 billion pounds since 1950, when pork provided half the national supply of red meat. Now it provides only a third.

Hog production remains farm-based. Investment opportunities and the importance of corn for feed have kept it that way, but the tie of hog production to land is no longer essential. Advances in technology have permitted hogs to be produced successfully without pasture. Hogs now are produced year-round in low-labor, capital-intensive systems conducive to large-scale production.

The number of hog producers has decreased rapidly. In 1950, there were over 2 million—in 1974, less than 500,000. Size of enterprise has increased accordingly. In 1974, 10,000 farms accounted for one-fourth of hog sales. Producers selling 1,000 or more hogs annually now account for about 40 percent of total production, compared with only 7 percent in 1964. Producers selling 5,000 head or more have at least a sixth of the market. And their operations are growing rapidly.

Lack of necessary managerial abilities and skilled labor and risks of disease have thwarted the successful establishment of extremely large hog production units in years past. But there are at least 15 to 20 firms now in the United States with annual marketings of 50,000 to 200,000 head. Their experience will largely determine the proliferation of other operations of similar size.

Technological changes, credit availabilities, public policies, economies of size, and inflation have been important forces stimulating changes in recent years. These same forces are expected to continue to influence the hog industry in the future and likely will lead to continuation of trends, unless strong countervailing forces develop.

PART III—REGIONAL CONTRASTS IN FARMING

There are similarities and significant differences in the transformation of farming among the U.S. regions. All regions have experienced declines in farm numbers and corresponding increases in farm size.

Several forces have been pervasive in influencing farming and how farms are organized and managed. Technology, nonfarm employment opportunities, credit availability, tax rules, and inflation have had impacts, albeit somewhat differently in each of the regions. Other forces have been important in different regions.

Forces important in the Northeast are: (1) limited amounts of highly productive land and a general division of most land into small parcels hampering the aggregation of large tracts for farm purposes, (2) government dairy programs and cooperative activities influencing the profitability of dairying and the way products are marketed, and (3) low transportation costs enabling producers in other regions to compete with Northeast producers.

Significant forces in the North-Central region are: (1) increased exports stimulating demands for corn and soybeans and thereby sharply higher farm earnings, (2) commodity programs mitigating the risks of lower commodity prices and increasing the chances of significant price increases, and (3) the original approach in settling the Northwest Territory combined with the contiguous nature of highly productive soils facilitating consolidation of land resources.

Major forces in the South, in addition to those common to each of the regions, are: (1) the flat terrain of the Delta facilitating farm enlargement, and (2) hilly terrain such as in the Piedmont retarding consolidation of resources into larger farms.

In the Great Plains, important forces are: (1) inadequate rainfall and, in turn, irrigation in some areas and extensive areas of grassland in others affecting types of farming and related investment requirements, (2) increased exports, especially of wheat, making it possible to relax acreage limitations, and (3) abundant supplies of feed grains and feeder cattle facilitating the development of large feedlots. These forces have combined with others, especially capital goods incorporated in new technologies and commodity programs, to influence farmer decisions in organizing and managing farm resources.

In the Southwest, numerous forces, many of them associated with the generally arid climate of the region and the prevalence of irrigation, have given rise to large-scale and diverse farming.

Forces especially important in the Northwest are: (1) water resource policies, (2) Federal policies related to labor, (3) distances to major markets, and (4) urbanization with population growth. These forces have interacted with others, especially availability of new technologies and Federal commodity programs, to give rise to farming involving (1) significant increases in irrigation, (2) decreases in farm numbers, (3) consolidation of resources into larger farms, and (4) linking of production of individual farms to a growing food processing industry.

In coming years, decisions by farm operators and other owners of resources employed in farming will be affected by continuation of the many forces determining these trends of the past. However, some of the forces may be changing in significant ways, and there are new uncertainties. Changes in energy prices create great uncertainty. The terms of trade among factors of production are changing and will encourage farmers to conserve land and capital goods (including associated energy) relative to labor. Uncertainty is especially great among farmers depending on irrigation. Energy is important to irrigation. Areas, such as the Texas High Plains, which depend on ground water for irrigation may confront pervasive adjustments from irrigation to dryland farming as available water becomes more limited. The possible application of size limitations on farms receiving water from federally funded projects and possible modification of the amount of public subsidy to agricultural users of water by market pricing of water, create other uncertainties in the West.

Unionization of labor and possible restraints on publicly supported mechanization research, stimulated by public concerns about effects of technological change on labor displacement, also may be important to farming, especially in the Southwest.

While there is great uncertainty, trends indicate a slowing of the decline in the number of small farms, a further decrease in the number of middle-size farms, and an increase in the number of large farms. Public debate in the 1980's likely will focus on the increased concentration of production among larger farms and the ever-decreasing marketing opportunities for small farmers. But these issues may be of secondary importance to another related issue—the separation of ownership and use of resources. This separation may increase, especially with respect to land. The substantial value of even moderate-size farms makes intergenerational transfer of resources to a single child extremely difficult, even if tax rules permit avoidance of large tax liabilities at the time of such transfers.

Thus, ownership of individual land parcels in the next two decades will involve multiple ownership by descendants of those who experienced the capital gains of the 1970's. This, in itself, may involve separation of ownership and use of land. Some children not farming will want to sell their interests, but family people may not be able to buy and potential buyers may not be farm operators. In fact, those family members farming likely will prefer that sales be made to people willing to rent the land to them.

The magnitude of these developments probably will be much greater than likely sales to non-Americans. However, the characteristics of the operators and the resulting organization and management of farms may not be greatly different.

Part I.

A National Overview

A Dramatic Transformation

Lyle P. Schertz

FARMS ARE FEWER AND LARGER

Changes in the number of farms and size of farms are two important indicators of the transformation underway in U.S. farming. The number of farms has decreased since reaching a peak of near 7 million in the mid-1930's (*14*).[1] By 1950, the number had declined to 5.6 million. In the following 25 years, the number dropped more than 50 percent to less than 2.7 million (figure 1).

However, the rate of decrease in number of farms has slowed from 2.7 percent per year in the 1950's to 1.1 percent in the 1970's, as indicated below:

Farm numbers		Decline		
Year	Number	Number	Time interval	Per year
	Thou.	*Thou.*	*Pct.*	
1950	5,648			
		1,693	−30	−2.7
1960	3,955			
		1,041	−26	−2.4
1970	2,944			
		216	−9	−1.1
1978	2,668			

[1] Italicized numbers in parentheses refer to items listed in Literature Cited.

A large proportion of the households associated with the 2.7 million farms remaining have nonfarm sources of income. In many cases, it is equal to or greater than their income from farming. Also, close to a third of these 2.7 million farms have annual sales of farm products of less than $2,500.[2,3]

Practically all of the land resources associated with the farms that "disappeared" were incorporated into other farms. Some land went out of production, especially in the Northeast and South. New land—especially in the Southeast and along the Mississippi River—also came into production. So total cropland used for crops in recent years has been almost identical to the total of the mid-1930's—370 million to 380 million acres (figure 2).

As a consequence, the increase in farm size measured by acreage is as dramatic as the decrease in number of farms. Average farm size in acres in the mid-1970's was almost twice that of the early 1950's (figure 3).

A decrease of 60 percent in the number of farms of less than 500 acres combined with an increase of 20 percent in the number of farms with more than 500 acres accounts for a major portion of the increase in average size of farm in the United States, as measured by acres.

The increase in size has been even greater, when measured in actual dollars of cash receipts (figure 4). When these data are adjusted for changes in prices received by farmers, however, the relative changes in average receipts per farm (expressed in 1978 dollars) have been roughly comparable to the changes measured in acres.

INCREASES IN CONCENTRATION AND PRODUCTION

National averages can be severely misleading as indicators of the way individual farms are organized. They mask great differences among farms. For example, in 1974, there were more than 225,000

[2] Time periods used for the analysis vary throughout this manuscript. To the extent possible, data for 1950 to date were utilized. In a limited number of cases, the data previous to 1950 were included to put changes since 1950 in perspective. On the other hand, limitations on availability of data made it necessary to utilize information for even shorter time periods.

[3] A new definition of a farm was introduced with the 1974 Census of Agriculture. However, to facilitate use of time series data, the 1959 definition of a farm is used in this publication: "A farm is any place from which $250 or more of agricultural products were sold, or normally would have been sold, during the census year or any place of 10 acres or more from which $50 or more of agricultural products were sold, or normally would have been sold, during the census year." (*19*) The 1974 definition involves a cutoff of $1,000 in sales receipts. The difference between the two definitions, in terms of the number of farms, was 152,000 in 1974.

FIGURE 1
NUMBER OF FARMS

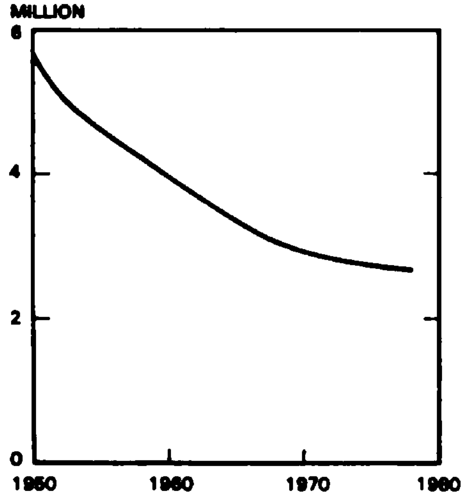


FIGURE 2
CROPLAND USED FOR CROPS

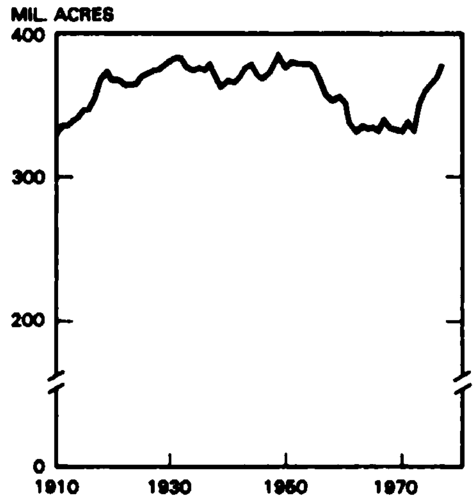


FIGURE 3
AVERAGE FARM SIZE

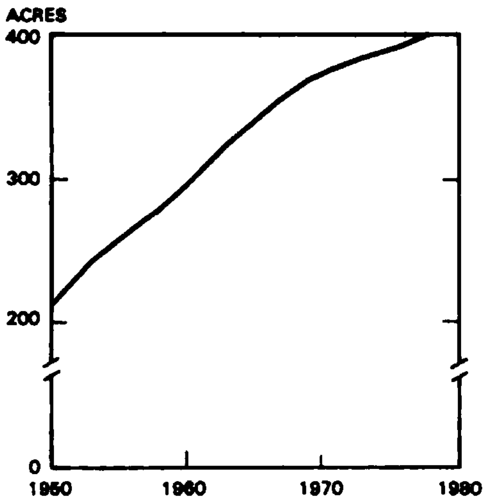
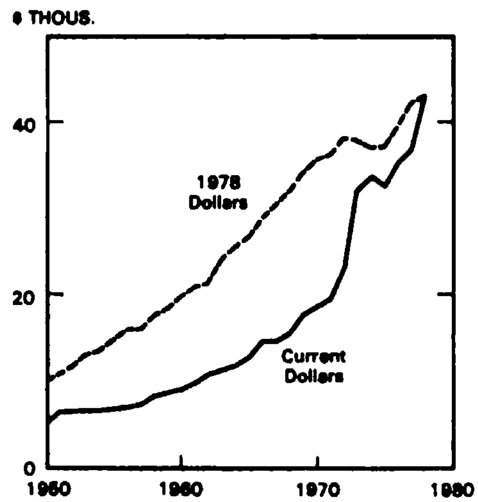


FIGURE 4
CASH RECEIPTS PER FARM



INCLUDES "OTHER FARM INCOME."

farms with less than 50 acres of land (*18*). Conversely, there were 150,000 farms with 1,000 acres or more of land (figure 5).

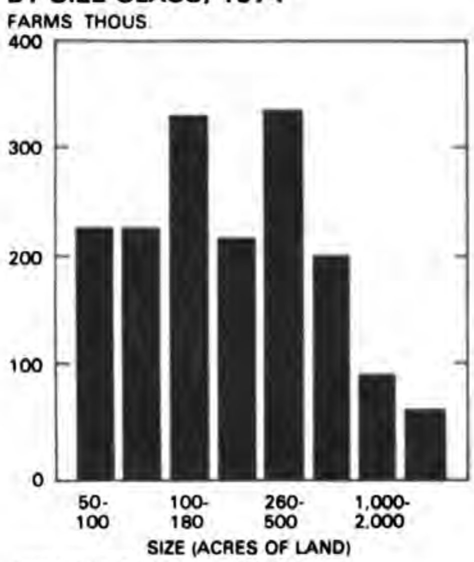
These distributions indicate substantial concentrations of land in large units (figure 6). The concentration is greater for total land in farms than it is for either cropland or harvested land. For example, only 42 percent of the land on farms and ranches comprised of 1,000 to 2,000 acres was harvested in 1974. On farms and ranches with more than 2,000 acres, 12 percent of the land was harvested that year. Range is an important component of land not harvested.

The concentration of land harvested by larger farms has increased over time. For example, on all farms with 1,000 or more acres of land, about 70 million acres were harvested in 1964. Ten years later, the total harvested by farms in the same size class was 100 million acres. Thus, in 1974, slightly less than 10 percent of the farms accounted for one-third of the land harvested in the United States.

Data on the number of farms categorized according to sales of farm products also indicate great diversity among farms (figure 7). Almost 1.8 million farms in 1978 had sales of less than $20,000. Conversely, 187,000 farms had sales of $100,000 or over; one-third of these farms had sales of over $200,000.

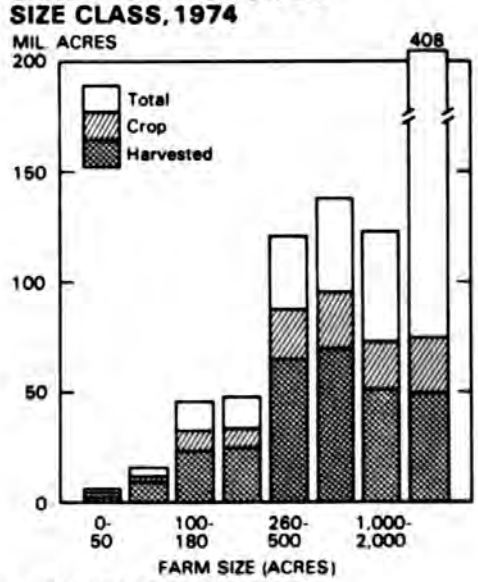
Comparisons over time of the number of farms in different sales classes are difficult to make because of the increases in farm product prices. For example, during 1960-78, prices received by farmers

FIGURE 5
FARM DISTRIBUTION BY SIZE CLASS, 1974



NOTE FARMS WITH MORE THAN $2,500 SALES

FIGURE 6
LAND DISTRIBUTION BY SIZE CLASS, 1974



NOTE FARMS WITH MORE THAN $2,500 SALES

FIGURE 7
FARM DISTRIBUTION BY SALES CLASS, 1978

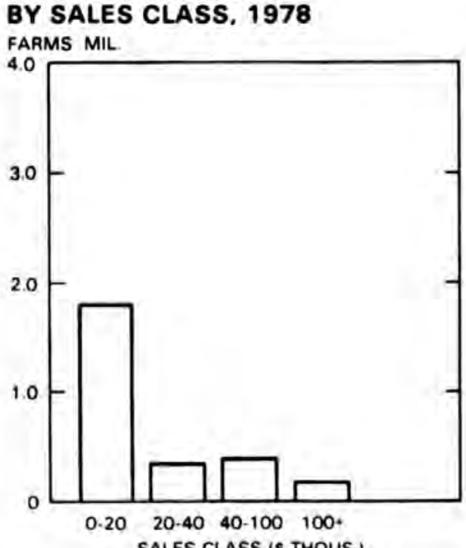
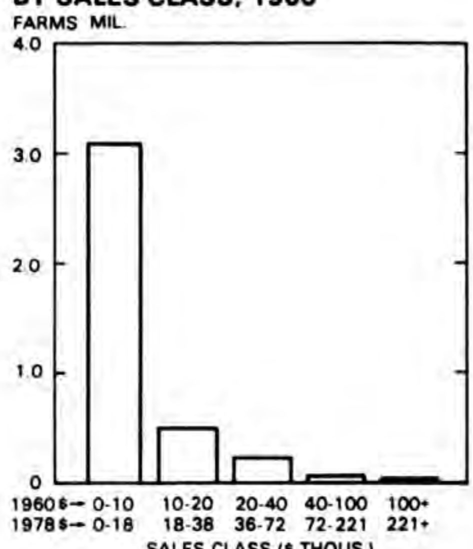


FIGURE 8
FARM DISTRIBUTION BY SALES CLASS, 1960



increased 121 percent. During 1966-78, they doubled (up 98 percent). One way to make a rough comparison, however, is to adjust the sales class "boundaries" by changes in farm prices. Figure 8 reflects this adjustment for 1960. For instance, farm product sales of $20,000 in 1960 would have been worth $44,000 at 1978 price levels, and $40,000 of products in 1960 would have been worth $88,000 at 1978 price levels.

Data for 1960, 1966, and 1978 with sales classes adjusted for changes in product prices reinforce the conclusion that the transformation of U.S. farming is leading to greater concentration of farming in large units, as shown below:

Number of farms by sales classes		1960	1966	1978
Current dollars	*1978 dollars*			
(Thousands)			*Millions of farms*	
0- 10	0- 22	3.1		
0- 10	0- 20		2.3	
0- 20	0- 20			1.9
			Thousands of farms	
10- 20	22- 44	500		
10- 20	20- 40		540	
20- 40	20- 40			253
20- 40	44- 88	227		
20- 40	40- 79		304	
40-100	40-100			390
40-100	88-221	90		
40-100	79-198		143	
100-200	100-200			124
100 & over	221 & over	23		
100 & over	198 & over		43	
200 & over	200 & over			63
Totals		3,963	3,257	2,672

Even though the number of farms with sales of less than $20,000 (1978 dollars) dropped by 40 percent, this group of farms in 1978 still represented two-thirds of all units considered to be farms. Members of households associated with many of these farms have nonfarm jobs as well. The requirements of farming, the increasing number of people per household involved in the labor force, and the amount and timing of hours required for nonfarm work make it increasingly possible for members of households to spend part of their available time farming and the other part engaged in a nonfarm activity.

Concomitant with the drop of nearly 40 percent in the number of farms with sales of less than $20,000 (1978 dollars), the drop of 50 percent in the number of farms with sales of $20,000 to $40,000 and the increase in the number of farms with sales of over $200,000/$220,000 is increased concentration of sales among the larger farms. The percentage of farms in the $200,000-and-over sales class (1978 dollars) almost tripled during 1960-78, and the percentage of sales of this group doubled as shown below:

	Percent of farms	Percent of sales
1960	0.9	19
1966	1.3	28
1978	2.4	39

An indicator of concentration that is not influenced by inflation is the share of total farm receipts received by the 50,000 largest farms. Sales of these farms accounted for 23 percent of farm receipts in 1960; 30 percent in 1967; and 36 percent in 1977.

These same farms constituted 1.3 percent of total farm numbers in 1960, 1.6 percent in 1967, and 1.9 percent in 1977 (*21*).

Ranking of all farms by volume of sales and noting the proportion of sales contributed by the largest 25 percent (4th quartile) is another useful indicator of changes in the concentration of U.S. farming among larger units, as indicated below:

Sales of 4th-quartile farms		
	Sales	
	Gross	Value added
	Percent	
1960	77	61
1970	82	70
1977	85	73

The largest one-fourth of farms accounted for over three-fourths of all farm sales in 1960. By 1977, it was 85 percent. Breimyer's estimates indicate that the concentration is somewhat less when net sales are used as the measurement (*1*). However, the increase in concentration during the 1960's is greater when measured this way.

The current levels of concentration of resources and production in the larger farms and ranches are high, compared with historic levels of concentration in farming. In contrast, these current levels of concentration are extremely low, compared with many industries in the United States—including some that provide inputs to U.S. farming and others that assemble, process, and/or distribute farm products.

Other indicators of the heterogeneity of U.S. farming are the contrasts in average farm size among regions, measured by acreage as well as by sales (figures 9 and 10). Some of the differences, of course, are attributable to differences in the productivity of land.

Many other factors also are important in explaining the heterogeneity of farms. Some of these are the original land settlement patterns, availability of labor, irrigation investments, and implementation of rules associated with available water.

Proximity of off-farm job opportunities also is important in understanding the heterogeneity of farms. Close proximity facilitates combining farm activities with nonfarm employment. Off-farm income is highest among families with small farm incomes (*11*). In fact, the "average" family farm operator with farm sales of less than $20,000 in 1978 had more off-farm income than net farm income. Of these farm operator families, those with $10,000 to $20,000 in sales had the lowest per-family income—farm and nonfarm—of any group of farms (figure 11).

FIGURE 9
AVERAGE FARM SIZE BY ACRES

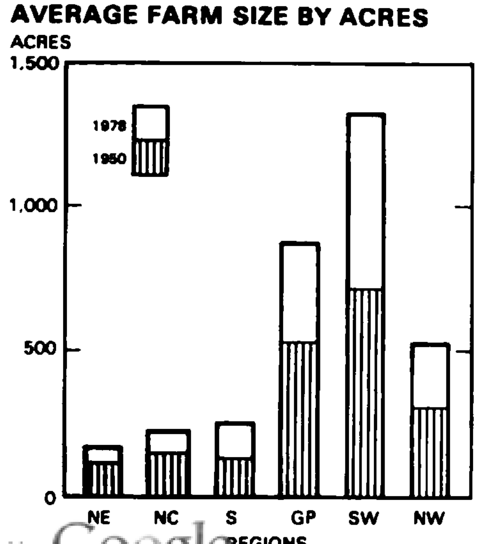
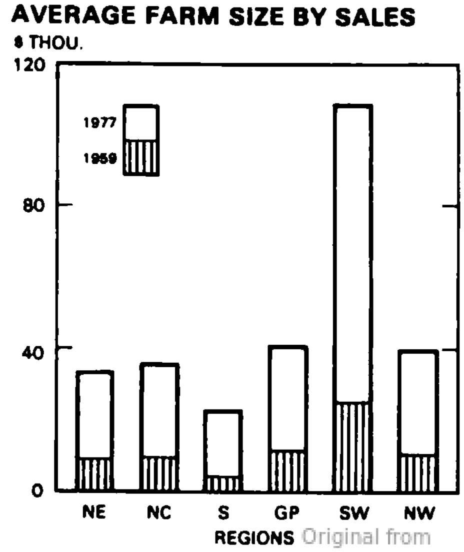


FIGURE 10
AVERAGE FARM SIZE BY SALES



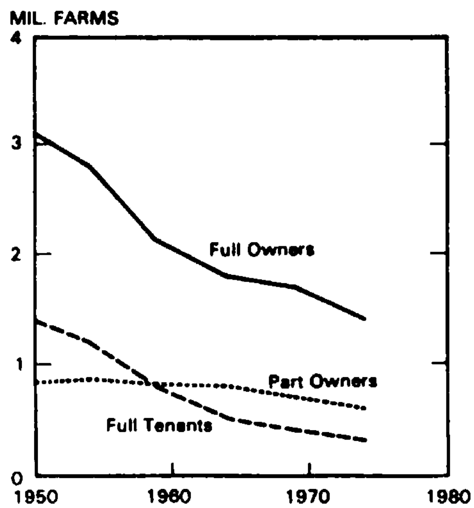
At the same time, we do not know very much about the distribution of off-farm income. The reporting of data does not indicate the proportion of farm operator families in different farm sales classes with off-farm income or the range of this off-farm income among these operators. Thus, significantly different economic situations are reflected in the averages reported. For example, a family with farm income of $7,000 and off-farm income of $2,000 earned by a member of the family working as a part-time carpenter would be included in the numbers for the sales class of $5,000 to $10,000. So would a family with the same amount of farm income but with $75,000 of off-farm income earned by one member of the family as a university professor or as a real estate salesman.

A report by Wilcox (*22*) indicates that a significant proportion of families with low farm income also have low off-farm income. Wilcox estimated, for 1973, the percentage of families living on farms with sales of $2,500 to $20,000 and with sales of $20,000 to $40,000 that had off-farm income of less than $1,000. For the first group of farm families, the percentage for the United States was 16. The range among farm production regions was a low of 5 percent for the Northeast and a high of 26 percent for the Lake States. For the second group of farm families, the percentage for the United States was 39. The range among farm production regions was a low of 23 percent in the Pacific region and a high of 51 percent in the Northern Plains.

PART-OWNER FARMS MORE DOMINANT

Land tenure issues have been enmeshed in many of the major political struggles in the history of our country. They were intertwined with the political philosophies of the framers of the Constitu-

FIGURE 11
NUMBER OF FARMS, BY TENURE OF OPERATOR



tion, who had been influenced by earlier European attitudes toward labor and tenancy. They related significantly to issues of slavery in the South and to the settlement of the Northwest Territory and the West. Through the years, political ideologies expressed in speeches and legislation have emphasized owner-operated farms.

Relevant facts related to land tenure on a national basis for the last 30 years are depicted in figures 11, 12, and 13. Note that:

- The number of farms in each tenure category is declining. However, part-owners (those who both own and rent part of the land farmed) are declining less rapidly; thus, as a percentage of the total number of farms, they have increased. In 1974, they accounted for 27 percent of all farms. Full-tenants have declined rapidly in both number and percentage. Full-owners have increased slightly in percentage.
- Part-owners and full-tenants have larger farms, and the size of their farms has increased faster than the average size of full-owner farms.
- The amount of land operated by full-owners and full-tenants has declined dramatically. Land farmed by part-owners now accounts for more than one-half of all land in farms. The decline of land in part-owner farms during 1969-74 was in three western regions: the Plains, Southwest, and Northwest. Even with the decline in actual acreage of part-owner farms during 1969-74, the percentage of land in those farms increased slightly.

One estimate (*15*) indicates that of the more than 900 million acres in farmland, almost 60 percent is operated by the owners (including land of full-owners and the owned portion of part-owner farms). However, these statistics are not fully adequate and are

FIGURE 12
FARM SIZE, BY TENURE OF OPERATOR

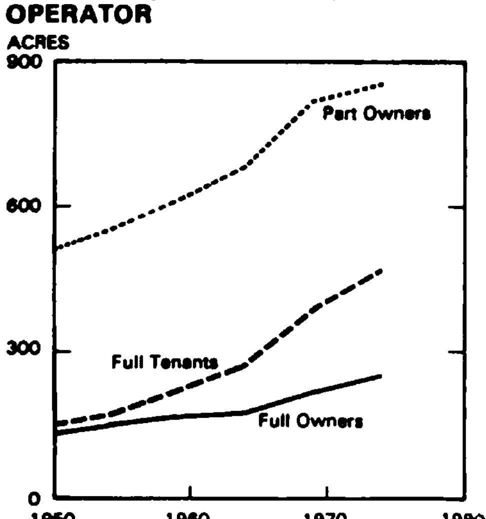
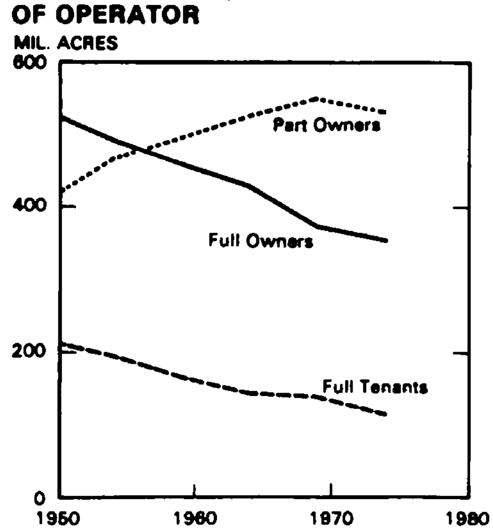


FIGURE 13
LAND IN FARMS, BY TENURE OF OPERATOR



complicated by changes in the way farms operated by managers were shown in tabulations for the 1964 and 1969 censuses. On the basis of these census data, Lewis and Boxley showed that the percentage of land owned by farm operators declined from 62.3 percent in 1954 to 58.0 percent in 1964 (*6*). The change during 1964-69 was confounded by the change in census tabulations. However, there apparently was a slight further drop in the percentage during 1969-74.

CORPORATE FARMS LARGE IN RELATION TO OTHERS

Over time, three primary forms of business organization have characterized farming and ranching operations:

* Sole proprietorships (individuals)
* Partnerships
* Corporations

Individual ownership historically has been the dominant form and in 1974 accounted for nearly 90 percent of farms with sales of $2,500 and over. That year, individually owned farms generally were smaller than partnerships or corporations, measured both by farm acreage and farm sales, as shown below:

Farms by type		Percentage distribution		
	Thousands[1]	*Number*	*Acreage*	*Sales*
Individuals	1,518	89	75	67
Partnerships	145	9	14	14
Corporations	28	2	11	18
Others	4	[2]	[2]	[2]

[1] With sales $2,500 and over.
[2] Less than 1 percent.

These percentages correspond to average acreages and sales per farm in 1974, as follows:

Farm size	Average acreage	Average sales per farm
		Dollars
Individuals	447	36,000
Partnerships	859	77,000
Corporations	3,380	417,000

The 28,000 corporations engaged in farming and ranching in 1974 can be classified by: (1) the proportion of corporate receipts from farming versus nonfarm business activities, and (2) whether the corporation was privately or publicly owned. Almost 97 percent of the corporations were privately held and three-fourths were classified as family corporations, as indicated below:

	Farm corporations Privately held		Publicly held and other
Type	Family	Nonfamily	
		Number	
Primarily farm	20,300	4,500	162
Business-associated	1,500	1,200	785

Some of the words used in the above tabulation have special meaning (*20*). They are:

- Primarily farm: Fifty percent or more of corporate receipts from farming.
- Business-associated: Less than 50 percent of corporate receipts from farming.
- Family: Fifty-one percent or more of stock owned by persons related by blood or marriage.
- Other: Held by religious orders and incorporated charitable and nonprofit organizations.

Over one-fifth of all farming corporations in the mid-1970's were located in California, Florida, and Texas. One-half of these were in California. These corporations were involved primarily in feeding cattle, producing fruits and vegetables, growing nursery and greenhouse plants, and producing sugarcane.

By most measurements, farm corporations are large relative to other farms (with sales of $2,500 or more).

- Family corporations in 1974 had: 1.3 percent of the farms, 7.8 percent of the land in farms, and 9.1 percent of the farm product sales.
- Publicly held corporations were even larger in terms of farm assets and farm production than family corporations and in the same year had: .06 percent of the farms, .6 percent of the land in farms, and 3.4 percent of the farm product sales.

These data further reveal that:

- Family farm corporations, in total, are a substantial part of farming, accounting for nearly one-tenth of farm sales in 1974. They are substantially larger than most farms in that they account for slightly more than 1 percent of the farms.

- The number of publicly held corporations is much smaller than the number of family corporations. However, the publicly held corporations are larger–in 1974, they accounted for more than 3 percent of farm product sales, but they represented only 6/100 of 1 percent of farms with less than 1 percent of the land in farms.

The involvement of corporations in farming attracted a great deal of attention in the last decade. Nationally, corporations are dominant in fruits and nuts, vegetables, nursery and forest products, poultry and cattle production, and sell 28 percent or more of each of these commodities in the United States. In 1974, corporations accounted for a total of 18 percent of "all sales" of farm commodities, as follows:

Sales of all farm corporations, 1974

Commodities	Share of total U.S. marketings	Distribution of corporation sales among commodities
	Percent	
Grain	5	8
Cotton	16	2
Tobacco	3	[2]
Other field crops[1]	25	10
Vegetables	37	6
Fruits and nuts	32	6
Nursery and forest products	60	7
Poultry	28	12
Dairy	6	4
Cattle	33	41
Other livestock	8	3
All sales	18	100.0

[1] Including peanuts, potatoes, sugar beets, sugar cane, popcorn, and mint.
[2] Less than 1 percent.

The farming activities of corporations are large; each averaged almost 3,400 acres and over $500,000 of sales in 1974 (*16*). However, they vary greatly, as indicated below, by average acreages and sales for different types of corporate farms:

Size of farm corporations, 1974

Type	Privately held: Family	Privately held: Nonfamily	Publicly held and other
	Acres		
Primarily farm	3,300	2,900	3,800
Business-associated	1,900	5,300	6,500
	Sales in thousand dollars		
Primarily farm	347	855	4,864
Business-associated	200	578	2,475

There is substantial concentration among corporate farms. For example, family farm corporations comprise 77 percent of all farm corporations and hold 74 percent of the land operated by corporations. But they account for only one-half of the sales by farm corporations, as shown below:

Mix of farm corporations

Type	Privately held: Family	Privately held: Nonfamily	Publicly held and other
	Percent of total		
Farm numbers	77	20	3
Acreage in farms	74	20	6
Sales	50	31	19

CAPITAL GOODS SUBSTITUTED FOR LABOR

Dramatic shifts in the mix and productivity of resources used have been key aspects in the transformation of farming. For farming as a whole, there has been:

- A sharp, long-term decline in the use of labor.

- Relative stability in the amount of land farmed.
- Expanded use of water.
- A large increase in the use of capital goods incorporating new technologies such as chemicals and machinery.

These trends have been associated with:

- A substantial increase in farm production, with increases in crop production relatively greater than increases in livestock production.
- Increased production per unit of labor input.
- Decreased production per unit of capital input.
- Increased productivity of all measured inputs as a whole.

Labor

During 1918, 24 billion man-hours were used in farm work. By 1950, the figure had dropped to 15 billion hours. And by the mid-1970's, less than 5 billion hours were used per year. About 40 percent of farm labor is devoted to the production of livestock and livestock products and 60 percent to crop production (*2*).[4]

While the number of family (operator and family members) and hired workers has declined since the 1930's, the family group has declined more rapidly than the other group—in absolute and relative terms. Family workers in 1977, however, still outnumbered hired workers by a ratio of 2 to 1 (figure 14).

Land and Water

Farms and ranches comprise almost 60 percent of the land surface of the United States. Two-thirds of this is utilized as pasture and rangeland. The remainder is cropland (about 460 million acres). Some of this cropland is used only for pasture, and each year some is left idle. In recent years, 370 to 380 million acres of cropland have been used for crops (figure 15). Of the major resources used in farming, the quantity of land is the most stable.

However, regional shifts have occurred over time. The Northeast has experienced a long-term decline in cropland acreage. In other regions, cropland acreage declined into the 1960's, but has increased since.

Farming not only is the major user of water in the United States, but its use of water also has been increasing. Total consumption of water withdrawn from streams and ground water sources in 1977 for

[4] "Changes in Farm Production and Efficiency, 1977" by Durost was especially helpful in the preparation of this part of the paper. It was the source for most of the data presented in the figures.

FIGURE 14
NUMBER OF FARMWORKERS

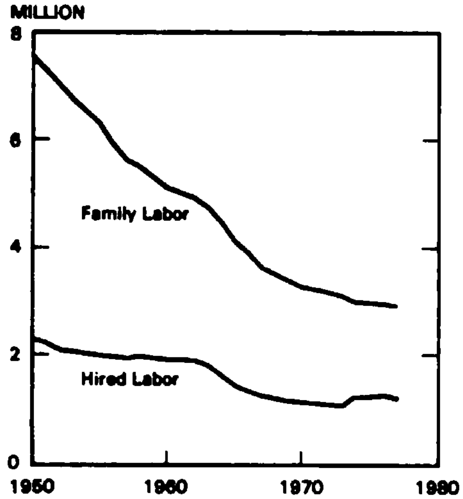


FIGURE 15
CROPLAND USED FOR CROPS

all purposes was close to 110 million acre-feet.[5] Agriculture used 80 percent of this total to irrigate more than 40 million acres of farmland, which was an increase from about 25 million acres in the late 1940's. Most of the irrigation in the United States occurs in the 17 Western States, and they have accounted for most of the expansion in the amount of water used in farming and ranching.

Capital

In the transformation of farming, the decline in labor inputs has been offset by increases in the use of capital goods such as fertilizer, machinery and associated fossil fuels, increased public capital, and higher yielding crops and livestock. The availability and effective use of these inputs reflect the increasing productivity of people providing labor and management.

Fertilizer use has increased more than fivefold since 1950. While the number of tractors has increased less than 30 percent in this same period, the horsepower incorporated in these tractors has increased almost 150 percent (figure 16).

The contrasting changes in the amounts of resources used in agriculture are reflected in the shifting mix of resources. A typical example is the relationship between labor and capital (figure 17).

In 1950, labor accounted for almost 40 percent of the value of all resources used in farming; by 1977, it had declined to 14 percent. In 1950, capital (machinery and chemicals) accounted for 25 percent of

[5] An acre-foot is equal to the volume that would cover 1 acre to a depth of 1 foot, or 325,848 gallons.

FIGURE 16
TRACTOR HORSEPOWER

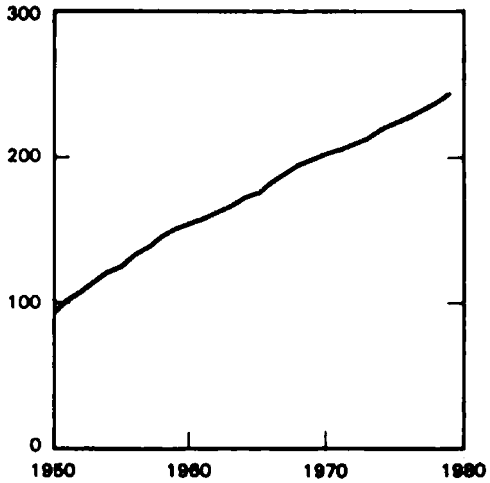
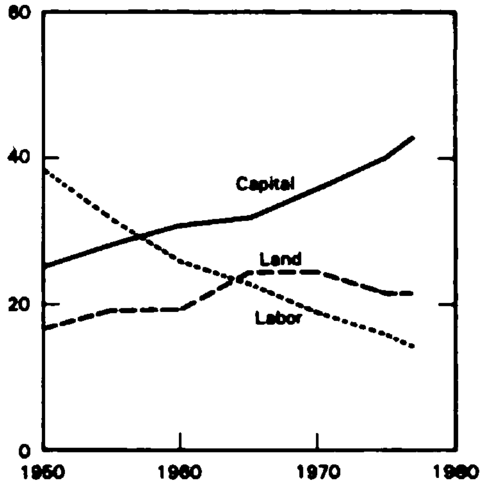


FIGURE 17
RESOURCES USED IN FARMING



all resources used in farming; by 1977, it had increased to 43 percent.

The shift in resource mix, showing a substantial substitution of capital goods for labor, reflects changes in the characteristics of inputs, as well as their productivities and changes in the prices of the inputs. The characteristics of each of the three general types of resources have changed dramatically. Land has been influenced by its tillage, cropping, and treatments (*9*). Today, laborers as a whole are better educated than they were 25 years ago. The mix of capital goods has changed substantially. In fact, an overwhelming majority of the capital goods used on farms in the 1950's would be considered obsolete today by commercial farm operators. Until the 1970's, there was a strong price incentive for farmers to substitute capital goods for labor. Figure 18 shows *changes* in prices by time periods—the decade of the 1940's and so forth. For example, the price of labor went up 229 percent during 1940-50. In contrast, land prices increased 103 percent.

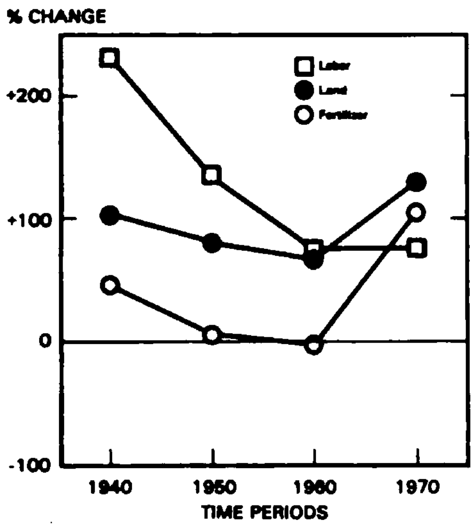
Note that the relative increases in prices paid for labor (wages) exceeded price changes in other categories of inputs during each of the three decades—the 1940's, 1950's, and 1960's. During 1970-77, however, the price increases for fertilizer and land exceeded wage increases. These changes are lessening incentives to substitute capital inputs for labor.

The total quantity of inputs in U.S. farming has been remarkably stable since World War II (figure 19). In contrast, the total quantity of farm output has increased over 60 percent since 1950. As a result, the index of productivity (output per unit of input) has increased approximately 70 percent since 1950 while in the preceding three decades it increased only 40 percent (figure 20).

While overall productivity has increased since 1950, there are significant contrasts in the way productivities of different inputs have changed during the period (figure 21). The ratios illustrating these changes must be carefully interpreted (*5*). For instance, the ratio of crop production to land reflects several things. It reflects both the productivity of land itself and the changing productivities and amounts of other inputs used in combination with land to grow crops. Examples of these other inputs are: capital items such as drainage associated with land, technology associated with seeds and other inputs such as fertilizers and their associated technologies, and human capital embodied in labor and management.

Similar reasoning is important in thinking about the productivity

FIGURE 18
CHANGES IN PRICES PAID BY FARMERS



CHANGES OVER TIME PERIODS — 1940's, 1950's, 1960's, AND 1970-77

FIGURE 19
FARM INPUT AND OUTPUT

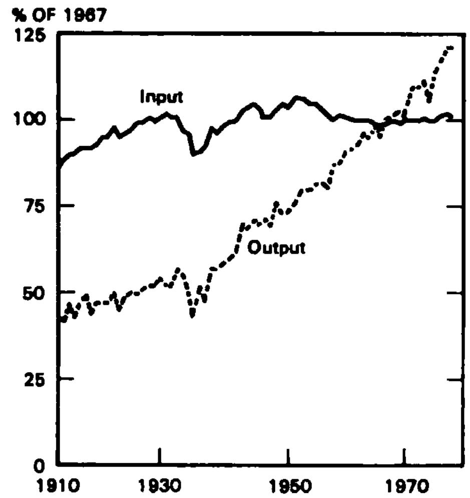


FIGURE 20
FARM PRODUCTIVITY

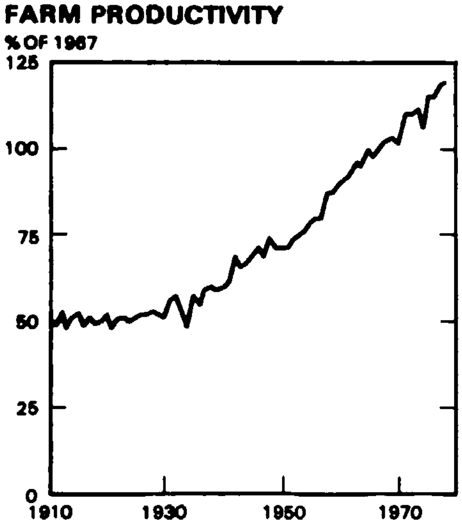
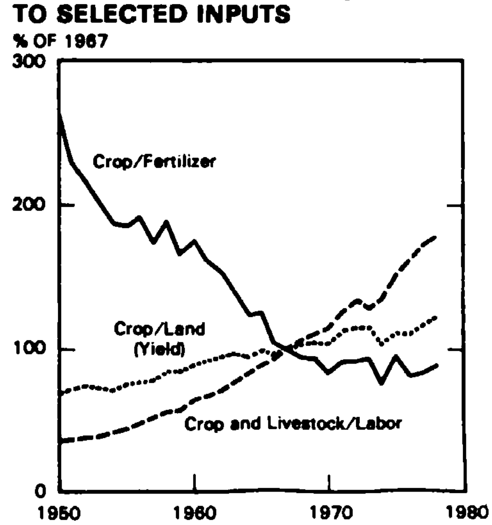


FIGURE 21
RATIOS OF FARM PRODUCTION TO SELECTED INPUTS



of labor employed in farm production. Thus, the ratio of crop and livestock production to labor reflects the productivity of labor in farming and the productivities and amounts of other inputs used in combination with labor to produce crops and livestock. Further, nonfarm labor is important to the manufacture and availability of many of these other inputs, such as machinery and fertilizers. Additional resources, especially capital goods and labor, are important to the marketing, processing, and distribution of farm products. Consequently, many types of work done on farms in earlier years are now done away from the farm.

The shift in location of different types of work is an important aspect of the transformation of U.S. farming. Farmers have become more specialized in production activities. More inputs are manufactured and prepared off of farms than previously. Marketing, processing, and distribution also have been shifted increasingly off of farms.

Labor productivity comparisons between the farm and nonfarm sectors often are made. Output per man-hour in farming has increased more rapidly than in nonfarm industry for many years. Problems of interpretation of these kinds of ratios are analogous to those cited above for land productivity. Estimates of the proportion of production specifically attributable to each factor of production (such as labor) are not available, either in terms of an average for U.S. production or how production would change if small changes were made in the amount of the individual factors of production.

In conclusion, the transformation underway in U.S. agriculture has, in the last 20 to 30 years, involved dramatic shifts in the mix of resources used in production. Farmers and ranchers, as a group, have increased the use of capital (such as fertilizer and machinery) and water. Their use of land has been relatively stable and their use of labor has declined greatly. While all prices have increased, there have been signifcant shifts in the relative prices of land, labor, and capital used in farming. The price of labor increased relative to land and capital items into the late 1960's. While all prices increased in the 1970's, prices of land and capital items increased more than the price of labor.

SUBSTANTIAL CHANGES IN DISTRIBUTION OF INCOMES AND WEALTH

Significant changes in the distribution of income among farm people and substantial adjustments in the distribution of wealth among Americans have accompanied the increasing concentration of farming into larger units. More specifically, financial data for farming reveal:

- Increased farm income.
- Large increases in the wealth of landowners.
- Increased returns to resources in farming.
- Greater concentration of income and wealth.

Increased Farm Income

The changes in distribution of income and wealth in farming are occurring in the context of significant changes in total income and wealth (*13*). Farm income of the farm population as a whole was relatively stagnant from the mid-1950's into the early 1970's (figure 22).[6] Farm income and export sales rose dramatically in 1973, and inflation influenced the level of practically all commodity prices.

Throughout the last 20 years, income of farm people from off-farm sources has increased steadily, as an increasing proportion of the farm population undertook nonfarm work while continuing to live on a farm. Since the late 1960's, the nonfarm income of farm people has been greater than their farm income—except in 1973 and 1974. The relative increases in per capita income of farm people were larger than the relative changes in total incomes shown in figure 22. For example, the farm population has dropped from 23 million in 1950—15 percent of the U.S. population—to less than 8 million in recent years, which is not quite 4 percent of the U.S. population.

The per capita income of farm people has increased substantially in the last 25 years[7] (figure 23). However, this increase has been so eroded by inflation that 1978 average income in terms of purchasing power was roughly equal to what it was in 1962-64.

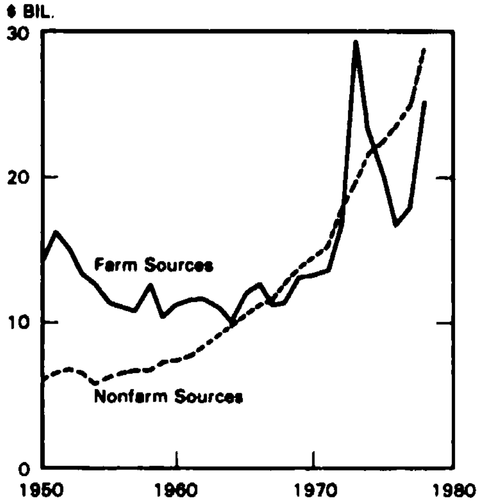
Measures of income to farming as an industry also show substantial increases over the years (figure 24). For example, average 1976-78 earnings of farm production assets, "farm earnings," were $20.3 billion. This was more than three times the average for 1960-62. Adjusting for inflation, the 1976-78 average was slightly more than 50 percent above the 1960-62 average.

Farm income of farm families does not include: (1) farm-related incomes of farmers who do not live on farms, (2) farm-related incomes of nonfarm landlords, or (3) farm wages of hired labor. "Farm earnings" are the total of: (1) net income of farm operators

[6] The farm population consists of people living in rural territory or places of 10 or more acres (if $50 worth of agricultural products were sold from the place in a year). People on places under 10 acres also are included if sales from their places are as much as $250.

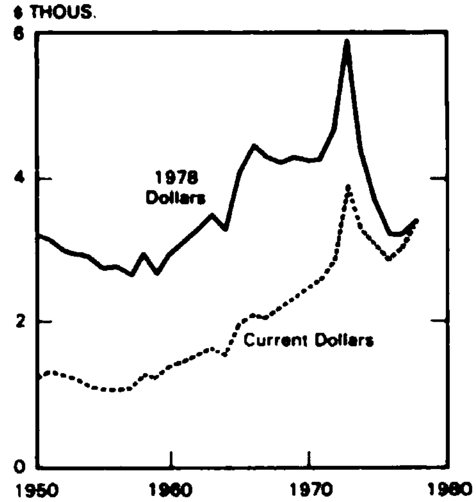
[7] Per capita income expressed in 1978 dollars takes into account both the change in population discussed earlier and inflation of prices of products purchased with incomes. These calculations used the index of prices paid by farmers for items used in family living.

FIGURE 22
TOTAL INCOME OF THE FARM POPULATION



FARM SOURCES INCLUDE GOVERNMENT PAYMENTS, AFTER INVENTORY ADJUSTMENT

FIGURE 23
PER CAPITA INCOME OF THE FARM POPULATION



NOMINAL INCOMES FROM ALL SOURCES DEFLATED WITH INDEX OF PRICES PAID BY FARMERS FOR FAMILY LIVING, 1978 = 100

living on farms; (2) farm income of farm operators living off farms; (3) cash wages and perquisites of hired labor; (4) interest on real estate and nonreal estate debt; and (5) net rent received by nonfarm landlords—less: the imputed interest portion of the rental value of farm dwellings and imputed returns to labor and management—as published in (*3*).

The Wealth of Landowners

Farm people have experienced a dramatic increase in wealth as a result of increases in farm earnings (*8, 10*). Farm physical assets (land

FIGURE 24
FARM EARNINGS

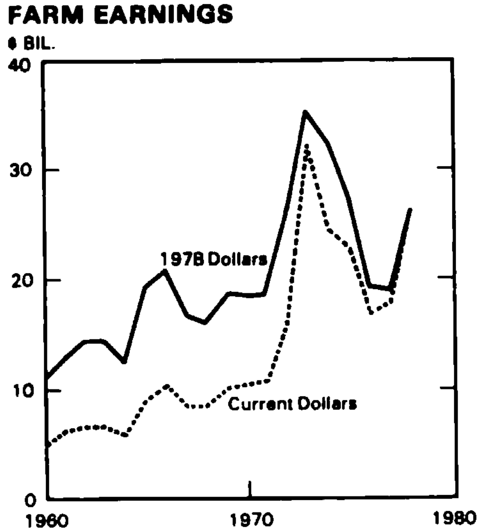
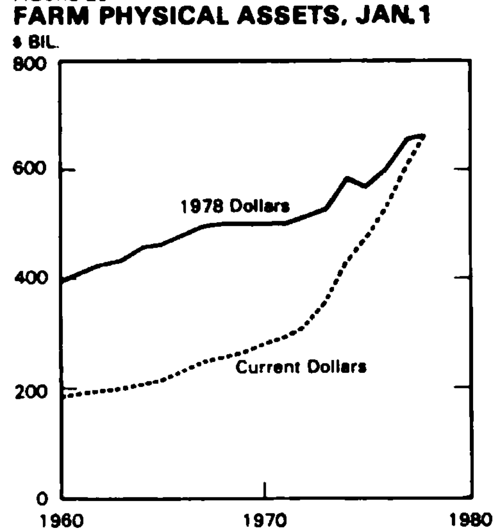


FIGURE 25
FARM PHYSICAL ASSETS, JAN. 1



and buildings, machinery, livestock, and crops stored on and off farms) more than tripled in value during 1960-78 (figure 25). When adjustments are made for inflation in the same 18 years, value increases from $400 billion to $660 billion, a rise of 65 percent.

Real estate is the largest component of assets (almost 80 percent) and accounts for a slightly larger proportion of capital gains—84 percent of the change in value of all farm physical assets minus net investment for the 1960-78 period as a whole.

The increase in value of farm assets, especially farm real estate (land and buildings), has had a strong influence on the wealth and, perhaps, income of those owning the assets. Further, it has had important implications for the entry of people into farming, the exit of others, and ownership of the physical resources devoted to farming.

The magnitude of *increases* in farm wealth may be understood better when related to changes in farm wealth (capital gains) as well as farm income over time (figure 26). For example, asset value changes in recent years have been much greater than in the 1960's. Increases in farm wealth also have been large compared with farm earnings and income of farm people, as indicated below:

Value of farm physical assets:	*Billion dollars*
January 1, 1960	180
January 1, 1972	315
Increase from—	
1960-71	140[1]
1972-78	433
Farm earnings—	
1960-71	98
1972-78	157
Farm-related income of farm population—	
1934-59	288
1960-71	141
1972-78	150

[1] Capital gains during 1960-71 were slightly greater than the change in asset values because of the small net disinvestment in farm real estate.

In the 7 years during 1972-78, the value of U.S. farm assets more than doubled. This increase of over $400 billion in wealth was nearly

3 times total farm earnings in the same period and equivalent to the total of farm income of *all* the farm population during 1934-71.[8]

It is useful to conceptualize the capital gains of farm physical assets in two components:

- The inflation offset—an amount of capital gains on assets that would retain the purchasing power of the value of the assets. Annually, this would be based on the rate of inflation and the value of the assets at the beginning of the year.
- Other capital gains—the remaining portion of the capital gains on the assets.

These capital gains on farm physical assets follow:

Period	Inflation offset	Other capital gains	Total
		Billion dollars	
1960-64	10	26	36
1965-69	36	33	69
1970-74	112	90	192
1975-78	158	128	286
Total	316	267	583

In only 2 years have capital gains failed to be equivalent to inflation (figure 27). Conversely, the "inflation offset" accounts for slightly over one-half of the capital gains. Thus, the increase in farm-related wealth of farm asset-holders has surpassed the effects of inflation by a wide margin, and their "real" wealth has increased substantially. Farm wealth as a proportion of total national wealth increased from 7.7 percent in 1970 to 8.7 percent in 1978 (*7*).

One perspective of the distribution of these capital gains is provided with the recognition that of all possible owners such as people, partnerships, and corporations, there are only 6.2 million owners of farmland in the country (*17*).

A further notion of the distribution of these capital gains is provided by estimates on the distributions of landowners and their land in 1978 (*17*). For example, in the Northeast, two-thirds of the landowners each owned less than 50 acres of farmland. Together,

[8] Four publications (*3, 4, 12, 13*) were especially helpful in the preparation of this section. These publications are the sources of all data related to wealth and income used in this part of the paper, unless indicated differently.

FIGURE 26
CAPITAL GAINS, FARM PHYSICAL ASSETS

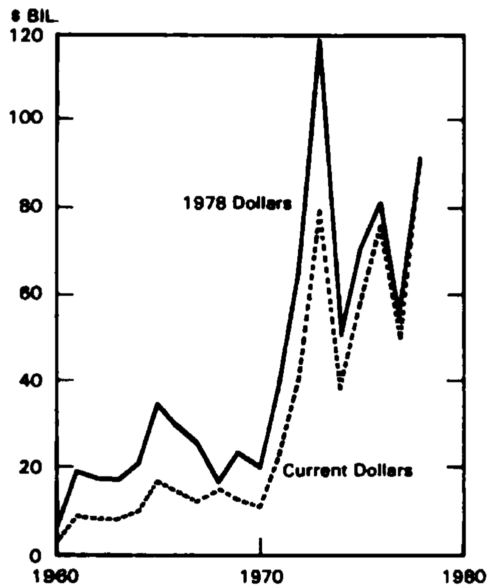
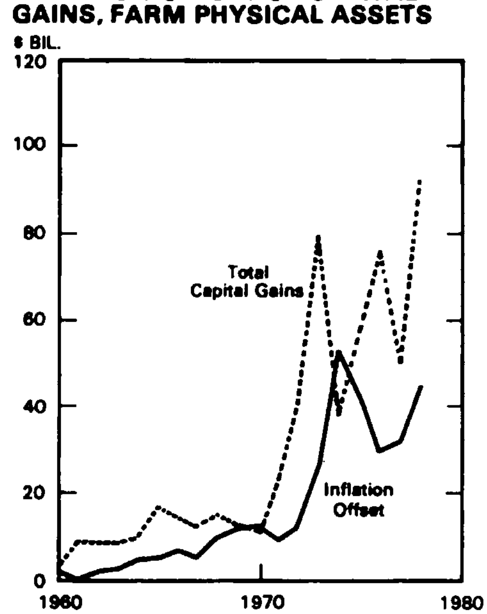


FIGURE 27
INFLATION OFFSET OF CAPITAL GAINS, FARM PHYSICAL ASSETS



these owners possessed 15 percent of the farmland of the region (figure 28). In contrast, two-tenths of 1 percent of the owners owned more than 1,000 or more acres of farmland. Together, they possessed 21 percent of the farmland of the region.

Comparable percentages for the six regions are:

Distribution of farmland owners and acreage owned

	Owners with less than 50 acres		Owners with more than 1,000 acres	
	Percent of—		Percent of—	
	Owners	Land	Owners	Land
Northeast	66.4	14.9	.2	20.7
North Central	43.5	6.8	.3	23.5
South	69.3	14.3	.4	26.3
Great Plains	35.0	1.8	3.3	23.3
Southwest	77.6	6.3	4.7	67.5
Northwest	72.7	6.3	5.9	60.9

Distributions according to value of land (estimated by owners) avoid problems associated with variations in quality of land and

FIGURE 28
DISTRIBUTIONS OF OWNERS AND LAND (ACRES)

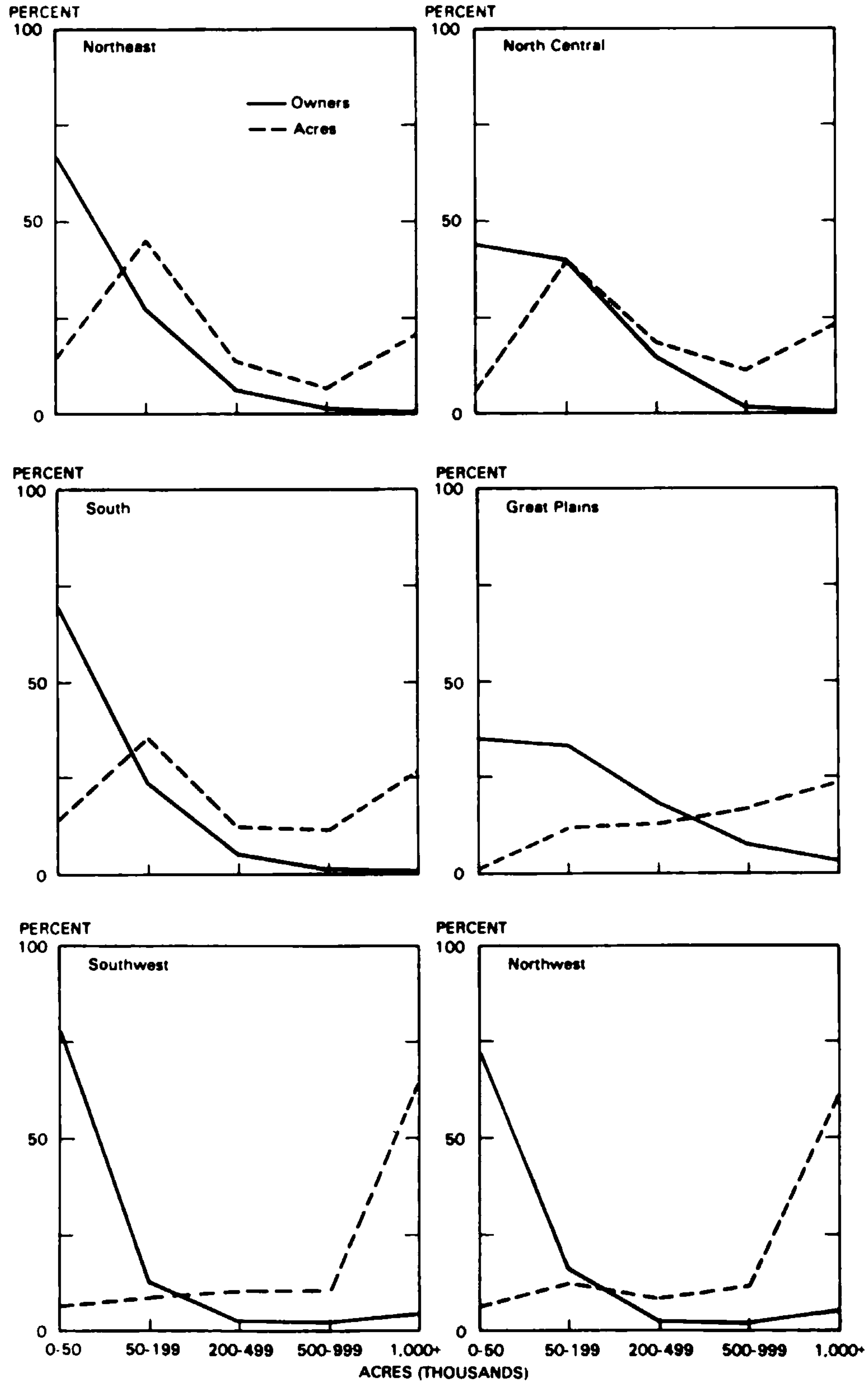
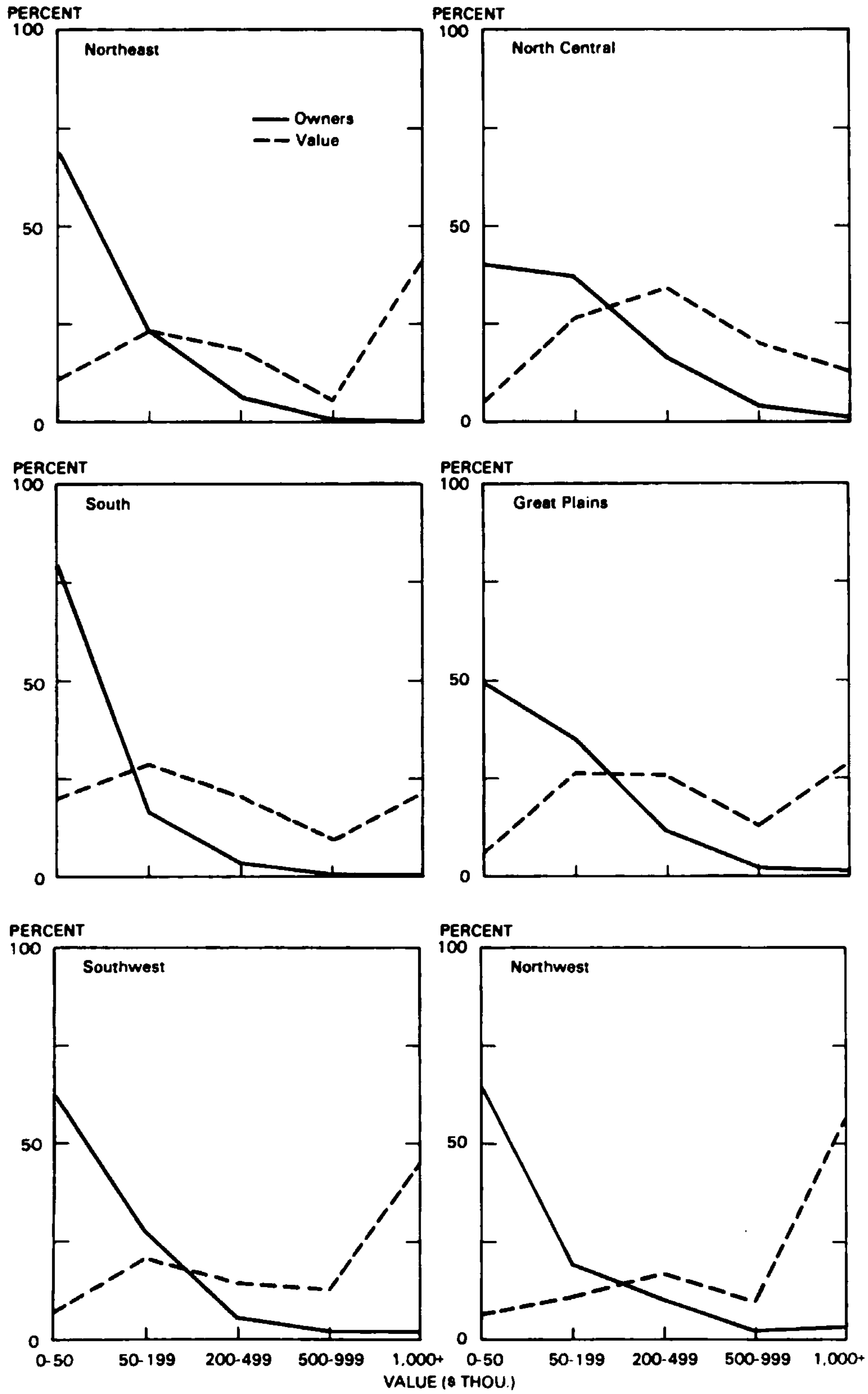


FIGURE 29
DISTRIBUTIONS OF OWNERS AND LAND (VALUE)



reinforce the conclusion that the capital gains associated with farm assets are highly concentrated (figure 29). Comparisons of distributions follow:

Distribution of farmland owners and value of land owned

	Owners with farmland valued less than $50,000		Owners with farmland valued more than $1 million	
	Percent of–		Percent of–	
	Owners	Value of land	Owners	Value of land
Northeast	69.0	11.2	.4	40.8
North Central	40.0	5.4	1.2	13.7
South	79.3	20.0	.4	21.3
Great Plains	49.4	6.1	1.1	28.9
Southwest	62.2	7.9	2.1	44.1
Northwest	64.5	7.0	3.4	55.6

Thus, owners of land worth $1 million or more constitute .4 of 1 percent to 3.4 percent of all owners of farmland in the six different regions. Together in the individual regions, these owners possess 13.7 percent to over 50 percent of all land, in terms of value.

Increased Returns to Resources in Farming

Returns to investments in farming have increased over time and relative to investments in common stock of U.S. industry (figures 30 and 31). These returns have affected expected future returns to farming and, in turn, the demand for farm assets, particularly land. The attractiveness of returns to farm assets relative to returns on common stock helps explain why some farm people are interested in expanding their holdings of farm real estate. This also is why nonfarm Americans and investors from other countries seriously consider farm opportunities.

A comparison of averages of these returns in the 1960's and the 1970's illustrates the increased financial attractiveness of farming relative to common stock, as shown below:

Returns: farming and common stocks

	Farming		Common stocks	
	Annual earnings	Capital earnings	Annual earnings	Capital gains
		Percent		
1960-69 avg.	3.46	4.53	3.19	6.99
1970-78 avg.	4.69	11.59	3.92	0.72

For example, the .27 annual earnings spread between farming and common stock in the 1960's widened to .77 in the 1970's. In the 1960's, the capital gain return from farming was one-third less than from common stock. In the 1970's the capital gain return from farming was over 11 percent per year, while the comparable common stock return was less than 1 percent (7).

Income and capital gains differ, but they both affect the economic welfare of people. Income is available immediately; capital gains are not, unless the assets are transferred. Conversely, capital gains are associated with asset values, and asset values often are the basis for borrowing money. Therefore, capital gains can be monetized even in the short run.

Income is taxable for the year in which it is received. Capital gains are not taxable until "realized"—and then only 40 percent of the

FIGURE 30
FARM RETURNS

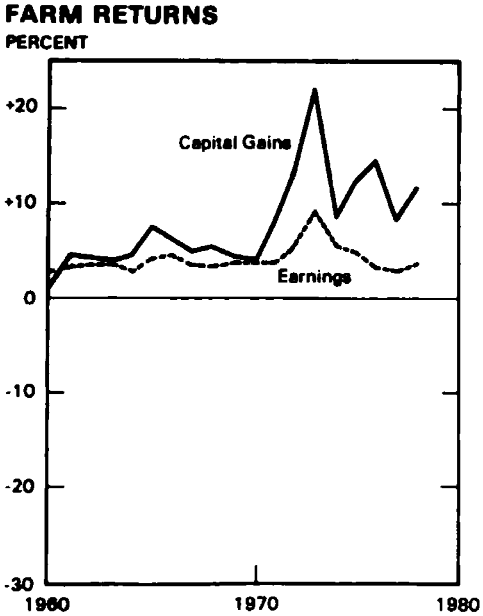
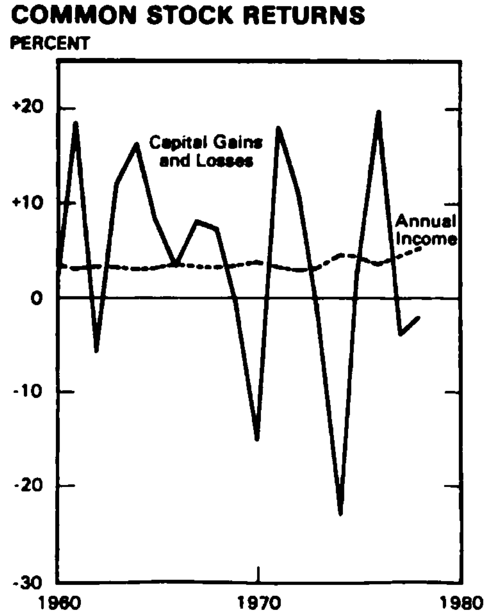


FIGURE 31
COMMON STOCK RETURNS



gain is subject to income taxes. Most people prefer to receive a portion of returns immediately as income or realized capital gains, while delaying the realization of a portion of the capital gains or perhaps some income (e.g., as with annuities). The balance varies among people and over time. Those without assets, of course, have no choice with respect to capital gains.

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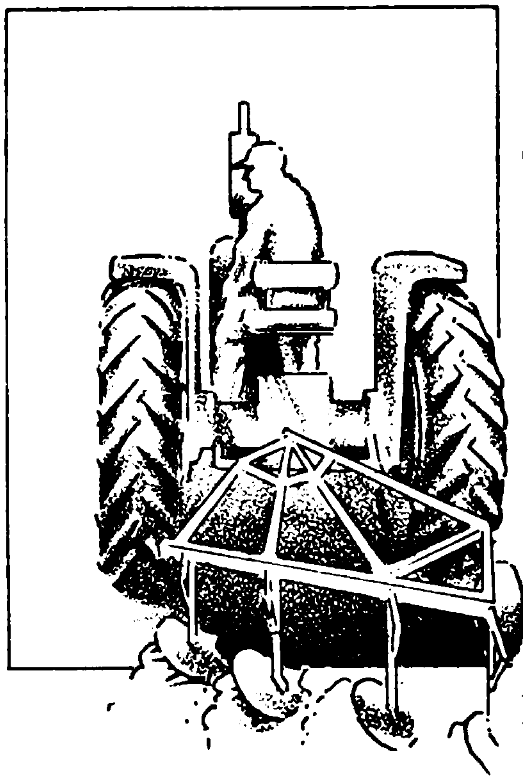


The Major Forces

Lyle P. Schertz

INTRODUCTION

Many forces have influenced the decisions of individual farm operators and providers of resources used in farming (*4, 8*). The combined effect of these forces has influenced the way individual farms are organized and managed and thus has influenced the total transformation of U.S. farming, as described in the previous chapter.

Of the many forces that have affected U.S. farming, seven have had an overriding influence on the way that individual farms are organized and managed. They are:

- Inflation.
- Increases in farm product exports.
- Availability of capital-intensive new technologies.
- Nonfarm employment opportunities.
- Availability of institutional credit for the purchase of land and capital goods.
- Commodity programs supporting farm product prices.
- Tax rules applicable to incomes and estates.

The effects of any one of these forces are influenced by the presence of other forces. For example, the full effects of increased farm exports on U.S. farm organization and management would have been significantly different if U.S. income tax rules had not allowed cash accounting by farmers and tax credits for investments.

Few professional research efforts have been dedicated to measuring the way different forces affect the size and number of farms and the concentration of production among farms. Neither the direction of the impacts of various forces nor the quantification of the relationships has been effectively studied. The consequent dearth of research information has led some people to be extremely cautious about ascribing any cause-and-effect relationship among variables—such as the forces listed above and characteristics of farming such as numbers and sizes of farms (*7*).

But such a posture is not sufficient for this effort. Instead, it was decided that, despite the dearth of research information, it would be useful to:

- Identify those forces the author believes have major effects on the way U.S. farming is organized and managed.
- Describe the characteristics of these forces.
- Postulate relationships among these forces and U.S. farming.

Thus, the following should be considered as a set of hypotheses to be discussed, criticized, revised, and researched.

There are problems in discussing the effects of forces on U.S. farming. Is the relevant standard and, therefore, basis for comparison of a socioeconomic system devoid of all aspects of the force being considered? This approach is not used in this chapter. Instead, attention is given to selective variations of the present. The contrast is illustrated by the following: there is uncertainty that the elimination of all income and estate taxes in the present system would contribute to a smaller or a larger number of farms. Conversely, selective changes in parts of the tax system would have a high probability of leading to a smaller number of farms. For other selected changes, a similar or opposite effect might be anticipated.

EFFECTS OF INFLATION

Inflation has a primary impact on four aspects of U.S. farming:

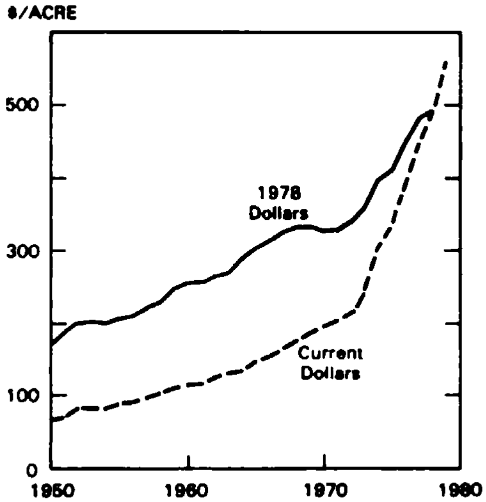
- It increases the wealth of those who own land.
- It increases the demand for land.
- It strengthens the relative economic position of the wealthier and higher income people in buying land.
- It increases input prices and stimulates farmer purchases of these inputs.

Through these effects, inflation (compared with stable prices) leads to fewer farms, larger farms, and greater concentration of production, income, and wealth among those associated with the larger farms.

Increased Wealth

The historic relationship since World War II between inflation and farmland prices is clear and unmistakable (figure 32). As previously

FIGURE 32
FARMLAND VALUE



described, the wealth of U.S. farmland owners has increased sharply during the last few years as prices of land and other assets have increased in response to increased returns—income and capital gains—from farming. Along with this increase, a greater concentration of the wealth (associated with land) among fewer landowners has occurred. Thus, the distribution of wealth among people in farming, as well as between the farm and nonfarm groups of people outside of farming, is affected by inflation.

Demand for Land

Inflation also leads to increased demand for farmland. An increase in wealth of those holding land is an important component of this demand. In inflationary periods, successful bidding to purchase land is heavily influenced by a combination of the policies of lending institutions and the cash flows available to bidders who are not dependent on the land being purchased. Thus, those with assets and related income streams can bid more successfully for land than can those without other assets.

The relationship between inflation and land prices has led to the expectation that, in the future, increases in land prices will be associated with inflation. For this reason, people seriously consider landownership as a way to accumulate wealth and hedge against inflation.

There are other opportunities for taking advantage of inflation and coping with its effects. For example, the availability of credit has increased opportunities to purchase houses. The prices of houses also have had a close relationship to inflation. At times in the past, industrial stocks also have been important options. Recently, foreign currencies and precious gems have been utilized more extensively than in the past, but credit for these activities is limited.

Farmland still represents a significant portion of the wealth of the United States, and its price has been especially attractive in relation to recent inflation. The pervasiveness of the presence of farmland and the record of its upward price changes have affected the desire of both rural and urban people to own land. It also is important to remember that inflation encourages present owners to retain their land, which limits the availability of land for sale.

Economic Position of Wealthy

Whether as protection from inflation or for other reasons, not everyone who wants to own land is able to do so, especially in the amounts that may be desired. Cash flows that are not dependent on the land being purchased, the availability of credit, and prices determine who can purchase farmland.

Purchasers of farmland today must have access to monies that are not dependent on the land being purchased. While the arithmetic is relatively simple, its effect is very selective in determining who is able to outbid others for the purchase of land. Interest rates for borrowing money from, say, the Federal Land Banks to purchase farmland are 9 to 10 percent. Estimates (*27*) indicate that in the 1970's returns to land based on land prices and land rentals have been about 5 percent.[9] Historic price changes suggest a long-term price increase in land of an additional 6 to 7 percent per year, yielding a combined eventual return of 11 to 12 percent annually to owners, based on current land prices. But the cash flow is negative if a significant proportion of the purchased price is borrowed. Only the current returns, such as land rentals (5 percent in this example), are available in the short run to pay interest charges and payments on principal associated with the purchase of land (*23*).

Thus, potential purchasers of land can be divided into two groups—those with income or monies in addition to the farm income attributable to the land purchased and those without such income or monies. The first group can outbid the second group for land. In some cases, the first group includes landowners who have income from land that previously was purchased or inherited. In other cases, they have other income or assets that can be sold to generate money with which to service the debt on the farmland to be purchased. Thus, people with sources of money other than the land being

[9]These estimates are based on the value of farmland and gross cash rent adjusted for property taxes, management, maintenance, and an allowance for buildings. The specific annual estimates ranged from 3.9 to 5.8 percent for this particular calculation of the rent.

purchased have a clear competitive edge over people without such alternate sources.

Intrinsic to this grouping of potential purchasers of land are the policies of lending institutions. Availability of money to prospective land purchasers (other than the potential earnings associated with the land purchased) influences the willingness of these institutions to extend credit. This is particularly true in inflationary periods when prices of the land and, in turn, the loan amounts, exceed levels consistent with the potential earnings of the land in farming. But such loan amounts may not be inconsistent with expected earnings that reflect annual incomes, as well as capital gains. The net result in terms of who buys land and, therefore, landownership and size patterns can be affected by lending policies. These relationships suggest that the effects of similar lending practices are different in periods of continuing inflation from those in periods of stable or falling prices. In turn, an important issue is raised–should lending practices change as the economy shifts from stable prices to inflation and vice versa?

Commodity programs and tax policies also reinforce the economic strength of those farm and nonfarm individuals who have cash flows other than those associated with land purchased. Because the risk of commodity prices falling below support levels is minimized, potential buyers and credit institutions are willing to extend themselves further than they might otherwise. Income tax regulations permit interest payments to be deducted from incomes associated with land purchased as well as other farm and nonfarm earnings; and only 40 percent of any capital gains is taxed when gains are realized. Thus, the trend toward increasing farm size and investments in farms for reasons other than farming are encouraged by inflation and reinforced by agricultural commodity programs and tax policies.

Input Prices and Farmer Purchases

The primary effect of inflated farm input prices on the organization of U.S. farming is twofold: (1) production costs rise in the short run; and (2) individual farmers accelerate purchases of capital goods (such as machinery) that have capacities greater than needed for their present farm.

Costs of farm inputs respond quickly to inflation. In comparing potential 1980 income conditions to 1974, Tweeten and Griffin (*24*) estimated that "... each percentage point increase in the inflation rate reduces net farm income ..." \$.7 billion to over \$2 billion (current dollars). The range of estimates was related to the level of price elasticity of aggregate demand used to make the estimate.

Unfortunately, they did not deal directly with the effect of inflation on the value of assets in farming and, in turn, on the wealth of those who hold these assets. The nonfarm inputs used in farming are produced largely by firms that operate within a system of administered prices. Negotiated wages, advertising to influence prices, restraints of production to levels less than plant capacities to maintain or increase prices, and regulatory setting of prices such as utility and transportation rates are involved. These kinds of changes respond quickly to inflationary forces and developments.

Inflation also affects the attitudes of farm operators toward the size of equipment and buildings purchased and influences the timing of the purchase of these and other farm inputs. One effect is that individual producers and the industry as a whole tend to overinvest in capital goods, when considered from society's viewpoint. But the actions are quite rational for individual entrepreneurs, whether they are farm operators or people engaged in doing custom work for farm operators. Their reasoning is that prices are likely to increase further; such increases could mean a speculative gain or at least mitigate potential erosion of the market price of the assets being purchased. This rationale also encourages lenders to make credit available for equipment, even if the capital goods will not be fully utilized immediately.

Thus, the effects of accelerating the purchase of these inputs are twofold. First, in the short run, the investments add to the cost structure of U.S. agriculture and are reflected in lower profits of the industry. This effect is translated into pressures for higher price supports and other government actions which would increase farm receipts. Second, in periods of inflation, people tend to purchase equipment with capacity greater than necessary for land under their control. They then seek more land, which contributes to the consolidation of land into larger operating units.

EFFECTS OF EXPORTS

There are three characteristics of changes in exports of U.S. farm products that have had a pronounced effect upon the organization of U.S. farming. They are:

- Large export sales of cereals and oilseeds to the Soviet Union and other countries in 1972-74. These led to sharp increases in farm product prices and domestic farm incomes.
- Sustained export demand for U.S. farm products. As a result of the export demand, there have been only modest restraints on production to realize politically acceptable prices and farm incomes.
- Increases in feed grain and soybean exports. These increases and

the resulting product prices have encouraged Corn Belt producers to specialize in the production of grain and soybeans.

In 1972, the Soviets purchased 28 million tons of cereals; 18 million tons came from the United States. Wheat purchases from the United States were one-fifth of the total U.S. wheat supply (1972 production plus stocks carried over from preceding years). U.S. farm prices and incomes increased in response. By 1974, prices received by farmers were 70 percent above 1971 levels. Prices of feed grains had more than doubled, and prices of food grains, wheat, and rice tripled. Realized net farm income of farm operators increased correspondingly, reaching $30 billion in 1973, compared with $13 billion in 1971. These dramatic developments led Carter and Johnson (*3*) to state that "... after the introduction of the tractor, the most important shock affecting the structure of American agriculture in this century has come from abroad in the form of increased market interdependence."

Many farmers received incomes never imagined before. In the short run, farmers were challenged to find ways to reduce their taxable income. Deferral of farm product sales and purchase of inputs for future production seasons were important options. In addition, tax regulations encouraged the purchase of capital items such as tractors, combines, and pickup trucks. Depreciation could be used to lower calculated taxable income, and investment tax credits allowed by tax regulations directly lowered any tax obligations. These purchases in many cases enhanced the capacities of owners to farm areas larger than they had previously operated. These capacities, combined with higher farm prices and incomes encouraged aggressive bidding for available cropland. Consequently, real estate prices and rents increased.

Expanding markets also have had a very important effect on commodity programs. For example, large increases in exports in 1972 and 1973 practically depleted the large stocks of grain held in the United States. In turn, farmland was no longer held out of production via commodity programs. Since the 1972-73 increases in exports, the volume of shipments has been sustained at high levels. These high export levels have resulted in commodity programs with only limited constraints on production. Some notion of the importance of these higher export levels is indicated by changes in the proportion of corn, soybean, and wheat production exported, as shown on top of page 49.

These exports have affected the organization of U.S. farming in another way. Increases were concentrated heavily in feed grains and soybeans. This put price pressures on the commodities. In turn, farmers in the North-Central region increasingly specialized in

Crop	1968-70 average	1976-78 average
	Percent	
Corn	12	29
Soybeans	43	55
Wheat	41	53

the production of grains and soybeans. Livestock became relatively less important in this region, as indicated by the following percentage distributions of cash receipts:

Cash receipts, North-Central States				
Period	Livestock	Crops	Corn	Soybeans
		Percent		
1959-61	70	30	10	8
1969-71	63	37	15	13
1975-77	51	49	20	17

EFFECTS OF NEW TECHNOLOGIES

Capital goods incorporating new technologies have had a vital role in the transformation of U.S. farming to larger and more specialized units. Four-wheel-drive tractors, electronically controlled harvesters, pesticides, fertilizers, hybrids, livestock disease-controlling drugs, and high-energy feeds are examples of new technologies for producing crops and livestock. These new technologies have been generated by public and private research endeavors. In recent years, there has been an increasing amount of new technology available for adoption and utilization in U.S. farm production, promoted by publicly supported educational endeavors and private business.

When adopted, the capital goods that incorporate new technologies lower costs of production and facilitate growth in the size of individual farms. In some cases, such growth is required for the capital goods to be economical. Most emphasize increased output per worker.

While technology has been important in the adjustments of farmers, it is not clear that it is more important than many other forces. It is a necessary but not a sufficient factor for the changes underway. For example, adoption among farmers and ranchers of new technologies has been stimulated by the competitive nature of farming and the drive by individuals to maximize incomes. Decisions to utilize new technologies and increase the size of farm activities have, over a period of time, been stimulated by increases in labor prices relative to increases in prices of capital goods. Other forces such as inflation and tax rules have encouraged these decisions as well. Thus, the net result has been the adoption of capital-intensive new technologies, and these have facilitated increases in the size of farms operated by the adopters.

Discovery and Communication of New Technologies

Both public and private monies are spent to discover and communicate new technologies that can be incorporated into capital goods useful in farming. Substantial amounts of money support public research and education aimed at maintaining and improving the efficiency of farm production. In addition, private U.S. businesses devote considerable resources to research that will enhance their profits. Further, in marketing their products, these businesses attempt to influence prospective customers' understanding of and attitudes toward the technologies incorporated in the products. The communication media also have been important in informing farmers of these new technologies.

Some new technologies discovered through research involve relatively simple adjustments to contemporary farm production methods. These findings often are directly communicated to producers. Increasingly, however, new technologies require incorporation into capital goods manufactured by industry. Capital goods such as drugs, pesticides, computers, machinery, and equipment constitute a substantial portion of the $80 billion to $100 billion total cash expenditures made annually by U.S. farmers. Some examples (1978 data) include:

Farm inputs, 1978	*Billion dollars*
Seed	3
Fertilizer	6
Machinery and equipment	6
Tractors	3
Livestock	10

In addition, there are several categories of expenditures (also in 1978), which are closely related to those identified above, such as:

Other inputs, 1978	*Billion dollars*
Fuels and oil	5
Repairs, etc., of farm capital items	6
Purchased feed	14

Demand for New Technologies

A primary effect of the new technologies is lower unit costs of production for adopters. Successful new technologies enable the adopters to expand production without incurring substantial increases in average costs of products produced; in some cases, the technologies lower the costs of production substantially. Further, especially with respect to mechanization (such as four-wheel-drive tractors), the new forms of technology are capable of being used in combination with large amounts of other resources such as land. Some technologies can be used on small as well as large production units; hybrid seeds and fertilizers are examples. However, for many technologies, large-scale production units are intrinsic to availability and adoption. In contrast, efficiencies associated with technologies that are discovered, developed, and distributed seldom are limited to small-scale units.

Even scale-neutral technologies often are biased toward large-scale production units. Such technologies facilitate control over larger quantities of farm resources and production. Production processes are more predictable and more stable because of them. Thus, the need for intense managerial attention to small quantities of resources used in production is reduced; this is especially important in dealing with crop pests and livestock diseases.

Studies of technical economies of scale (input and product prices not affected by farm size) for alternative levels of production on individual farms and ranches are limited in number and generally dated. These studies reflect the technologies of the late 1950's and, with one notable exception, assume that size of farm does not affect prices paid for inputs or prices received for products.

Studies of the technical economies of size generally indicate that average production costs decline until a farm size utilizing 3 man-years of labor is reached. In 1976 dollars, this would imply approximately $1 million in assets (*25*).

Most of the limited number of studies indicate, as does Martin (*15*), that "... economies of size exist in farming, and ... these economies, whether technical or pecuniary, have been a driving force toward larger and fewer farming units in the United States, especially in the irrigated West."

Significantly, four-wheel tractors, electronic harvesting equipment, and computerized systems for monitoring crop conditions have become available since the period for which most studies apply. These technologies probably have lowered the potential average costs of production on larger farms.

The concept of the smallest size at which lowest average costs are realized is important, but of equal and perhaps greater importance is the characteristic of costs beyond the point where the lowest costs are first realized. Available studies do not show significant diseconomies for farms substantially larger than those associated with the lowest cost estimates. On the other hand, the gradualness of the increase of farm size for most farm products suggests that either the risks of increasing size at a faster rate are very high or that diseconomies are significant.

In addition, pecuniary economies are available and can have substantial effects on costs and incomes. For example, Krause and Kyle (*11*) in 1971 estimated the differences between input and output prices among different size corn farms ranging from 500 to 5,000 acres. Input prices for the largest farms were estimated in some cases to be as much as 25 percent below the prices paid on 500-acre farms for the same inputs, amounting to savings of slightly over $13 per acre. And the return received for corn was $.05 a bushel more. Thus, the pecuniary economies associated with larger farm size reinforce the economies resulting from the adoption of technologies.

As Paarlberg (*18*) points out, farms of a size beyond the point that efficiencies are realized can make more money because of larger volume—not because of lower per unit costs of production. Most farmers prefer more rather than less income and, in fact, will make substantial efforts to realize larger incomes. Thus, an appreciation of the "lack of diseconomies" and pecuniary economies can be of substantial importance to an understanding of the increases in farm size.

In some cases, the new technologies have involved costs that are not internalized in the costs to the individual farmer, but nonetheless must be borne by society. For example, some people argue that certain additives fed to livestock and pesticides used on crops have detrimental effects on the health of people because of concentrations of chemicals in the food chain. Economy-of-size calculations do not reflect costs of this nature. In addition, some economic entities find it economical to acquire and manage additional resources (including farm resources) to spread overhead-type costs over a larger volume of business. Legal, accounting, and computer costs are examples. Such costs typically are not included in economy-of-size studies.

Dynamics of Adoption

The adoption of capital goods incorporating new technologies is influenced by several considerations, aside from effects on management control and economies of size. They include:

- Nature of competition among farmers.
- Drive for increasing incomes.
- Changes in the relationship of labor and other input prices.
- Pecuniary economies of size.
- Conditions of the other major forces discussed in this chapter.

The nature of competition among U.S. farmers and ranchers and the drive to maintain and increase income and wealth by some farm operators and people who provide services and resources to farmers are two factors which explain why technologies are adopted.

For most products, the vast majority of the producers are small in the sense that changes in the quantity of their production will not significantly affect the prices of their products. Therefore, individual producers focus on ways to lower costs and expand production. Early adopters of new cost-reducing techniques realize the benefits in terms of higher profits. But as adoption becomes more prevalent, the production of many producers increases, and the effect on market prices becomes significant. Those who have not yet adopted the new techniques find themselves on a "treadmill." They must consider using these techniques to avoid a squeeze on income or discontinue farming or ranching.

Those techniques that lower costs significantly can mean substantial rewards for the early adopters. The income of the entire industry may be smaller due to the inelasticity of demand, but so long as individual producers cannot influence price, they do not consider such overall effects in making their decisions to adopt new technologies.

Coupled with the treadmill phenomena is the "drive" of some farm operators, as well as providers of goods and services to farm producers, to increase income and wealth. Profits of businesses serving agriculture are closely related to the volume of their sales. Thus, they encourage the adoption of their capital goods by producers. Other suppliers of resources to farming also strive to increase their income and wealth. Included among these people are the entrepreneurs who are amassing substantial amounts of land, accumulating production assets such as feedlots, acquiring large-scale equipment, and/or assuming product and price risks associated with large-scale production such as beef feeding. The human capabilities involved in these aspects of the transformation of U.S. farming include not only technical knowledge but also organizational and profit-maximizing interests and abilities. Therefore, these human abilities are being associated increasingly with capital-intensive technologies.

Sometimes, single individuals are the key input to the decisions. In many others, however (e.g., the larger beef-feeding lots, poultry production farms, and fruit and vegetable farms), the management skills of large industrial firms such as the multinational grain trading firms and the international fruit producing firms are involved.

Further, it is possible that the purchase of some capital goods also is stimulated by pecuniary economies of scale. The Krause and Kyle study of corn farms showed that large farms have an advantage in purchasing inputs and selling products. We also know that buying and selling activities of large farms are spread over larger volumes. Therefore, when there are advantages to doing so, large farms devote increased attention to shopping for inputs and products, staying abreast of such markets, bargaining for price advantages, and considering adjustments in quality, quantity, and timing of products produced to realize price gains.

In addition, commodity programs mitigate the financial risks of such decisions; prospective inflation encourages early commitments to acquire the related resources; tax rules encourage expenditures to obtain investment tax credits and "move" current income to "potential" capital gains; availability of credit makes it possible for many, especially those with assets, to implement their decisions.

Entry and Exit Easy for Some

In combination, these conditions have meant that entry into farming and enlargement of farm activities was relatively easy for those who had initial assets—farm and/or nonfarm—and the drive to expand. The expansion of large-scale beef feedlots in recent years is a good example. Those with money, some nonfarm and farm investors, were looking for alternatives and larger income streams and were willing to invest in cattle-feeding operations. Organizational innovators saw an opportunity to feed cattle on a large scale because technologies that facilitated the confinement of large numbers of cattle together became available, and production of feed grains in the Texas and Oklahoma Panhandles increased.

The technical capability of confining large numbers of poultry and a dramatic expansion in demand for poultry meat made it possible for some operators to expand rapidly and others to enter poultry production on a large scale. Resources formerly used in poultry production were transferred to other activities, rather than accepting the unit returns acceptable to the new competition. This willingness to leave was influenced by possible returns in other agricultural pursuits and in nonagricultural activities.

Implicit in these aspects of the transformation of U.S. farming is product specialization. The farmers who gave up poultry production while continuing to farm used their resources on a smaller number of products. At the same time, adopters of the new technologies found it advantageous to emphasize production which exploited these technologies. Pecuniary economies reinforced this orientation.

One of the major results of the new technologies is to facilitate efforts by some individuals to control large amounts of production resources. It is this control over a large amount of resources (large farms and ranches) that affords the opportunity to realize increased income and wealth. In crop production, the adoption of modern machinery has led to production systems that have extremely high unit costs at small volumes of production and low costs at large volumes. Similar production functions are associated with large-scale poultry, beef, drylot dairy, and confinement hog-feeding units.

EFFECTS OF NONFARM EMPLOYMENT OPPORTUNITIES

Over many years, the opportunity for farm people to migrate to cities for better economic opportunities has facilitated the consolidation of land into larger farms.

The migration out of farming has been extensive. Higher urban wages and salaries, more attractive jobs, and better educational opportunities in contrast to lower relative farm wages, limited employment opportunities, and low returns in agriculture combined to produce a large exodus of people from rural agricultural communities to urban centers. By 1977, the U.S. farm population was less than 8 million, compared with a high of over 32 million in the post-World War I period and again at the height of the subsequent depression. The changes in farm population during the decade of the 1960's illustrate the differences among certain regions, as shown below:

	Farm population		
	1960	1970	Percent decline
	Million		
Northeast	1.0	.6	39
North Central	4.4	3.3	25
South	4.8	2.3	52

EFFECTS OF CREDIT EXPANSION

There has been a rapid expansion in the use of credit for purchases of real estate and capital goods to be used in agricultural production. The productivity of land and other inputs such as buildings and machinery in agricultural production affects the demand for credit. But demand for credit is affected significantly by inflation as well because (as indicated in the discussion of inflation) speculation based on farm assets recently has yielded very attractive returns.

Credit for agricultural activities is obtained from many sources—including the national and foreign money markets, insurance companies, local banks, sellers of inputs, the farm credit system, Farmers Home Administration (FmHA), Commodity Credit Corporation (CCC), and owners/sellers of farm real estate. Some of this credit is based on savings of agricultural income and increases in the value of farm assets; much of it, however, is based on savings of nonagricultural income and, to some extent, on taxes.

It follows from the discussions in the section on inflation that the effects on U.S. farming of the availability of institutional credit in periods of stable prices are different from the effects in periods of inflation. In periods of stable prices, availability of institutional credit strengthens the economic position of those with limited resources who want to farm relative to wealthier and higher income people. In contrast, in inflationary periods, availability of credit strengthens the economic position of the wealthier and higher income people relative to those with limited resources.

Thus, in inflationary periods, contraction of institutional credit would restrain price increases of farmland, land price earnings ratios would be lower, and the gap between earnings and payments to service farm loans would be narrower.

Expansion

The use of credit in farming has expanded rapidly since World War II. In 1950, farm debt was only $12 billion. By 1978, it was $120 billion (figure 33). This increase has been related to increases in the prices of land and capital goods, as well as large increases in the quantity of capital goods (figure 34). In addition, farmers and those who lend to them have been more willing in recent years than in the past to arrange greater amounts of debt for given levels of assets. This means that debt-to-assets ratios have increased substantially since the 1950's, even though they are still less than representative averages for nonfarm industries.

There are wide differences in the use of credit among farmers and regions. Farm debts as a percent of total farm assets are highest in the Southwest and lowest in the Northeast, as shown below:

Region	Debt-to-asset ratio Average 1975-77
	Pct.
Southwest	20
Northwest	19
Plains	16
South	16
North Central	14
Northeast	13

Farmers with large operations utilize more credit than do those with smaller farms—both in terms of quantity of debts and debts relative to assets. Estimates of average per-farm debt and total debt in the farming sector by class of farms as of January 1, 1977, were as follows:

	Agricultural debt, 1977		
Sales class	Average per farm	Total, all farms	Debt-to-asset ratio
Thou. dol.	*Thou. dol.*	*Bil. dol.*	*Pct.*
Less than 2.5	4	4	4
2.5 to 5	7	2	6
5 to 10	10	3	8
10 to 20	17	5	9
20 to 40	47	15	17
40 to 100	89	31	19
100 and over	264	43	24
	38	103	16

Demand

Historically, farming activities have been financed primarily from savings out of incomes earned in farming. These savings frequently have been supplemented by inheritances and other gifts, but the relationship between farm income flows and asset values of typical

FIGURE 33
FARM DEBT

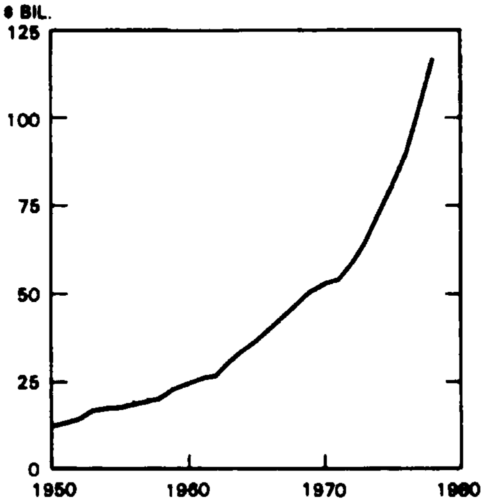
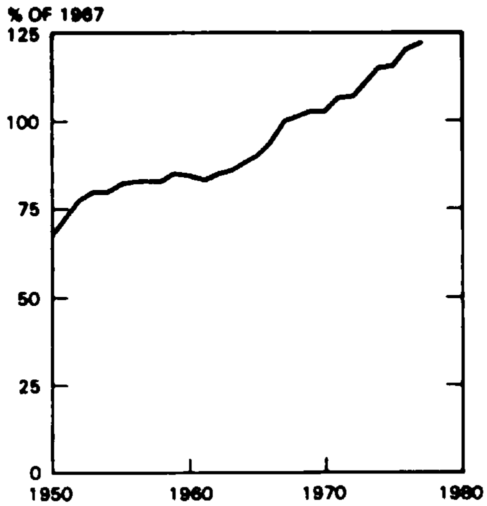


FIGURE 34
CAPITAL GOODS USED IN FARMING, UNITED STATES, QUANTITY INDEX



farms has been such that internal savings could pay for a farm in a lifetime . . . a more difficult accomplishment now. This shift is illustrated by the following comparison of U.S. estimates of proprietors' farm income and farm assets:

	Proprietors' farm income	Farm physical assets, Jan. 1	Assets-to-income ratios
	Billion dollars		*Percent*
1950	15	119	8
1960	13	191	15
1970	16	292	18
1977	24	621	26

The dynamics of inflation can enable proprietors to escape the restraints implicit in these asset-income ratios. The challenge is to price the assets before inflation but pay for them in later years with higher commodity prices. In summary:

- Farm-related incomes are increasingly inadequate to pay for a farm in a lifetime.
- Potential capital gains, however, make asset ownership extremely attractive. Thus, there is increased demand for credit to provide an opportunity to receive the associated income and increase in value of assets, such as land. In contrast, if prices began to decline and deflation, rather than inflation, ruled,

assets would be revalued. Debt-equity ratios would change dramatically, and demand for credit would diminish.

Supply

Credit for agricultural pursuits is made possible by the savings of American farm and nonfarm people, as well as people and governments of other countries. In addition to savings, U.S. taxes provide a base for a limited amount of credit available through CCC loans and FmHA loan programs. The supply of credit available to the agricultural community is related to:

- Nonfarm lending opportunities perceived by those who control the savings.
- Attitudes of lenders toward risks in agriculture.
- Institutional arrangements for tapping money markets, such as the Federal Land Bank selling securities in New York and, in some cases, Europe.
- Government programs which make it possible to use taxes either directly to make loans, such as the CCC price-support loans, or indirectly by guaranteeing loans from nongovernmental institutions.

There have been substantial changes in the relative roles of the various suppliers of credit (figures 35 and 36). The Federal Land Bank currently supplies one-third of the credit secured by farm real estate. Individuals–often sellers–provide almost the same amount. While the relative role of life insurance companies has declined, the total value of farm real estate mortgages held by insurance companies has tripled since 1960. The proportion of insurance company

FIGURE 35
FARM DEBT BY LENDER

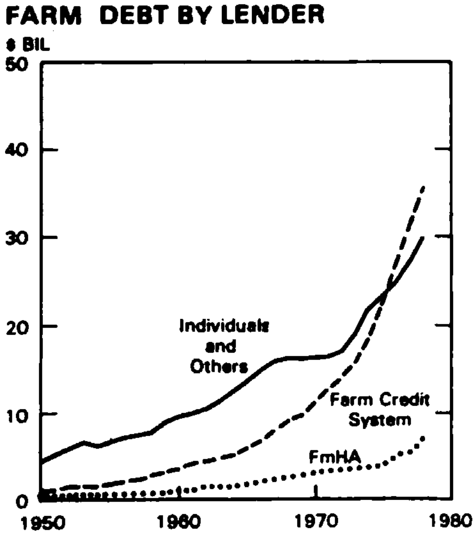
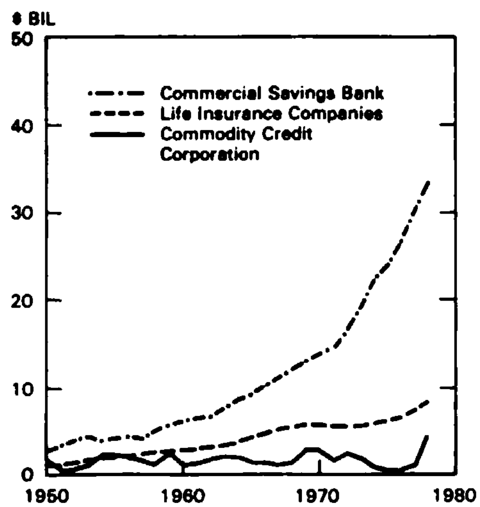


FIGURE 36
FARM DEBT BY LENDER



mortgage portfolios that are farm mortgages has stayed about the same during the period.

Thus, a prominent feature of the transformation of U.S. farming has been the increased availability of institutional credit for purchases of farm real estate and capital goods. There is general agreement that this increased availability of credit has contributed to the increase in farm real estate prices, but the extent to which those price changes are related to this increase in credit is uncertain.

The rules applied by lenders in responding to demands for credit and for servicing loans have a substantial influence on who survives in farming. Such rules influence the income and wealth positions of both the survivors and the nonsurvivors. Farmers who own land that can be pledged as security for a new mortgage have a special advantage in obtaining credit and buying more land. Nonfarm income is considered in appraising ability to repay loans and setting down payment requirements. But probably of greater importance is the way that the economic forces associated with inflation affect potential borrowers differently, and thereby determine who obtains credit to buy land.

U.S. commodity programs have accelerated the shift to large farms by supporting commodity prices and increasing the chances of significant price increases. In this way, commodity programs have enhanced the: (1) confidence of people aggressively willing to accumulate land and/or invest in capital goods that facilitate large-scale production of commodities, and (2) willingness of lenders to extend credit to these kinds of people.

Modification of commodity programs so that there were greater risks of commodity price declines would discourage increased farm size and product specialization, and make farm resources less attractive as an investment opportunity. The risk of price declines would diminish the confidence of people who otherwise would aggressively accumulate farm resources. It also would cause lenders to be more cautious in extending credit. The increased risk of price declines also could lead some producers to be more willing to enter into contractual arrangements with processors.

EFFECTS OF COMMODITY PROGRAMS

U.S. commodity programs have included support prices and arrangements for diverting acreage from production. Both incomes and prices have been supported with government purchases of commodities, loans to producers, the withholding of supplies from markets through marketing orders, diversion of cropland from production, and direct payments. Direct payments have increased in relative importance, compared with loans, in the last 10 to 15 years. Thus, the risk of low commodity prices has been reduced.

At one time, the loan storage programs tended to limit potential price increases. During the 1950's and 1960's, government stocks of grain were large. Legislation provided that these stocks could be sold domestically when market prices reached 110 percent of support prices, including carrying charges. These provisions, in combination with the relatively large stocks held by the government, severely limited the possibilities of substantial increases in related commodity prices. Provisions now, however, allow sales of government stocks only at much higher prices relative to support prices, thus increasing the likelihood of price increases, compared with earlier programs. These possibilities are reinforced by increased instability of the international markets combined with a closer interface between the international and U.S. markets. These possibilities of sharp increases in prices and corresponding shortrun increases in farm income as a result of unexpected expansion in demand or contraction of production reinforce the incentive for people to accumulate assets such as land.

At the same time that government programs, adjustments, and supply and demand conditions have increased the possibilities of substantial increases in commodity prices, the risk of low prices to producers for their products and consequent low incomes are mitigated. This results from the availability of commodity loans to farmers and by transferring income directly to those farmers who voluntarily agree to make production adjustments deemed necessary by the Secretary of Agriculture. These loans and payments enhance both the ability and willingness of many producers to increase investment in capital and accumulate more acres of farmland. Because of government support prices with an effective "floor" and supplementing incomes with payments, reduced risk and uncertainty enhance the willingness of farmers to invest, adopt new technology, and increase output. Income supplements through payments, support prices, and CCC loans facilitate increased output and farm size adjustments by affecting the: (1) actual annual cash flow of farmers and (2) longer run expectations of the average profitability of investment in farming on the part of farmers and farm creditors.

The above remarks as to how support prices and income payments affect farm size are reflected in an analysis by Nelson and Cochrane (*17*) of the economic effects of the programs during 1953-72. They concluded that the actual programs, compared with what would have occurred with no programs and a free market policy:

- Increased the quantity of assets, value of annual capital expenditures, and farmland prices.

- Reduced the level of land and labor inputs relative to other inputs used in farming.
- Increased the annual average rate of decline in farm numbers and agricultural employment, and increased the average size of farms over time. (With a free-market policy sustained from 1953-72, there would have been 24 percent more farms than there were in 1972, and average farm size would have been 19 percent smaller.)
- Increased crop resource productivity (output-input ratio) in all years after 1958.
- Increased net farm income in the short run and intermediate run (1953-65), with net farm income lower than 1965-72 net farm income. (Without the programs for 1953-72, residual returns to landowners would have been negative for 1954-62, similar to the low-income depression years, 1930-33.)

The mitigation of risks of commodity prices falling below price-support levels also enhances the willingness of lenders to provide loans for the accumulation of farmland and for purchases of capital goods that facilitate large-scale production of commodities. Two effects of the commodity programs, therefore, are to: (1) stimulate the demand for credit by a group of aggressive borrowers and (2) encourage lenders to be more willing to arrange for loans that allow large-scale accumulation of land and capital goods.

Admittedly, the support of commodity prices probably discourages some people from selling their land. However, land prices, potential tax liabilities, and family circumstances probably are much more important in these decisions.

Those who want to increase their income and wealth find that commodity programs–along with credit programs, tax rules, and the effects of inflation–facilitate the accomplishment of their objectives. It is in this context that commodity programs accelerate the consolidation of farmland resources into larger farms. An analysis of the impacts of price-support programs by Boehlje and Griffin (*1*) concluded that "the great majority of the benefits of such a program (that guarantees cash flows) goes to larger, high-equity producers."

There are limitations on the amount of commodity program payments to individual producers. However, these limitations are so high that they have little relevance in terms of significantly stifling the growth objectives of those seeking to expand. For example, the aggregate limitations included in the 1977 Act on payments for wheat, feed grains, and upland cotton together were $40,000 in 1978, $45,000 in 1979, and will be $50,000 in 1980 and 1981. Payments are based on the difference between the market prices and the target prices for the respective crops, yields, and acreages. In 1978, only 1,184 producers out of 750,000 participants in the wheat, feed grains, cotton, and rice programs were affected by the limitations. On the average, these 1,184 producers would have received $20,000 in additional payments if the limitations had not been in effect.

The difference between the loan rates and the target prices is an appropriate method for measuring possible effects of the payment limitations, because market prices are not likely to fall significantly below the loan rate. The differences for 1978 and 1979 were:

Commodity	Loan rate	Target price	Difference
Cotton (lb.)	*Dollars*		
1978	0.48	0.52	0.04
1979	.48	.577	.097
Wheat (bu.)			
1978	2.35	3.40	1.05
1979	2.35	3.40	1.05
Corn (bu.)			
1978	2.00	2.10	.10
1979	2.00	2.20	.20

Using 1978 average yields, these differences result in the following maximum acreages before a payment limitation of $40,000 would be initiated in 1978 and a limitation of $45,000 would be initiated in 1979:

Commodity	Calculated maximum acreage without payment limitation
Cotton	
1978	1,919
1979	890
Wheat	
1978	1,270
1979	1,429
Corn	
1978	4,255
1979	2,394

In addition, it is important to recognize that the distribution of payments under the target price system is skewed heavily toward large producers. Any commodity price-raising effect of the programs is similarly skewed. One report (*26*) estimated that 10 percent of U.S. farm producers received about 50 percent of the total commodity program payments made to all U.S. producers in 1978.

In summary, U.S. commodity programs have accelerated the shift to large farms by supporting commodity prices and increasing the chances of significant price increases. In this way, commodity programs have enhanced the: (1) confidence of people aggressively willing to accumulate farmland and/or invest in capital goods that facilitate large-scale production of commodities, and (2) willingness of lenders to extend credit to this group of people.[10]

EFFECTS OF TAX RULES

Several rules for income and estate taxes have a significant effect on farming. In total, they increase the attractiveness of owning farm assets and lead to: (1) larger investments by nonfarm people in farm assets, (2) larger farms owned and/or operated by those farmers who are able to exploit tax opportunities, and (3) more corporate farms.

There are several features of U.S. income and estate tax rules that are relevant to how farms are organized and managed. Some of these rules are particularly applicable to farming; others are more generally applicable, but because of the nature of the rules and farming the effects on farm activities are significant.[11]

The adoption of numerous rules relating to U.S. income and estate taxes was motivated by a combination of factors—growth, efficiency, greed, and equity. One effect of these rules is that the taxes actually paid by many people differ significantly from the amount indicated by a quick glance at tax tables specifying income levels and tax rates. The deviations are especially related to the rules for calculating "income" that is taxed.

The rules particularly applicable to farming relate to:

- Methods of accounting for income and expenses.
- Designation of expenses as current expenses or capital investments.
- Designation of receipts as ordinary income or capital gains.

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[10]See Moore (*16*) for a detailed listing of Federal policies and programs which affect the organization and management of U.S. agriculture. Commodity programs are included in Moore's list. In addition, many other programs such as construction of irrigation dams and market news are included. This conclusion also is generally in accord with Kyle, Sundquist, and Guither (*12*), who concluded, "Overall, however, with the exception of tobacco farms and perhaps other limited situations, the impact of government payments has been to help finance the growth to large operators for many farmers. At the same time, programs have provided income stability and adjustment assistance to some farmers who have chosen not to increase the size of their farm operations or who were unable to do so."

[11]This section relies heavily on papers by Sisson and Krause (*22, 10*).

Rules more generally applicable but important to farming relate to:

- Calculation of estate taxes and when they are payable.
- Differences between corporate and individual tax rates.

These rules:

- Lower the incidence of taxes on farm-related activities.
- Generate greater demand (and therefore higher prices) for farmland and capital goods used in farming than would be the case without these tax rules.
- Lead to larger farms.

Rules Applicable to Farming

There are three Federal income tax rules that apply particularly to the calculation of taxable income from farming and substantially influence how farms are organized and managed. The same rules cannot be utilized by taxpayers in calculating income from nonfarm activities. The rules, therefore, affect the economic decisions of people as they attempt to maximize their after-tax income.[12] They are:

- A taxpayer may choose either a cash or an accrual accounting system for determining income taxes for farm activities.
- Expenditures for the development of orchards, vineyards, ranches, and breeding livestock may be considered as current expenses in the tax period in which the expenditures are made.
- Gains from sales of purchased and breeding livestock are treated as capital gains. They must have been held for specific time periods—24 months for cattle and horses and 12 months for all other qualifying livestock.

First, the choice of accounting system permits the selection of cash accounting and therefore enables people with farming activities to more easily choose the years in which to make sales and purchases. For example, after the large increases in farm income in 1973 and 1974, it was reported widely that farmers postponed the sale of commodities and accelerated the purchase of inputs such as fertilizer to even out taxable income from year to year. An accrual system of accounting, required for other businesses in determining income taxes, would have necessitated taking account of changes in inventories. With an accrual system, therefore, it would not have been as easy to "even out" the receipts and the expenses for years involved.

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[12]See (*1, 2*) for discussions of the origins of these "rules" and how they apply to farming. These are important techniques for lowering the amount of income subject to Federal income taxes in any given time period.

Second, the rule that permits "current expensing" for orchards, ranches, and breeding livestock development costs is straightforward. This rule makes it possible to claim larger expenses in the tax period in which the "development" expenditures are made. Incomes in later tax periods are larger, but not necessarily by a corresponding amount. In contrast, most capital expenditures–whether incurred in farming or in other businesses–cannot be considered as current expenses.

A related concept is that capital expenditures are made to generate income in future years. Therefore, depreciation schedules are developed to "schedule" the depreciation "expense" across the time periods during which the capital gives rise to income. For example, a farmer purchasing a tractor for $70,000 in 1979 cannot consider the entire $70,000 as farm expenses in 1979. Instead, a depreciation schedule is developed. If the "straight-line" method of depreciation is used and the tractor is expected to last 10 years, $7,000 of depreciation would be considered as an expense in determining 1979 costs for tax purposes. In contrast, a farmer spending $70,000 in 1979 to develop an orchard that will begin to generate income in 1983 can consider the entire $70,000 as expense in determining 1979 costs for tax purposes.

Third, capital gains are taxed at a lower rate than ordinary income. Thus, the more income that qualifies as capital gains the lower the tax liability. That is why the third rule is important. For capital gains received by individuals, only 40 percent of the difference between the "cost" of property and its sales price is taxed as ordinary income. The remainder is not taxed. Suppose, for example, a young heifer is bought for $200 and sold as a mature cow for $600 at least 24 months later. In the year of sale, $160 (40 percent of the $400 increase) would be taxed. In keeping with the second rule, the feed and other costs associated with the care and development of the animal are considered as current expenses in the tax period in which the expenditures were made.

These three rules have been criticized as giving advantages to many farmers that are not available to other citizens who do not have farm activities. In some cases, the rules also have been criticized as being unfair to certain farmers. For example, in the 1970's, there was a great deal of publicity and criticism concerning "syndicates" using the cash accounting system in combination with prepayment of feeds and other current expenses for beef feeding. This approach enabled the owners of the syndicates to "defer" income (for income tax purposes) to later years. In turn, the 1976 Act prohibited syndicated custom cattle feeders from taking income tax deductions for prepayment of feed expenses. But nonsyndicated custom cattle feeders can still prepay these expenses, as can other "farmers" and "ranchers."

[See Dietrich and others (*6*)]. As another example, the rules induced investments in almond groves. These investments expanded the supply of almonds and depressed farm returns, which led to pressures to modify the rules. As illustrated by the cattle feeding and almond growing experiences, the tax rules affect investments and, in turn, the size of farms, their ownership, and patterns of farm production.

To a large extent, activities that result from these rules are considered as abuses only if people who have not been farming utilize them to become farmers. This is a misplaced emphasis. Those who have been in farming can influence income and wealth distributions among all Americans as much as, and in some cases more than, those who become farmers because of the rules.

Other Rules Important to Farming

Estate Taxes

Special advantages under the tax rules are allowed to those estates that involve small businesses. These advantages seem to be the greatest, however, when farming and farmland are involved. The regulations mean substantially lower estate taxes for estates with farmland that qualify than for other estates for comparable market value but that do not involve qualifying farmland. These conditions should lead to greater demand for land and thus higher prices for such resources.

There are two key provisions. First, in valuing assets for estate tax purposes, "use-value" rather than "fair market value" may be used. Because of the particular way that use-value of farmland may be calculated, this provision is likely to be more advantageous to estates that involve farmland than to those estates which do not. For qualifying land, the estate tax value likely will be determined by dividing the net cash rentals (equal to gross rent less State and local real estate taxes) by the Federal Land Bank interest rates for new loans. Thus, the numerator will reflect the economic returns that are consonant with farming. The denominator—the interest rate—will reflect not only the economic productivity of capital but also the effects of inflation. In this way, the valuation of the farmland will be lowered and estate taxes lowered accordingly.

Second, estate taxes on closely held farm properties can be deferred. For qualifying property, estate tax payments are not required during the first 5 years. Payments can be made during the 10 years following the death of the owner. Interest is charged on the unpaid estate taxes at 4 percent. This can be an important economic advantage to those estates that qualify relative to those that do not. For every 1 percentage point that interest rates for commercial loans are above 4 percent, the undiscounted advantage to holders of $1 million estates accumulates to $33,000 over a 15-year period (*10*).

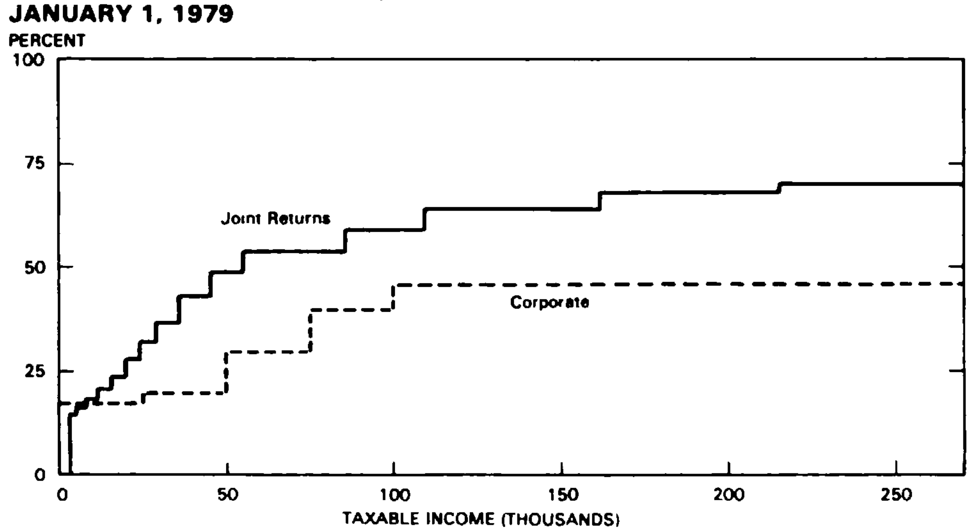
These provisions make holding farm assets increasingly attractive, relative to other kinds of wealth. Because of this attractiveness and undoubtedly to limit the number and type of people who can take advantage of these rules, several restrictive conditions must be met to qualify for the use-value provision. These relate to the proportion that the farm and/or other closely held business assets is of the total estate, length of ownership, type of heirs, and so forth (*10*).

The special rules for valuing farm assets in an estate will not benefit people with limited amounts of property. Assume (1) an estate in 1981 when the "unified tax credit" is to be $47,000, (2) a surviving spouse, (3) utilization of the minimum marital deduction of $250,000, (4) administrative expenses of 3 percent, and (5) zero State inheritance taxes. In such a situation, taxes on estates up to $438,000 would be zero (*14*).

Incentive to Incorporate

Except at relatively low levels of income, the tax rates for corporations are less than the rates for individuals (figure 37). The corporate tax rates were lowered by the Revenue Act of 1978. Therefore, farmers have an increased incentive to incorporate and not to elect use of Subchapter S of the Internal Revenue Code. Subchapter S allows a farm corporation to not pay Federal income taxes by having the corporate income tax paid by the shareholders (*9*).

FIGURE 37
FEDERAL INCOME TAX RATES, JANUARY 1, 1979



Advantages of Small Businesses

Families associated with small businesses enjoy other tax advantages. In some cases, expenditures can be counted as business expenses while the same kind of expenditure by a wage earner cannot be used to lower taxable income. For example, there is no way the use of gasoline can be precisely separated for tax purposes when the fuel comes from the same tank and trips to town involve farm and family activities. In urban settings, similar opportunities arise where materials and equipment can be used by the family and in the business. The same is true with respect to products. While these practices are widely recognized, studies documenting the magnitudes involved are not available.

Implications

No one knows the net effects of the interaction of the many rules for tax computation with other incentives that impinge on economic decisions in society. It is highly probable, however, that the structure of agriculture would be different if the incidence of taxation on farmers had been different. Further, changes in the rules could have substantial effects on purchases of capital goods, investment rates, and timing of expenditures and sales in the future. Some of these effects are especially conditioned by the ease with which resources can enter or leave farming. For example, new rules which would lead to high taxes on farming investments and related activities likely would diminish the attractiveness of ownership of farm assets as investments. Thus, land prices would be affected, and individuals wishing to enter farming would find it easier to do so. And the opposite likely would be the case if taxes related to farming were lowered relative to other investment alternatives.

While the evidence is not conclusive, the limited research findings available suggest that our present income tax system, compared with a system that does not have the preferences applicable to farming, has:

- Lowered the incidence of taxes on farm-related activities.
- Increased demand (and therefore prices) for farmland and capital goods used in farming more than would be the case without these tax rules.
- Promoted larger farms.

On the basis of 1969 tax returns, Sisson (*21*) concluded that "farmers do enjoy lower tax burdens than nonfarmers." He estimated that families with more than half of their income from farm sources "would have paid nearly $1.1 billion more in taxes if their tax burdens had been commensurate with the tax burden the general public pays." In 1969, taxes paid by these farmers totaled $6.9 billion. Of special importance to the possible attraction of farm investments for "nonfarm" people is Sisson's conclusion that the gap in "tax burden seems to widen as income increases." Sisson's work dealt with property and income taxes but did not encompass estate taxes.

The burden of property taxes on the farm and nonfarm sectors was examined by Stam and Sibold (*22*). One of their approaches—using net income—suggests that farms have a higher tax burden than the nonfarm sector. But another of their approaches using wealth suggests the opposite condition. They estimated that, since the mid-1930's, property taxes have taken 7.9 percent of farm income—in contrast to 4 percent of income of the nonfarm income sector. On the other hand, they note, ". . . the agricultural sector traditionally has paid proportionately fewer property taxes than has the nonagricultural sector . . ." when measured by the ratio of property taxes to wealth. For example, since the mid-1930's, taxes on agricultural property have been equivalent to 0.6 to 1.0 percent of wealth in the agricultural sector. In contrast, comparable percentages for the nonfarm sector have been 1 to 1.5 percent.

Many issues and unanswered questions underlie consideration of the effects of taxes on demand for land and size of farms. They relate especially to farm product prices and profits, and tax shelters.

There are two extreme lines of reasoning about the effect of taxes on farm product prices and profits. Both have implications for the distribution of income and wealth among sectors of our economy. One theory is that taxes paid by farmers are no different than any other costs and, further, the prices of farm products are directly related to the costs of farming. Thus, if the rules decrease taxes paid by farmers by calling certain income capital gains rather than ordinary income, this line of reasoning says that farm prices will be lower by a corresponding amount. This would be the case, however, only if the quantity of farm products was not affected by prices, a condition that simply does not exist. Further, if this condition existed, it would have important international distributional effects, since a substantial portion of U.S. farm production is exported. Prices on those exports would be lower by the amount of the lower taxes, and foreign consumers would benefit from the lower tax burdens. In short, foreign consumption would be subsidized. But these conditions are not likely. Farm prices are affected by costs, but they also are affected by both domestic and international demand.

The second line of reasoning is that taxes paid by farmers merely affect their profits and have no effect on production in the short run or long run. But this is not likely either. Farmers reinvest some of their profits in farm activities. And some who have not been farmers use savings from other economic activities to make investments in farming to realize the tax savings and other benefits of farm activities.

Thus, it is likely that tax advantages for farming activity probably lead to somewhat lower farm prices, lower before-tax profits, and somewhat higher farm after-tax profits. But aside from Sisson's estimate, our information on the extent of either is very limited. In addition, studies of the effects of these changes in prices and profits are limited.

Lin and Carmen (*13*) estimated that if tax rules required development costs to be capitalized rather than treated as operating costs, two of three farms studied would reduce tree plantings. The reduction would be 10 percent of total acreage on the three farms. In another report, Carmen (*2*) concluded that "... the increased acreage of California orchards and vine crops due to tax incentives is a comparatively small percentage ... for most crops it will range from zero to five percent of the acreage."

Another study by Dean and Carter (*5*) suggested the following hypotheses and cited tentative estimates of the "aggregate effects of income taxes:"

- The income tax system for "current expensing" of development costs leads to greater amounts of risk capital in agriculture. Dean and Carter demonstrated that unprofitable activities, on the basis of zero taxes, can be profitable, given the income tax rules.
- The income tax structure may lead to higher land prices because it reinforces demand for land. Potential investors can pay more for land than if there were no income taxes, and those in the highest tax brackets, farm and nonfarm, can pay the most. Further, the provisions for exchange of property tend to "spread the effect of localized urban and industrialized demand."

Observers of U.S. tax rules and the effects of these rules have noted that some people who combine nonfarm activities (income) with farming activities deliberately generate a loss (calculated on the basis of tax rules) in farming. This accounting loss is then combined with income from nonfarm income to lower the amount of tax paid. In many cases, a shift of current income to capital gains is involved. For example, depreciation allowances for farm assets and current expenses for tending cattle are used to show losses or lower farm income while the major product is breeding stock that can be kept 2 years and then sold. The sales are considered capital gains and therefore only 40 percent of the increase in value is considered in calculating taxable income.

The usual concept of these tax shelters is related to individuals who traditionally have not been in farming making investments in farming (*28*). In addition, individuals who traditionally have been in farming are making investments increasingly in nonfarm activities and combining farm and nonfarm incomes for tax purposes. These developments may tend to alter the attitudes of farm people toward tax shelters.

It is important to recognize that this common concept of tax shelters relates to individuals "outside of farming." However, the same tax provisions are used regularly by farmers to lower their taxable income. For example, a lawyer may utilize a farm operation to generate $50,000 of accounting losses to place against his $75,000 income from practicing law, or a farmer may utilize a similar set of farm resources to generate $50,000 of accounting losses to place against $75,000 of income from other farm operations. Should the two situations be viewed differently?

This gives rise to issues common to the behavior of special groups in our society. The objectives of many special-interest groups are to gain special advantages by arranging special tax rules, administrative pricing, and special demands for their products while at the same time limiting the ability of outsiders to make investments and other adjustments in their economic activities to take advantage of these conditions.

The recent legislation applicable to valuing estates involving farm assets illustrates these kinds of considerations. For example, to be able to utilize the use-value approach in estimating the value of an estate for tax purposes, the assets must be closely held, and the immediate family must be active in its management. Many people will find the potential "tax returns" worth less than the costs of transferring their assets into such an arrangement. However, some will shift their assets into farming because of the tax rules and thereby increase the demand for farm assets, especially land.

At the same time, there are other ways, such as via gifts and trusts, to minimize taxes on intergenerational transfers of wealth. People with farm assets increasingly will use these techniques.

This discussion has been focused primarily on rules that guide calculations related to farm income and wealth. We have not reviewed rules that apply to calculations of income related to other businesses. But there are many rules that specify exceptions and create opportunities for economic gain by different people and businesses in our society. For example, taxes paid to foreign governments by U.S. corporations are credited against taxes that the corporations would otherwise have to pay to the U.S. Government, rather than considering them as a cost and using them merely to lower the amount of income on which taxes are based. Banks can deduct as an expense a "bad-debt loss" of 5 percent of loans, regardless of the level of their bad-debt losses. Any judgment as to the fairness of tax rules, especially those related to farming, would involve the consideration of tax rules that are advantageous to other groups in our society.

CONCLUSIONS

Interactions of the seven forces discussed above have contributed separately and jointly to the transformation of U.S. farming in major ways. In many cases, the presence of one of the seven forces without some of the others would have meant quite different outcomes in how the resources used in U.S. farming have been organized and managed.

Further, there are other forces that have interacted with these seven, and certain observers would have included some of the others as most important. One such force, human capital, transcends the forces discussed above. Throughout American history, individuals and society have foregone some consumption to obtain better health care, on-the-job training, formal education, adult training, and better knowledge of economic opportunities . . . and they have pursued other activities that enhance the capability of humans (*19*). In other words, the capabilities of humans to work in farming, organize resources, and manage these resources have improved. This has resulted in a significant number of people from both the farm and nonfarm sectors aggressively applying their talents to farming to increase their income and wealth. Regardless of their origins, they have the ability, aggressiveness, and ambition to cope with the disequilibria resulting from the interaction of the seven forces (*20*). It is these people who will transform the management and organization of U.S. farming even further.[13]

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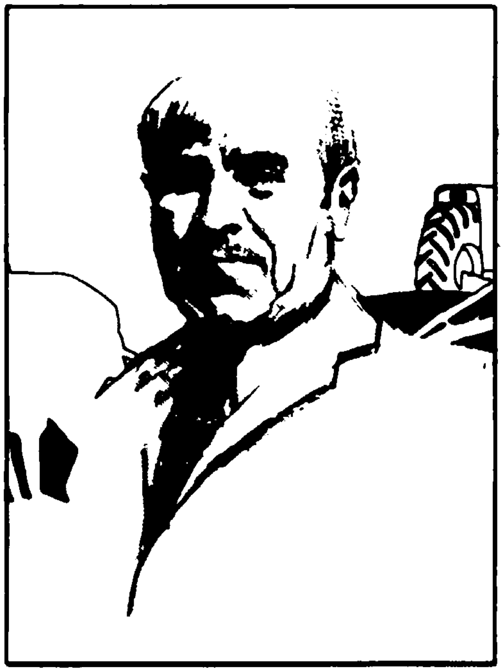


A Preview of the Future

Lyle P. Schertz

PROSPECTIVE NUMBERS

The prospective number and size of farms are difficult to estimate. Trends indicate that the total number of *all* farms will continue to decline. However, if trends continue into the future, the number of larger farm units will increase, and their average size measured by acres or sales will increase. An increased concentration of production would be associated with a decline in the number of farms.

An indication of possible changes in the mix of farm size is conveyed in figures 38 and 39. These figures show, historically, numbers of farms by size, as measured by acres and sales; the estimates shown for the year 2000 are trend values reported by Lin (*3*).

These estimates suggest that, if past trends continue, the number of farms with 500 acres or more and those with sales greater than $40,000 will increase. Projections included in two other research reports suggest that there will be between 1 million and 2 million farms in 2000 (*4, 5*). This, of course, is still a large number of farm units, compared with the amount of concentration in many U.S. industries.

Other indicators of change in farm size are estimates of the number of farmers who account for selected percentages of total farm sales and land in farms (figure 40). For example, Coffman (*1*) estimated that 125,000 farms out of a total of 2.8 million accounted for one-half of total farm sales in 1974. Should this trend continue

FIGURE 38
FARM NUMBERS BY SIZE

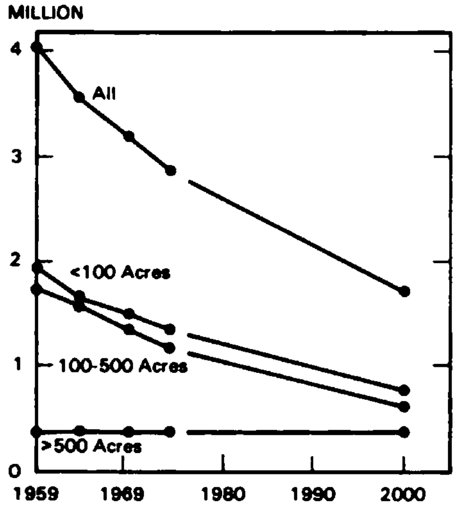
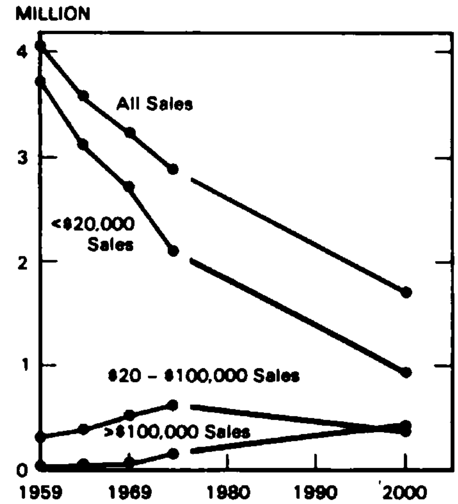


FIGURE 39
NUMBER OF FARMS BY SIZE (SALES CLASS)



to 2000, the number will halve and 70,000 farms are likely to make one-half of total farm sales.

The reliability of trends for anticipating the future is suspect when new technology cannot be predicted . . . especially when the economy is experiencing many shocks and may experience others in the future. And, of course, many of the forces discussed in the previous chapter will continue to influence decisions of people interested and involved in farming.

CHANGES IN MAJOR FORCES

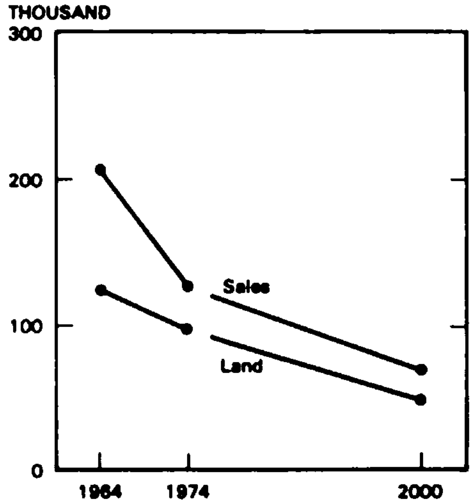
The character and degree of influence of the seven forces have changed in ways of great significance for the future transformation of U.S. farming. The three most important changes have been:

- Increased rates of inflation in the economy.
- Higher energy costs influencing the economics of using capital goods and the costs of transporting farm products.
- Changes in tax rules increasing the attractiveness of farm-related incomes and farm assets.

Higher Rate of Inflation

The recent *higher rates of inflation* reinforce the trend toward increased farm size and could contribute to much greater separation of ownership and use of farmland and equipment. Most farm and nonfarm people are searching for ways to enhance their economic welfare. As indicated earlier, capital gains associated with changes in land prices make land an attractive alternative—especially in infla-

FIGURE 40
NUMBER OF LARGEST FARMS WITH 50 PERCENT OF TOTAL SALES AND LAND IN FARMS



tionary periods when land prices rise faster than other prices. Nonfarm investors as well as farmers are thus encouraged to invest in farmland. However, as discussed in an earlier chapter, interest rates during inflationary periods are substantially greater than rates of earnings from farming. This difference makes it impossible to service loans from farm resources acquired by loans. Other monies are required. Among farm people, those who already own assets have a competitive advantage to make down payments, obtain credit, and service loans necessary to acquire land. Such financial transactions lead to a consolidation of resources by those who already have resources and thereby encourage fewer but larger farms. And land acquired and owned by nonfarm people usually is available to rent for farming. Increasingly, this land is rented to those who already own and rent some land elsewhere, further contributing to larger and fewer farms.

Higher Energy Costs

The prospect of *higher energy costs* injects substantial uncertainty into the future of U.S. farming, particularly the way in which it will be organized and managed. The eventual effects, however, will influence: (1) where production will be located in the United States, and (2) the kind of mix of resources that will be used in farming and ranching.

In considering location of production, one thing seems obvious. The relative competitive position of that segment of farming dependent on irrigation water will diminish to the extent that higher energy costs of society are paid by agricultural users. This might happen in the following way: Over the past 20 years, there has been an increasing concentration of fruit and vegetable production reliant upon irrigated agriculture. In many cases, this concentration has involved a shift of production among regions of the country—especially to the irrigated areas of the Southwest and Pacific Northwest. With this shift, transportation distances from producers to consumers have increased. Higher energy costs will continue to inflate these transportation costs, as well as irrigation costs, and thereby likely will encourage a shift of production from these areas to producers closer to the more metropolitan, consumer centers of the North. Because farms in the North have been smaller traditionally than those in the Southwest, the shift in production likely will be to farms in the North that are smaller than those in the irrigated West. At the same time, new methods of irrigation that reduce water usage will be adopted to mitigate the effects of higher energy costs and, in some cases, limited supplies of water.

Higher relative energy costs also will stimulate individual farmers throughout the country to adjust the mix of resources they employ in farm production. The extent of the cost changes and the energy efficiencies of various available technologies will influence choices regarding their use. This, in turn, will affect farm size. In an extreme case, energy could be so expensive that the resource mix would involve increasing relative proportions of labor and land to capital. This would reverse present trends toward larger and fewer farms, as measured by gross sales and by land area.

Changes in Tax Rules

Modifications in Federal tax provisions have made ownership of farm assets increasingly more attractive. The effects on farmland prices are predictable—they are higher than otherwise. Additionally, these tax provisions, if continued, will accelerate the decrease in farm numbers and increase the size of remaining farms.

Nonfarm investors, as well as farmers, are encouraged by these tax provisions to seek farm investments. Farmers and ranchers and their heirs also are encouraged by these provisions to continue to farm and retain ownership of their assets. This incentive will be especially strong among those families whose assets qualify for use valuation and deferral of the payment of estate taxes under provisions which "allow 15-year installment payments at 4 percent interest on as much as $345,800 . . ." of estate taxes (*6*). Reasoning similar to that included above in the discussion of the effects of inflation suggests that nonfarm investors, possessing other assets and realizing nonfarm income, and farmers with substantial equity will be the ones able to obtain assets and take advantage of the tax provisions. Such benefits are simply worth more to them than they are to people of lesser means. Therefore, they will be the successful bidders for assets when they are sold.

OTHER FACTORS

It also is useful to consider other factors that might impinge on the transformation of U.S. farming. For example, the income and wealth positions of some of the farm population have improved substantially in recent years. And these people are giving increased attention to how to retain and perhaps enhance their new economic positions. Accordingly, attention is being directed increasingly to estate planning and financial management by people with farm assets. These activities have included pressing for changes in estate tax rules to make it easier to accomplish intergenerational transfers. Even if these efforts are successful, it is obvious that the assets of even moderate-size farms cannot easily be aggregated into the hands of one or two children when other children are involved. The earnings from farming do not support such an approach today. And the natural inclinations of "other" children are not likely to lead them to give up their inheritance. So it seems highly likely that landownership will, in the next 20 years, increasingly involve multiple ownership by descendants of those who experienced capital gains in the 1970's. It also is quite possible that farmers with substantial capital will invest some of their wealth in nonfarm investments to spread their risks and provide liquidity.

Dispersion of ownership is likely to add to the impetus for corporate ownership. The corporate form is a useful technique for clarifying rights and responsibilities among people, as well as for making intergenerational transfers. However, it will be increasingly difficult to keep such corporations closely held. Even if sales are not made outside of family descendants, in-laws, rather than sons and daughters, will soon be involved. They may or may not embrace the economic objectives of the farm. Regardless, they will confront other nonfarm economic needs and opportunities. Therefore, some will want cash from their inheritance to undertake these other activities. Obviously, current owners can forestall these kinds of developments through use of wills and other legal instruments. However, not all landowners leaving their estates will want to place these prohibitions on their heirs. Even if they did, such actions might not survive a legal challenge.

Therefore, it seems likely that ownership of land would go first to descendants who sell their interests. Buyers will be available, and they may or may not be involved with farming. In turn, the transactions would lead to adjustments in asset prices whereby returns on farmland and other investments were roughly equivalent. In addition, this likely would encourage a system of farming with considerable further separation of ownership and use of land.[14] A possible extreme configuration would be land operators (private or corporate) who rent land from land corporations.

Other scenarios also could develop. For example, farm returns could be depressed for any number of reasons. In turn, farm asset values might drop, and people interested in farming might find it possible to pay for a farm from farm earnings in a lifetime. Energy developments could lead to increased dependence on organic farming and a return to mixed farming and systematic crop rotations. With high product prices and changed diseconomies of size, the requirements for intensive management might increase and size of farm would change accordingly.

CHANGES IN WAY POLICIES ARE IMPLEMENTED?

Regardless of the eventual scenario and whether the changes are realistically described as developments, a transformation, or a "revolution," government policies and programs will both influence and be challenged by the events.

In rare cases, new programs may be developed; in a few other situations, old programs may be discarded. The more likely outcome is that the objectives of individual programs and related policies which guide their implementation will be challenged and may be found wanting. For example, many of the policies and programs intensively involved with the seven forces previously described are oriented to farmers as a group, and there is only limited recognition of the great differences among farmers. Yet it is commonly known that the benefits of government programs–even welfare programs–are regressively distributed among those affected. This issue becomes especially important for two reasons. One is that income and wealth of some farm operators and nonfarm landowners has increased. The second reason is that people with wealth may be increasingly attracted to investments in farmland to benefit from the returns associated with farming–including the tax advantages.

In turn, policies and programs will be under increasing pressure to discriminate among recipients to dampen the potential regressiveness of their benefits. Consideration might be given to focusing on income problems of farmers on an individual basis–an approach similar to the ways our society relates to income problems of people who are

[14]See Lee's perceptive paper (*2*) prepared more than 10 years ago for a discussion of the potential for widespread separation of ownership and use of resources in farming.

not farmers. In this context, incomes from both farm and nonfarm activities would be considered. And criteria used in deciding upon implementation of programs, such as credit programs, would give central emphasis to general economic and social objectives of the country, such as price stability, employment, and balance of trade.

Thus, the changes in the way that programs are implemented may be as dramatic as the changes in farming—and equally revolutionary.

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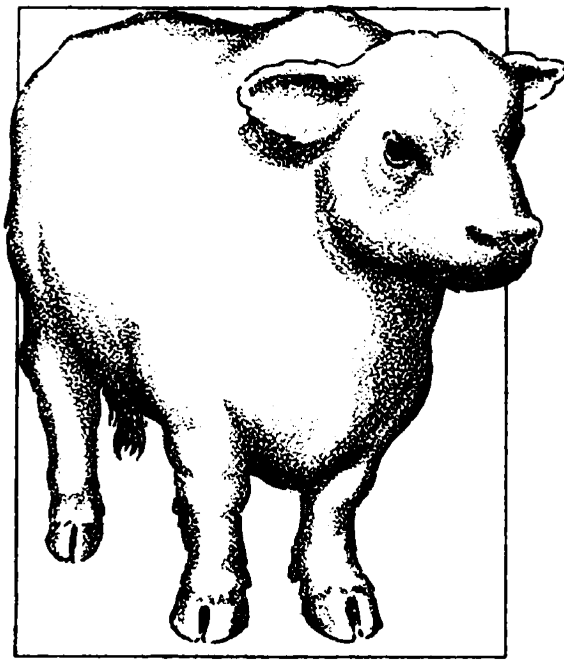
Part II.

Livestock Production



Beef

J. Rod Martin

SUMMARY

Significant structural changes in beef production have occurred in the United States in a relatively short period of time. These changes can be characterized as follows:

- *Beef production doubled in a period of only 20 years.*
- *The most dramatic increases in production have resulted from structural changes in cattle feeding rather than cattle raising.*
- *The number of cattle fed more than doubled during the 1960's–from 12.4 million head in 1959 to 25.3 million head in 1971.*
- *Cattle feeding has shifted away from large numbers of small feedlots with: (1) seasonal cattle feeding enterprises on grain farms, (2) use of feed produced on the farm, and (3) employment of unpaid and otherwise underutilized family labor.*
- *At the same time, cattle feeding has shifted to very large commercial feedlot operations using: (1) highly specialized skills and technology and (2) industrialized approaches to management, financing, and marketing.*

- *Large commercial feedlots have developed so rapidly that: (1) more than half of all fed cattle are now fed in 422 feedlots, each of which averages over 30,000 head marketed a year, and (2) half of the cattle are fed in 131,500 smaller feedlots, each of which averages only 90 head marketed annually.*

- *Increases in cattle raising on many farms and ranches have made a significant contribution to increases in beef production since 1950.*

- *Increases in beef cattle numbers have been greatest in the eastern half of the United States, particularly in the Southeast and higher rainfall areas of the Southwest and Great Plains.*

- *The eastern half of the United States now produces more beef from cattle raising than the traditional western range areas.*

- *A combination of a number of factors has increased beef production through cattle raising. Individually, these factors would have small impacts, but collectively they have led to a steady increase in cattle raising.*

- *Factors encouraging expansion in cattle raising include: (1) relatively high beef prices resulting from increasing demand for beef in the U.S.; (2) farm consolidation, which has increased acreage enough to support cattle raising; (3) shifting of land resources formerly used in dairying, feed for workstock, and crop production to cattle raising; (4) government commodity programs and tax policies; (5) new production technology, particularly forage production technology; and (6) increasing part-time farming, which is compatible with cattle raising.*

- *Factors that have caused significant structural changes and increases in cattle feeding include: (1) government farm commodity programs, mainly feed grain price supports which have encouraged large supplies and low and stable feed grain prices; (2) new technology in feed grain production; (3) increasing U.S. demand for fed beef in connection with rising consumer incomes; and (4) economies and incentives associated with operating large commercial feedlots (new production and organization technology) in cattle feeding.*

- *Structural changes will continue to occur in cattle feeding at a rapid rate. The technology of feeding cattle in large commercial feedlots is proven and will remain, however. Feedlots may not* *continue to grow in size because ownership, marketing, processing, and other vertical stage linkages have more influence on economies than size—once a large capacity (40,000 to 50,000 head) has been achieved. There is significant potential for change in the ownership and vertical stage organization structure of large commercial feedlots.*

- *Structural changes in cattle raising will occur slowly. The ownership and location of resources used in cattle raising are widely scattered and cannot be easily concentrated. This condition, along with limited new technology in cattle raising, is not conducive to changes in production methods or organization. However, due to the important relationships between cattle feeding and cattle raising, structural changes in cattle feeding will influence changes and may act as a catalyst for innovations in cattle raising.*

INTRODUCTION

The U.S. beef production industry has undergone dramatic changes in the last 30 years. Many of these changes have been associated with increases in cattle feeding and the development of large commercial feedlots. However, regional shifts in the location of cattle raising or the production of calves for feeding also have had important impacts on the characteristics of many farms throughout our country.

Changes in beef production have a widespread effect on U.S. farming because they involve large amounts of resources and a major component of U.S. farm cash receipts. Sales of cattle and calves in 1977 totaled about $20 billion more than one-fifth of total U.S. farm commodity cash receipts. This is more than twice the cash receipts from corn, the most important crop commodity, which totaled about $9 billion in 1977 (*7*).[1] Consumers spend 2 to 2.5 percent of their disposable income on beef, and per capita consumption of beef has nearly doubled in only two decades (*18*).

The changes that are occurring in the structure of beef production relate to both cattle raising and cattle feeding, which are mainly separate operations that involve different types of firms and entrepreneurs. Structural changes in beef production are an important part of the transformation of farming underway in the United States because of the magnitude of beef production and many of the cattle raising activities are located throughout the United States. This chapter focuses on:

[1] Italicized numbers in parentheses indicate references listed at the end of this chapter.

- Changes that have occurred in both cattle raising and cattle feeding.
- Factors that have caused these changes to occur.
- Future adjustments that may occur in beef production.

Emphasis is placed on beef production through cattle raising and cattle feeding. Availability of inputs and marketing, processing, and distribution are considered only to the extent that they have had important effects on cattle raising and cattle feeding.

The two beef production stages or activities, cattle raising and cattle feeding, utilize different mixes of resources, and involve different farm organizational arrangements and types of firms and entrepreneurs. Further, responses to economic conditions differ between the two production stages.

Cattle raising utilizes large amounts of forage and, therefore, depends heavily on land. The high fixed cost requirements (primarily in terms of land investments), instability of forage supplies influenced greatly by weather conditions, and biological restraints permitting only slow expansion of brood cow herds influence cattle raising and give rise to slow production responses to price changes and production cycles.

In contrast, cattle feeding is a specialized operation where feeder cattle are fed grain in confinement to condition and fatten them for the fed beef market. The utilization of large quantities of feed, feeder cattle, and other variable input items results in high variable costs relative to fixed production costs and tends to make cattle feeding responsive to price changes and economic conditions. Although cattle raising and cattle feeding are different, they have strong functional relationships, since the major product of cattle raising is the production of feeder cattle for cattle feeding.

Total beef production has more than doubled in the United States since the early 1950's. The supply of beef increased from 10.8 billion pounds in 1950 to more than 26 billion pounds in 1978. It is important to recognize that much of the increase in beef supplies since the early 1950's has resulted from dairy-to-beef shifts and increases in grain feeding of young beef animals or, in other words, structural changes in cattle feeding (*20*). A significant adjustment has occurred in the United States in terms of increasing numbers of beef cows, an increase of more than 130 percent since 1950. However, dairy animals also provide a source of beef, and the number of milk cows has decreased rapidly since 1950. Consequently, the net increase in all cow numbers is less than the increase in beef cows. In terms of all cow numbers, the change between 1950 and 1978 was an increase of only 22 percent. The following tabulation indicates changes in cattle raising during 1950-78:

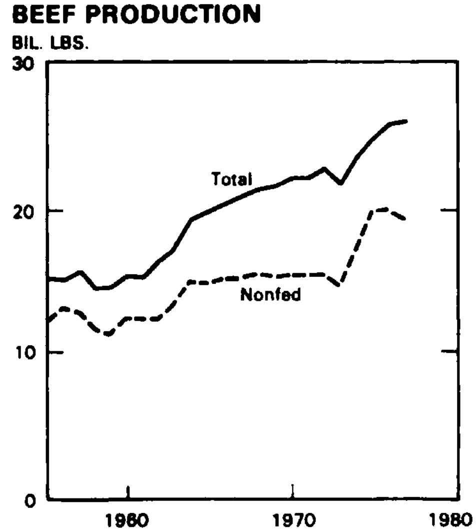
Cattle raising[1]				
			Change	
	1950	1978	Amount	Percent
	-------- *Thousand head* ----------			
Beef cows	16,743	38,664	21,921	131
Milk cows	23,853	10,916	−12,937	−54
All cows	40,596	49,580	8,984	22

[1] Includes 48 States.
Source: Derived from (5)

Nevertheless, the increase in beef production through cattle raising has been much greater than indicated by the increase in all cows because milk cows do not produce as much beef as beef cows. Beef production has increased significantly as beef cows have taken the place of dairy cows.

No comparative figures are available concerning the proportion of beef produced from cattle raising and cattle feeding. This may be estimated by using information available concerning the number of fed cattle marketed by assuming a certain amount of weight gain in the feedlot (5). Based upon these estimates, 68 to more than 75 percent of U.S. beef production comes directly from cattle raising

FIGURE 1
TOTAL AND NONFED
BEEF PRODUCTION



SOURCE DATA FROM (8) AND ESTIMATES DEVELOPED IN THIS ANALYSIS

Table 1—Beef production and estimated changes in fed and nonfed beef production, 1955-77

Year	Total beef production	Nonfed beef production[1]		Fed beef production[2]	
		Amount	Percent	Amount	Percent
	Mil. lb.	*Mil. lb.*		*Mil. lb.*	
1955	15,147	12,333	81	2,814	19
1956	16,094	13,132	82	2,962	18
1957	15,739	12,791	81	2,948	19
1958	14,516	11,437	79	3,079	21
1959	14,588	11,235	77	3,353	23
1960	15,835	12,359	78	3,476	22
1961	16,342	12,631	77	3,711	23
1962	16,311	12,478	76	3,833	24
1963	17,352	13,259	76	4,093	24
1964	19,442	14,968	77	4,474	23
1965	19,719	14,816	75	4,903	25
1966	20,606	15,263	74	5,343	26
1967	20,976	15,265	73	5,711	27
1968	21,582	15,546	72	6,036	28
1969	21,798	15,385	71	6,413	29
1970	22,240	15,508	70	6,732	30
1971	22,414	15,588	69	6,826	31
1972	22,839	15,591	68	7,248	32
1973	21,634	14,787	68	6,847	32
1974	23,624	17,325	73	6,299	27
1975	24,849	19,313	78	5,536	22
1976	26,822	20,296	76	6,526	24
1977	26,113	19,401	74	6,712	26

[1] Total beef production minus estimated fed beef production.

[2] Fed beef production is estimated by assuming that all fed cattle marketed [reported in (5)] gain 450 pounds in the feedlot (1,050 lbs. slaughter weight minus 600 lbs. entrance weight) and yield 60-percent beef equal to 270 lbs. (60 percent of 450 lbs.).

Source: Derived from (5).

activities and dairy cattle [figure 1 and table 1]. Thus, one-fourth to one-third of U.S. beef production is associated with cattle feeding operations.

This situation has changed significantly in the past 30 years. In 1955, less than one-fifth of U.S. beef production was associated with cattle feeding. Furthermore, a higher proportion of the total increase in U.S. beef production since the 1950's has been associated with cattle feeding activities. While growth and adjustments have occurred in cattle raising in the United States, the increasing level of beef production, growth, and structural changes in cattle feeding have overshadowed those that have occurred in cattle raising.

PAST AND PRESENT

Cattle Raising

Decreasing Number of Small Producers

There has been a trend toward fewer but larger cattle raising operations. The number dropped by 23 percent during 1964-74. There is a large number of ranches and farms in the United States that have a small number of cows for beef-calf production. But large farms and ranches account for a significant proportion of such production. The number of U.S. farms and ranches with beef cows dropped by about 300,000 during 1964-74. This drop occurred even though beef cow numbers increased by more than 8 million head.

The average size of beef cow herd on farms and ranches increased by nearly 63 percent. Data on farms and ranches with beef cows follow:

	Farms and ranches with beef cows		
	Number of farms	Total number of beef cows	Average number of beef cows
1964	1,323,912	32,719,199	25
1974	1,024,935	41,257,898	40

Source: Census of Agriculture.

Although average herd size in the United States is small, there is some concentration of production in cattle raising. Only 8 percent of the farms and ranches have 45 percent of the beef cows. Although about half of all farms that have beef cows have less than 20 cows, only 11 percent of the cows were in these small herds in 1974 as shown on top of page 92.

However, the increasing size of operations appears to be mainly a result of the consolidation of small farms, rather than the growth of large farms and ranches. The proportion of operations with less than

Farms and beef cows by herd size in 1974

Number of beef cows	Percent of farms	Percent of beef cows
Fewer than 20	49	11
20-99	43	44
100-199	5	17
200 and over	3	28

Source: Census of Agriculture.

20 beef cows decreased 20 percent (from 69 to 49) during 1964-74. Data on farms and beef cows for 1964 follow:

Farms and beef cows by herd size in 1964

Number of beef cows	Percent of farms	Percent of beef cows
Fewer than 20	69	20
20-99	27	42
100-199	3	14
200 and over	1	24

Source: Census of Agriculture.

The concentration of beef cows in large operations did not appear to change significantly—4 percent of the farms and ranches had 38 percent of the beef cows in 1964 and 3 percent had 28 percent of the beef cows in 1974.

Diverse Characteristics in Cattle Raising

Wide differences exist in terms of the characteristics of farm and ranch operations in cattle raising. Typical operations have little meaning except in small subregional areas of the United States. But beef cattle raising enterprises include cow-calf, cow-yearling, and stocker systems. Combinations of two or more of these enterprises often are included on the same farm, and a wide range of quantities and qualities of different types of inputs are utilized in connection with each system. Farms and ranches of the same size have very different forage conditions, and this explains some of the great variation in brood cow herd sizes and operations.

In the cow-calf system, a beef brood cow produces a calf each year which is weaned after 6 to 8 months and usually weighs 350 to about

500 pounds. Brood cows utilize large amounts of forage from grazing some type of pasture. Thus, large herds require many acres of land or highly improved pasture. Breeding, calving, and marketing programs vary according to region and type of farm or ranch. Producers may elect to sell calves when they are weaned or keep them longer.

If calves are weaned and carried to heavier weights before they are sold, the cow-calf system evolves into a cow-yearling system. This system also requires much forage and may be found on farms and ranches that have more grazing than can be utilized by the brood cows. Through the years, calf weights at weaning have increased enough that weaned calves can be moved immediately, or after a relatively short grazing period, as yearlings or stockers to feedlots. But lightweight calves require a lot of feeding, compared with heavier cattle placed on feed, so young calves are marketed and moved to feedlots when the price of feed grain is relatively low.

The stocker system involves purchasing calves produced in cow-calf or cow-yearling systems and grazing them on lush pastures 4 to 8 months. After grazing these pastures, they are sold as feeder cattle at 600 or more pounds. Many cattle produced 20 to 30 years ago in stocker operations would go directly to slaughter. Most cattle now are fed and conditioned in feedlots before slaughter. If feed grain prices are low, feedlots take young light calves. But if grain prices are high, feedlots prefer heavier cattle that can be conditioned with relatively little feeding. Most cattle are fed today because U.S. beef consumers have a preference for fed beef.

In view of the different production systems and possible combinations, it is not difficult to understand why great differences exist in how cattle are raised on farms and ranches in the United States. However, another source of difference is in the types of people who raise cattle. There are no statistical estimates pertaining to the types of persons involved or their importance. Some farmers and ranchers tend to be somewhat specialized in cattle raising. Many of these operators inherited the operation from their parents and have been in the cattle business most of their lives. These operators do not change their production levels as much as other types and are relatively steady producers. They probably are becoming a smaller proportion of the total number of cattle producers. More and more cattle are being raised by farm operators with major crop enterprises and general farm operations.

Part-time farmers also have become more important cattle raisers in recent years. Many of these operators are ex-farmers who still own their land but work off the farm for the major part of their income. This group also includes a number of producers who have inherited land and, although they are employed in nonfarm operations, raise cattle on the farm to supplement their income. Part-time farming favors a cow-calf enterprise that can be operated after regular work and on weekends.

Other cattle producers own land and produce livestock for various reasons—including prestige, recreation, investment purposes, and to obtain income tax benefits. These producers are businessmen, professional people, and others who have invested in land resources. The motives and actions of this group are almost impossible to depict, and their relative importance in production is not known. Their operations range from large sophisticated ones to only a few head of cows.

Significant Regional Differences in Cattle Raising

Climatic differences in the United States occur, in general, from east to west and north to south. As an example, average precipitation levels favor the eastern areas in forage production, which has an important input resource role in cattle raising. The longer growing season in the southern areas also affects forage production. Thus, various regions of the United States have different types of forage and other resources utilized in cattle raising, and changes have occurred along regional lines. The United States may be divided into at least seven different cattle raising regions (figure 2). There are significant differences in changes in the number of beef cows (beef cattle raising) among regions (figure 3).

Southeast—The Southeast has led all regions in terms of increasing both beef cows and all cows. Data on cattle raising in the Southeast during 1950-78 follow:

Cattle raising in the Southeast

	1950	1978	Change: Amount	Change: Percent
	Thousand head			
Beef cows	2,816	9,923	7,107	252
Milk cows	4,767	1,634	−3,135	−66
All cows	7,583	11,557	3,974	52

Source: Derived from (*5*).

Cattle raising in the Southeast may be summarized thus:

– The area is now the most important cattle raising region, in terms of beef cows and all cows;

FIGURE 2
CATTLE RAISING REGIONS

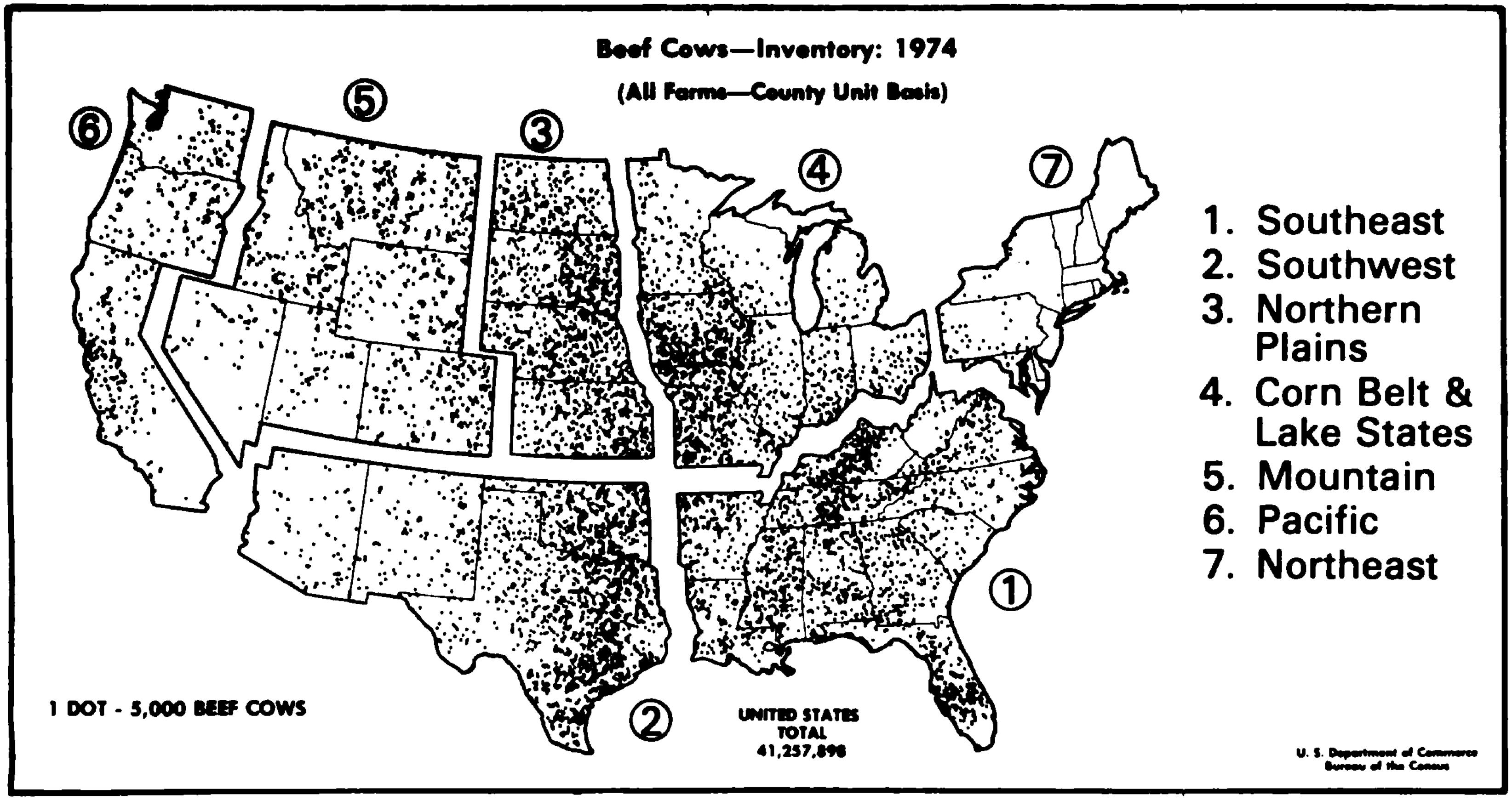
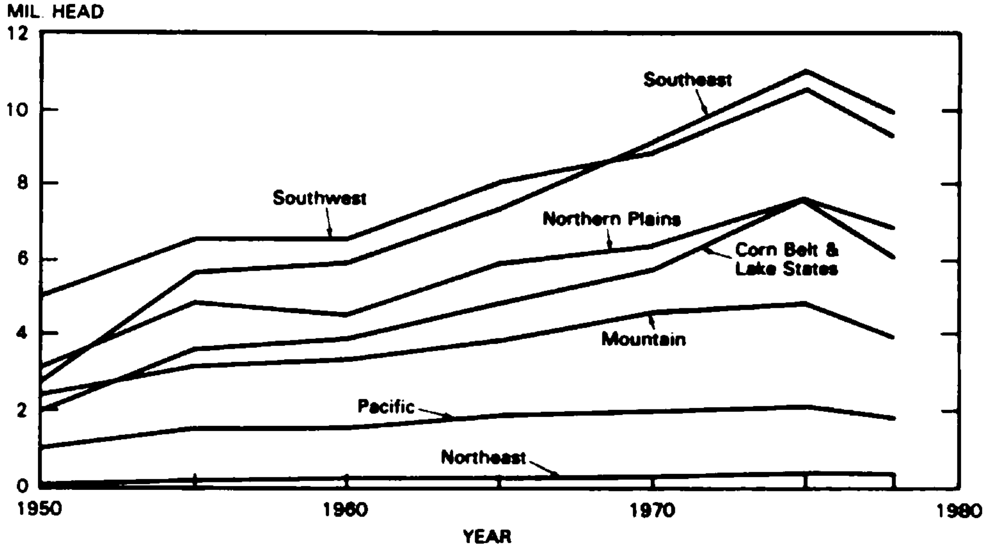


FIGURE 3
NUMBER OF BEEF COWS BY REGIONS, SELECTED YEARS, 1950-78



SOURCE (8)

- This region has led all others in growth of cattle raising since 1950;
- Prior to 1950, cattle raising was limited on the typically small, intensively cropped farms in this region of low native grass production;
- Farm growth and consolidation since 1950 have made improved pastures and cattle raising more profitable operations;
- Mechanization of crop production has released forage supplies to cattle raising rather than maintenance of workstock;
- Cotton and other crop production has been curtailed in many areas of this region, and much of this land use has shifted to cattle raising;
- Many farm operators in this region have taken off-farm employment while continuing to raise cattle on a part-time basis.

Southwest–The Southwest has been an important beef producing area for many years; nevertheless, cattle raising has increased significantly since 1950. Data on cattle raising in the Southwest during 1950-78 are shown on top of page 97.

The Southwest is one of great extremes in resources for cattle raising:

- Eastern parts exhibit characteristics like the Southeast; much of the expansion in cattle raising developed in the eastern area, where moisture is not a limiting factor;
- The central Southwest is included in the Southern Great Plains, the region that has led the United States in being the new growth area of cattle feeding;
- Higher mountain areas are similar to the mountain States;

Cattle raising in the Southwest

	1950	1978	Change: Amount	Change: Percent
	Thousand head			
Beef cows	5,081	9,339	4,258	84
Milk cows	1,827	527	−1,300	−71
All cows	6,908	9,866	2,958	43

Source: Derived from (*5*).

– The southwestern portion of the region is unique; much of it is suited only to livestock grazing and has been nearly fully developed in beef production for many years.

Cattle raising has increased in the Southwest region in connection with increases in pasture and range acreage.

Northern Plains—Increased emphasis on beef cattle raising in the Northern Plains has led to doubling of beef cow numbers since 1950. Data on cattle raising in the Northern Plains during 1950-78 follow:

Cattle raising in the Northern Plains

	1950	1978	Change: Amount	Change: Percent
	Thousand head			
Beef cows	3,132	6,146	3,025	97
Milk cows	1,903	532	−1,371	−72
All cows	5,024	6,678	1,654	33

Source: Derived from (*5*).

The following adjustments in the Northern Plains had a significant influence on increasing cattle raising during 1950-74:

– The shift from crop production in connection with wheat, feed grain, and conservation reserve programs released cropland that was used to produce beef cattle;

– The more humid eastern areas responded to improved forage production;

– Land consolidation brought larger acres of pasture, better management of forage resources, and greater fertilization of land resources for increases in cattle raising.

Corn Belt and Lake States—Farmers in the Corn Belt and Lake States have made a significant adjustment to more beef cattle raising, although the increase in beef cow numbers has tended to offset the decrease in dairy cows. Data on cattle raising in the Corn Belt and Lake States follow:

Cattle raising in the Corn Belt and Lake States

	1950	1978	Change: Amount	Change: Percent
		Thousand head		
Beef cows	2,070	6,951	4,881	236
Milk cows	9,717	4,565	−5,152	−53
All cows	11,787	11,516	−271	−2

Source: Derived from (*5*).

Following are some characteristics of cattle raising in the Corn Belt and Lake States:

– Beef cow-calf operations have been established mainly in the traditional dairy areas of the Lake States and areas of low soil productivity in the Corn Belt;
– Emphasis in this region has been on crop production, stocker operations, and cattle feeding as an off-season enterprise;
– This region has good potential for cow-calf operations, but lack of fencing, water, other investment requirements, managerial experience, and small fragmented landholdings have prevented more cattle raising.

Mountain States—Cattle raising has increased slowly but steadily in this region since 1950, as indicated below:

Cattle raising in the Mountain States

	1950	1978	Change: Amount	Change: Percent
		Thousand head		
Beef cows	2,473	3,947	1,474	60
Milk cows	717	339	−378	−53
All cows	3,190	4,286	1,096	34

Source: Derived from (*5*).

Changes that have occurred in the Mountain States follow:

- This region has been nearly fully developed; thus, changes have been slow;
- The mixed crop-livestock farming areas with supplementary cow-calf operations have increased cattle raising more than other areas in the region;
- Farm consolidation, utilization of irrigated forages in combination with other pastures, and aftermath grazing have increased cattle raising.

Pacific States—Cattle raising has increased slowly in the Pacific States, as indicated below:

Cattle raising in the Pacific States

	1950	1978	Change: Amount	Change: Percent
	Thousand head			
Beef cows	1,107	1,952	845	76
Milk cows	1,369	1,115	−254	−18
All cows	2,476	3,067	591	24

Source: Derived from (*5*).

In considering cattle raising in the Pacific States, the following are important:

- California is the main cattle raising State in the region;
- More rapid increases probably have been restrained by land being converted to nonagricultural uses.

Northeast States—The Northeast region is not an important beef production area. Beef cattle raising has been expanded somewhat to utilize resources formerly allocated to dairy cattle but has not offset the decline in milk cow numbers, as shown below:

Cattle raising in the Northeast States

	1950	1978	Change: Amount	Change: Percent
	Thousand head			
Beef cows	75	406	331	441
Milk cows	3,553	2,204	−1,349	−38
All cows	3,628	2,610	−1,018	−28

Source: Derived from (*5*).

Cattle Feeding

Changes

- Small farmer-feeders (feedlots less than 1,000-head capacity) produced most of the fed beef in the United States prior to 1960.
- In contrast, more than half of the fed cattle marketed now are fed in about 420 large commercial feedlots.
- Small farmer-feeders now account for less than one-third of the cattle feeding.

There was a substantial increase in the aggregate annual feedlot capacity in the 1960's and early 1970's. During 1962-72, the number of fed cattle marketed increased almost 80 percent, while the number of feedlots decreased by 33 percent (*5, 12*). On the average, more than 1 million additional cattle were fed each year during this period, while feedlots decreased by more than 7,500 each year. Small feedlots of less than 1,000-head capacity declined in number each year, while large commercial feedlots increased by about 60 lots annually.

The increase in feeding capacity has been associated with large lots. In 1962, almost 64 percent of the fat cattle marketed were fed in feedlots with a capacity of less than 1,000 head. These feedlots now account for less than one-third of the fed cattle marketed. Cattle still are fed in more than 130,000 of these small feedlots, but 38 percent are fed by the 200 largest feedlots (*5*) (table 2). Although small feedlots still are important in terms of total beef produced, the production of fed cattle is rapidly becoming more concentrated. Several feedlot firms have a one-time capacity in excess of 100,000 feeder cattle. Since cattle generally are fed for less than 6 months before moving to market, a 100,000-head feedlot can produce more than 200,000 head per year.

The Southern Plains region has accounted for nearly all the growth in cattle feeding since 1955 and is now the major cattle feeding area (figure 4). This area accounts for 44 percent of all fed cattle marketed, while the Corn Belt now accounts for about 20 percent.

In absolute numbers of cattle fed, cattle feeders in the Corn Belt currently feed more now than in 1955. However, comparing the current level of feeding in the Corn Belt with any period prior to 1960 is deceiving, considering adjustments that have occurred there. The Corn Belt has experienced both a significant growth and dramatic decline in cattle feeding since 1960 (figure 5). The rapid growth period, 1963-69, is not surprising—there were strong incentives for increasing production of fed beef. All feeding areas increased production during the period. The dramatic decline in

Table 2—Fed cattle marketed, feedlots, and cattle marketed per feedlot, by capacity groups, 1964, 1974, and 1977

Feedlot capacity (Head)	Fed cattle marketed		Feedlots		Fed cattle marketed per feedlot
	Number	Percentage	Number	Percentage of total feedlots	
	1,000 head	*Percent*		*Percent*	*Number*
1977					
Under 1,000	7,927	31.9	130,049	98.6	61
Over 1,000	16,934	68.1	1,880	1.4	9,007
1,000 to 1,999	1,176	4.7	819	.6	1,436
2,000 to 3,999	1,186	4.8	401	.3	2,958
4,000 to 7,999	1,653	6.6	238	.2	6,945
8,000 to 15,999	3,583	14.4	221	.2	16,213
16,000 to 31,999	4,846	19.5	140	.1	34,614
32,000 and over	4,490	18.1	61	.05	73,607
Total	24,861	100.0	131,929	100.0	(avg.) 188
1974					
Under 1,000	8,261	35.4	135,810	98.6	61
Over 1,000	15,073	64.6	1,922	1.4	7,842
1,000 to 1,999	981	4.2	747	.5	1,313
2,000 to 3,999	1,065	4.6	484	.4	2,200
4,000 to 7,999	1,541	6.6	258	.2	5,973
8,000 to 15,999	2,854	12.2	212	.2	13,462
16,000 to 31,999	4,174	17.9	148	.1	28,203
32,000 and over	4,458	19.1	73	.05	61,068
Total	23,334	100.0	137,732	100.0	(avg.) 169
1964					
Under 1,000	11,094	61.1	223,071	99.3	50
Over 1,000	7,050	38.9	1,668	.7	4,227
1,000 to 1,999	1,043	5.7	826	.4	1,263
2,000 to 3,999	1,147	6.3	435	.2	2,637
4,000 to 7,999	1,377	7.6	244	.1	5,643
8,000 to 15,999	1,772	9.8	119	–	14,891
16,000 to 31,999	1,153	6.4	36	–	32,028
32,000 and over	558	3.1	8	–	69,750
Total	18,144	100.0	224,739	100.0	(avg.) 81

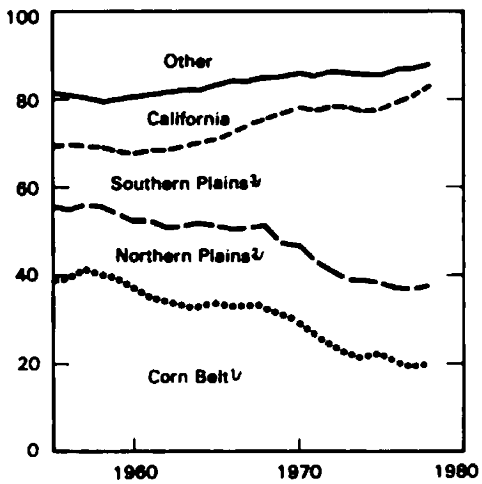
Source: (*5*).

1973-75 also is not surprising, because heavy losses occurred in cattle feeding in all areas then and total cattle feeding was reduced sharply. However, it is not clear why cattle feeding declined in the Corn Belt during 1969-72, because other areas significantly increased production during the period. It also is not clear why the Corn Belt has not returned to higher levels of feeding.

Farmer-Feeders—Traditional Technology

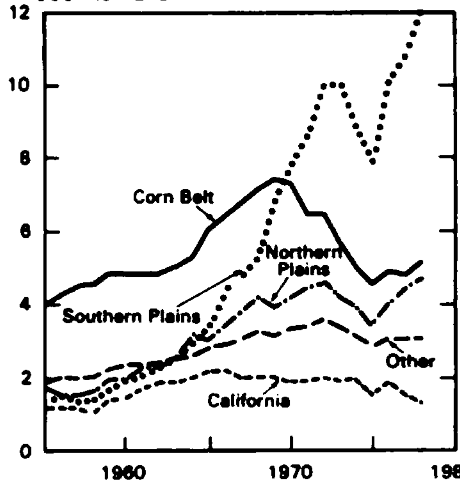
Cattle feedlot operations may be divided into two basic types—traditional farmer-feeder and large commercial feedlot. The size that

FIGURE 4
PERCENT OF U.S. FED CATTLE MARKETED BY REGIONS, 1955 THROUGH 1977



SOURCE: (8).
1/ IOWA, MISSOURI, ILLINOIS, INDIANA, AND OHIO.
2/ NEBRASKA, SOUTH DAKOTA, AND NORTH DAKOTA
3/ TEXAS, OKLAHOMA, KANSAS, COLORADO, AND NEW MEXICO

FIGURE 5
NUMBER OF FED CATTLE MARKETED BY REGIONS, 1955 THROUGH 1977



SOURCE: (8)
CORN BELT: IOWA, MISSOURI, ILLINOIS, INDIANA, AND OHIO
NORTHERN PLAINS: NEBRASKA, SOUTH DAKOTA, AND NORTH DAKOTA
SOUTHERN PLAINS: TEXAS, OKLAHOMA, KANSAS, COLORADO, AND NEW MEXICO

delineates the two is somewhat arbitrary, but most farmer-feeders operate with a capacity of less than 1,000 head (*12*). Many farmer-feeders keep fewer than 200 cattle, usually during the noncropping season, and raise most of their own feed. Feed and labor costs make up a high proportion of the total cost of feeding cattle. Consequently, the utilization of off-season labor, nonsalable roughage, and other low-cost inputs makes cattle feeding an attractive supplementary enterprise for many grain farmers.

The volume fed by farmer-feeders depends upon the price relationships between their alternative farm enterprises, off-season labor availability, and off-farm employment alternatives. The large farmer-feeders tend to operate on a year-round basis with more specialized feeding facilities.

Farmer-feeders typically are in the older cattle feeding areas—the Corn Belt, Northern Plains, and Lake States—but are declining rapidly in number and relative production. This is particularly true in the Northern Plains, where large commercial feedlots are being established.

The percentage distribution shown on top of page 103 of feedlots and fed beef marketings in 1974 in nine Midwest States (including the Corn Belt) illustrates the size of farmer-feed operations.

Commercial Feedlots—New Technology

- Fewer than 2,000 commercial feedlots produce more than two-thirds of the fed cattle.

Fed cattle marketings, 1974[1]

Feedlot marketings	Feedlots	Fed-beef marketings
	Percent	
Under 100	86	30
100-199	7	15
200-499	5	24
500-999	1	13
1,000 and over	1	18

[1] Includes Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, Pennsylvania, and Wisconsin.
Source (*10*).

- More than 130,000 farmer-feeders produce less than one-third of the fed cattle.

Large commercial feedlots represent a new technology in cattle feeding, being highly mechanized and efficient. Labor is specialized and professional nutritionists, veterinarians, and accountants are retained to formulate feed rations, treat animal health, and deal with financial problems. The managers are well informed on national and local grain, cattle, and beef markets and can receive information on demand concerning specific buyer activities. Many subscribe to commercial information services and prices. The large feedlot managers, or their buyers, are continuously in the market for feeder cattle on a broad geographic basis. They have current information on prices, sources of inputs, and availability and feeding quality of cattle coming from different geographical areas during different seasons. They vary their feeding programs to take account of the age and weight of cattle placed on feed, kinds of feed available, and the finish or grade desired. The feed milling equipment and feed formulation technology are capital-intensive. Management is aided by a detailed set of records kept for each lot of cattle.

Most of the largest commercial feedlots are incorporated, but a number of the lots, particularly the moderate-sized ones, are not. According to estimates developed from USDA and Census data, 54 percent of all feedlots with 2,000-head capacity or more in 1974 were incorporated (*5, 17*). However, these incorporated feedlots accounted for 87 percent of all fed cattle marketed by all feedlots with 2,000-head or more capacity.

About 94 percent of all incorporated feedlots are closely held firms; 68 percent are owned by fewer than 6 shareholders, and 90 percent are owned by fewer than 11. One or two shareholders constitute a majority of the ownership in 70 percent of these feedlots. More than three-fourths of all closely held incorporated feedlots involve related shareholders. Thus, most incorporated feedlots are closely held or family corporations. The widely held corporations accounted for about 7 percent of the cattle marketed in 1974, with most of these by lots having at least 50,000-head capacity.

There are 23 feedlot firms with a one-time capacity of over 50,000 head. These firms fed 14 percent of all fed cattle in 1974. Analysis of limited information reported in the Census of Agriculture reveals that these large feedlot firms, when compared with smaller ones, have more multiple feedlot operations, depend relatively little upon custom feeding, are more integrated with other agricultural operations, and frequently are more involved in activities not related to agriculture (table 3). More than 60 percent of the firms with 50,000-head capacity feedlot operations had nonfarm activities, two-thirds of them outside agriculture.

Incorporated firms with cattle feeding operations of 12,000 to 50,000 head are surprisingly similar in type of corporation and integrated and custom feeding activities. These commercial feedlot firms marketed about 25 percent of the fed cattle in 1974, and they can be characterized as closely held or independent corporations, sparsely integrated, and heavily dependent upon custom feeding activities (table 3).

Corporate feedlot firms with cattle feeding operations under 12,000-head capacity marketed about 14 percent of the fed cattle in 1974. Less than 3 percent of these firms are public corporations, and less than 6 percent have more than 10 shareholders. Only 16 percent of these feedlot firms have nonfarm business activities. Less than one-third of the feedlot firms with nonfarm business activities involve business operations outside the food and fiber industry. Custom feeding activities decline rapidly as feedlot size decreases.

Custom Feeding in Commercial Feedlots

In custom cattle feeding, a feedlot performs the service of feeding cattle under agreement with individuals or other types of clients who own the cattle. The custom arrangements vary, but one more or less typical arrangement is for the feedlot to bill the cattle owner a basic charge—including a markup for each ton of feed plus a per-head charge for medication, dehorning, and other services. Few, if any, lots specialize solely in custom feeding. Many large commercial feedlots are heavily involved in custom feeding.

Development of custom feeding activities has closely paralleled the growth and development of large feedlot operations (*3*). The reason

Table 3—Characteristics of large corporate cattle feedlot firms, United States, 1974

Item	Unit	One-time capacity of feedlot firms (head of cattle)[1]							
		All corporate feedlot firms	2,000 to 3,999 head	4,000 to 7,999 head	8,000 to 11,999 head	12,000 to 19,999	20,000 to 29,999	30,000 to 49,999	50,000 and over
Firms	No.	635	181	164	82	89	48	48	23
Fed cattle marketed	Mil.	12.3	.7	1.4	1.1	1.9	1.6	2.4	3.1
Proportion of U.S.[2]	Pct.	53	3	6	5	8	7	11	14
Parent corporations	do.	11	2	9	7	19	19	19	57
Public corporations	do.	6	1	3	5	7	10	8	44
Privately owned	do.	94	99	97	95	93	90	92	56
More than 10 shareholders	do.	10	5	8	6	14	21	18	50
Multiple feedlot operations									
More than 1 feedlot	do.	15	6	11	9	16	21	27	87
More than 3 feedlots	do.	4	1	3	1	3	10	2	48
More than 5 feedlots	do.	2	—	2	—	2	6		30
Nonfarm business activities	do.	19	13	18	21	17	25	17	61
Related to agriculture	do.	84	70	90	94	73	92	75	93
With farm input	do.	36	44	27	26	46	36	33	54
With processing	do.	41	44	38	31	64	27	17	62
With wholesaling or retailing	do.	38	44	31	44	27	6	67	46
With services and other	do.	14	6	27	6	18	27	—	—
Not related to agriculture	do.	39	43	31	12	60	33	38	64
Custom feeding activities	do.	55	25	53	62	81	85	88	61
Proportion of cattle custom fed	do.	53	20	37	51	65	68	70	41

[1] Combined capacity presented for firms with more than one feedlot.
[2] Total fed cattle marketed in the 23 important cattle feeding States in 1974 was 23,330,000 head (*8*).
Source: (*17*).

is clear. Capital requirements and risks associated with the operation of large feedlots are so high that traditional means of financing agricultural production have been inadequate to support the new system. At current price levels, the total financing of 30,000 cattle on feed can exceed $15 million. Custom feeding is a means of providing the large-scale financing needed for the new feedlots.

About 53 percent of the cattle marketed from incorporated feedlots with a capacity of 2,000 or more head were custom fed in 1974 (*17*). This proportion was equal to about a fourth of all fed cattle marketed in 1974. Taking into account custom feeding at nonincorporated feedlots would raise the share to 30 to 35 percent. The year 1974 was not a typical custom feeding year, due to large losses that occurred in cattle feeding. The proportion of cattle custom fed during a "normal" year probably exceeds 40 percent. A special study conducted for the National Commission on Food Marketing estimated that 38 percent of the fed cattle marketed in 1964 were custom fed cattle (*16*). The proportion of cattle custom fed apparently increased by less than 10 percent during 1964-74. Nevertheless, the number of fed cattle marketed in 1974 was 41 percent or 6.8 million head more than in 1964. Thus, in absolute numbers, custom feeding increased by about 4 million head.

Feedlot clients who have cattle custom fed must, of course, assume the financial risks involved, and these are high, compared with other agricultural enterprises. Financial institutions will loan as much as 70 to 80 percent of the total cost, which at current prices is as much as $700 per head. The client may need to provide only $160 per head, with the remainder provided by a commercial bank or other lender.

A 1972 study identified the legal form of organization of custom feeding clients in the Southern Plains as 38 percent sole proprietors, 31 percent partnerships, 21 percent corporations, and 10 percent cattle-feeding clubs and limited partnerships. The primary occupations of custom feeding clients, in terms of the proportion of cattle fed, were identified as professional feeders (30 percent), farmers and ranchers (28 percent), livestock dealers (15 percent), and 26 percent fed by all other occupations, including bankers, retailers, doctors, lawyers, teachers, and meat packers (*4*).

Vertical Integration

Many of the large commercial feedlots are involved in parts of the beef industry other than feeding. It is doubtful that any one feedlot operation is involved in every stage of production and distribution, but it is fairly common to be in at least two different stages. The other functions include cattle production, transportation, packing, retailing, and restaurants.

To achieve feed economies, many large feedlots have vertically integrated with grain elevators and feed manufacturers. This is a logical development, because feed accounts for a high proportion of the total cost of producing fat cattle and any savings would offer a significant competitive advantage. Most large commercial feedlots have not undertaken ownership of land or other resources required to raise cattle or produce grain for feed because of the large capital requirements.

A Growth and Development Example

Since the Southern Plains is the major growth area for large commercial feedlots, explanation of the reasons for structural changes in cattle feeding in this area is very important (figure 5). Commercial cattle feeding in the Southern Plains grew rapidly as a result of:

- Rapid increases in feed grain production as a result of government programs and technological developments in feed grain production.
- New developments in financing agricultural production (cattle feeding) and spreading the production risks by utilizing the equity of a second party (custom feeding).
- Industrialization of production through the importation of new types of management abilities.

These influences also were felt in areas other than the Southern Plains, but to a lesser extent.

Feed grain production in the Southern Plains has increased significantly as a result of a shift from cotton and wheat production to hybrid grain sorghum. It was considered a minor feed grain crop in the mid-1950's, and acreage controls did not apply to it. The government feed grain program did, however, provide an indirect price support which encouraged sorghum production. In 1954, the planted acreage of sorghum increased by about 2 million acres in Texas alone. This was offset by a decrease in cotton production, a crop for which acreage restrictions were in effect. Grain sorghum, with similar climatic, cultivation, and mechanization requirements as cotton, was a natural alternative—in many cases the only one to cotton.

The introduction of hybrid grain sorghum shortly after the cotton acreage program was initiated further accelerated the shift (table 4). The hybrid development made it economical to develop new irrigation systems solely for sorghum production. Farmers also intensified their inputs such as fertilizer and adopted other yield-increasing

Table 4—Grain sorghum production and cattle marketed from feedlots, Texas, 1951-73

Year	Grain sorghum production	Marketings from feedlots
	Thousand bushels	*Thousand head*
1951	74,193	NA
1952	54,264	NA
1953	56,837	NA
1954	[1] 135,630	NA
1955	148,309	227
1956	124,202	307
1957	[2] 244,075	291
1958	251,427	296
1959	257,832	403
1960	258,552	477
1961	229,635	548
1962	201,006	756
1963	242,860	896
1964	215,648	971
1965	294,056	1,094
1966	311,896	1,412
1967	343,485	1,669
1968	340,780	1,970
1969	309,800	2,706
1970	329,616	3,138
1971	303,004	3,663
1972	391,780	4,308
1973	417,000	4,412

NA =not available.

[1] In 1954, sorghum increased by 2,029,000 acres as cotton acres decreased 2.4 million acres because of cotton acreage allotments.

[2] The first sorghum hybrids were available to farmers in 1957.

Source: (*18*).

practices. The result was a substantial increase in sorghum production in a period in which there was a concentrated effort through the feed grain program to curb production. Sorghum production in Texas increased by 300 million bushels during 1953-68.

The second important factor in the development of large feedlots in the Southern Plains was the emergence of entrepreneurs skilled in the utilization of outside equity capital to operate the feedlots and spread the large financial risks. This was done mainly through custom feeding in the large feedlots for many types of clients. The custom feeders brought capital from people who otherwise would not have been investing in cattle feeding. Commercial banks, particularly the large metropolitan banks in the Southern Plains, worked diligently with feedlot managers to develop procedures for financing both the feedlots and their custom feeding clients. The shortrun nature of the production of fat cattle along with the increasing value of cattle used as loan collateral makes cattle feeding loans an attractive alternative to bank loans. Later, new types of capital raising activities evolved—including debentures, public stock offerings, banker acceptances, and limited partnership arrangements for financing cattle feeding and custom feeding clients.

The third important factor involved in the structural change, the importation of management, is difficult to measure. Many feedlot managers were brought into the High Plains from California, the Corn Belt, and other areas. Many of these managers had previous cattle feeding experience. However, the management of these large feedlots represents much more than just the feeding of cattle and goes far beyond the usual type of management in traditional farming. This management involves organization and direction of people, capital, machines and equipment, feed formulas, recordkeeping, analysis of these records and other data, time and motion studies, experimentation, and working with consultants. Managerial abilities required to operate these large feedlots more nearly approximate those found in the industrial sector than the traditional agricultural sector.

Additional factors likely contributed to the development of the large feedlot industry in the Southern Plains, but simply delineating these factors misses the most important point. What is important to understand is that it was the convergence of several seemingly unrelated phenomena–including government commodity programs, development of hybrid sorghums, strong demand for beef and high consumer incomes, Federal tax policies, and new approaches to management and finance–that brought about major structural changes. This observation suggests that structural changes occur in response to the secondary and tertiary impacts of public policies and programs and other factors interacting with each other. In view of the complicated interrelationships involved, it is difficult to predict structural changes.

WHY BEEF PRODUCTION HAS CHANGED

Cattle Raising

Factors that have caused changes in cattle raising are:

- Profitability in connection with increasing demand for beef. This is important in accounting for the increase in cattle raising since 1950.
- Increasing size of farm and farm consolidation. This added enough pasture acreage to support cattle raising.
- Resources formerly used in dairying and crop production. These were shifted to cattle raising.
- Government commodity programs and tax policies. They provided incentives for cattle raising.

- Production technologies, mainly forage crop technology. They encouraged increases in cattle raising.
- Farm adjustments that increased part-time farming activities. This encouraged expansion of beef cattle numbers and cattle raising.

Profitability has been important in accounting for increasing cattle raising activities. Much of the expansion that has occurred since 1950 can be attributed in part to producer responses to favorable price expectations for beef. Favorable beef prices have resulted from increasing consumer income and demand for beef (*20*).

Agricultural adjustments that decreased the number of farms and farm consolidation also were important in encouraging increases in cattle raising. This was particularly so in many of the traditional small farm areas of the United States, including the Southwest, eastern Texas, and Great Plains States. Increasing farm size led to enlarged pastures and encouraged improvements which increased the supply of forage enough to support beef cattle raising activities.

Beef production has been expanded in many regions of the United States through shifting land and forage resources formerly used in dairying to beef cattle raising. In 1950, there were more milk cows than beef cows in the United States. Technology in milk production has allowed milk cow numbers to be reduced by almost 13 million head, a 54-percent reduction since 1950. Also, mechanization of farming in the United States released cropland, pasture, and forage resources formerly used to support workstock. There are no available statistics pertaining to the total number of cropland and/or pasture resources diverted to cattle raising; however, 19 million acres of cropland were used to produce feed for workstock in 1950. Only 5 million acres were used to produce feed for workstock in 1960. Thus, 14 million acres of cropland were released, and many of these resources probably were diverted to cattle raising.

Government commodity programs such as cotton and grain acreage allotments in effect much of the time since the 1950's also have diverted many land resources to forage production for cattle raising. Special provisions of the wheat, feed grain, and cotton acreage diversion programs in effect mainly during the 1960's provided 50 million to 60 million acres of cropland to be used on a limited basis in cattle raising. Much of this acreage, particularly diverted cropland in the Southwest and Great Plains, was used for winter pasture to support an expanding beef cow herd.

Tax policies have encouraged cattle raising. However, no studies have estimated the importance of this factor. Federal income tax regulations provide an incentive for investors to own beef cattle through capital gain and depreciation allowances. Real estate tax provisions in some urban fringe areas where land is appraised for tax purposes on the basis of current use, rather than market value, also may give landowners incentives to maintain beef cows.

In addition to the crop mechanization and dairy production technology which released resources for producing beef cattle, new production technology utilized directly in cattle raising had some impact on expanding beef output. This includes the application of forage production technology in the form of fertilization, weed control, and introduction of improved grass varieties.

Part-time farmers have become more important in cattle raising in recent years. Many of these operators own land resources as ex-farmers through inheritance or via investment purchases. Many are employed in nonfarm occupations or have important sources of nonfarm income. Cattle raising has low labor requirements, compared with other types of farm enterprises. Thus, part-time farming favors a cattle raising enterprise that can be managed very well in connection with off-farm work. The nonfarm income of part-time farmers also is an important source of capital for investments in cattle raising.

Cattle Feeding

Factors that have caused changes in cattle feeding are:

- Government farm commodity programs.
- Technological developments in grain production.
- Rising consumer incomes leading to a strong demand for beef, particularly fed beef.
- Economies and incentives associated with large commercial feedlots—the new technology in cattle feeding.

Strong Demand for Beef

When assessing the forces behind structural changes, it is important to understand that a stong increase in demand for fed beef occurred as large commercial feedlot operations developed. The strong demand was partly responsible for relatively high fed beef prices. Per capita consumption of beef increased by about 51 pounds, from 63 pounds in 1950 to 114 pounds in 1970. This can be attributed to an increase in nominal per capita disposable income—from $1,400 to about $3,300—in the early 1970's. Consumers historically have increased the proportion of beef in their diet as income levels increased. In addition, population increased from about 151 million in 1950 to more than 200 million in 1970. The increase in consumption of beef during 1950-70 was equal to about 140 percent of total production in 1950. This increase in beef production was facilitated by the growth and development of cattle feeding.

Feed Grain Supplies

The strong demand for beef influenced cattle feeders to utilize farmers' tremendous capacity to produce feed grains. Feed grain production increased from 113 million short tons in 1950 to more than 200 million tons in 1974. During much of this time, feed grain programs were in effect. Large quantities of feed grains were under loan or owned by the Federal Government, and production exceeded the needs of livestock producers. The resulting low and stable feed grain prices encouraged the growth of cattle feeding. Utilization of corn and sorghum in cattle feeding increased from 11 million tons in 1960 to about 37 million tons in 1972 (*19*).

Feeder Cattle Supplies

The increase in feeding could not have occurred so rapidly without adequate feeder cattle supplies. Over the decade of the 1960's, the cattle herd, and thus the calf supply, increased by one-third. But the large proportion of calves formerly slaughtered as nonfed beef provided a major source of new feeder stock for feedlots. The proportion of the calf crop slaughtered as nonfed beef decreased from 21 percent in 1960 to 5 percent in the early 1970's.

Forage supplies for cattle also increased as acreage formerly devoted to cotton and grain was shifted into forage. Much of this adjustment was due to the movement of cotton production out of the Southeast. In the United States, as a whole, more than 50 million acres of cropland were shifted to conservation practices, much in forage, as a result of the cropland diversion and conservation programs in the 1950's and 1960's. The productivity of acres diverted from crops to forage was high, compared with other land in forage. Even though there were regulations limiting the use of diverted acres, grazing was allowed except during a 5-month growing period. As a result, farmers and ranchers planted their diverted acreage in crops for winter and early spring grazing.

Although an adequate supply of feeder cattle in the United States during the 1960's encouraged the growth and development of cattle feeding, a different situation exists today. The "reservoir" of cattle available for feeding, but slaughtered as nonfed beef, was virtually depleted by 1973. The acreage and conservation reserve programs have not been in effect since the early 1970's, and high grain prices caused many farmers to shift acreage from forage to grain production. Later, a sharp drop in feeder cattle prices led to liquidation of cattle herds which only now are beginning to be rebuilt.

Advantages of Large-Scale Feeding

The development of new institutional technology—the large commercial feedlot—was another important factor influencing structural changes in cattle feeding. There are efficiencies in feeding cattle in large feedlots (*2, 10, 11, 13*). In addition to these technical efficiencies, economies of size in buying inputs and selling fat stock, in the acquisition of information and capital, and in developing risk-diversion strategies may offer additional competitive edges to large units. The existence of substantial scale economies permitting them to produce at a lower average cost per unit than smaller producers has contributed to the decline in number of feedlots and may lead to even further concentration.

Large feedlot owners and their custom feeding clients also may be able to prosper with relatively low feeding margins per head because of the large volume of operation. Their use of highly leveraged capital (very little owned capital relative to borrowed capital) may mean that a net margin of $4 to $5 a head will provide an 8- to 10-percent annualized return on their invested capital.

Custom feeding has helped large feedlot operators to achieve economies of size without assuming unacceptable levels of risk. Most of the risks are shifted from the feedlot owners to custom feeding clients. The feedlot operators are able to feed their own cattle efficiently, even if limited in number, since custom feeding gives them the necessary volume to spread costs. Small feedlot operators cannot justify the additional recordkeeping and expense of dealing with custom feeding clients or banks.

Large feedlots also have been able to cooperate, or "informally integrate," with packing plants that have located adjacent to their feeding areas. Such arrangements with meatpackers apparently have reduced cattle assembly costs and production scheduling problems of beef processing plants. Thus, relocation of the meatpacking industry, allowing new and more efficient plants to be located near concentrations of feedlots, has been important in the relocation of cattle feeding.

Growth of large feedlots also has been abetted by provisions in the tax laws which make feeding attractive. Although recent changes in the tax laws limit former tax advantages for agricultural limited partnerships and syndicated custom feeding operations, there still are income tax management strategies that can be followed when feeding cattle—and these can be advantageous to cattle feeders and custom feeding clients. Tax regulations permitting farmers and individuals to use cash accounting (rather than capital accounting) for tax computation are used to advantage by cattle feeders, including custom feeders, many of whom are seeking tax shifts for high farm and nonfarm incomes.

FUTURE CHANGES IN BEEF PRODUCTION

Cattle Feeding

Many adjustments still are occuring in cattle feeding and fed beef marketing. Although there is concentration of cattle feeding and production of fed beef, market coordination in terms of supply controls has not been achieved. Under these conditions, cattle feeding remains a high-risk enterprise. Large economic losses have occurred in cattle feeding in recent years. These unprecedented losses raise structural questions about the best form of organization for large feedlot operations. Many changes in feedlot ownership and organization have occurred since the mid-1970's, partly as a result of the large economic losses that occurred.

Fed beef processing and marketing methods also are changing. Due to advantages in transportation and more efficient use of labor, more beef is being precut at packing plants or fabrication centers, and more processed beef is being sold on a formula basis than in open-marketing transactions. More than two-thirds of the beef entering supermarkets no longer arrives in carcass form. Increasing quantities of beef are moving to retail stores in the form of "boxed beef."

One of the large beef processors has entered into a joint venture with several large feedlots organized as a farm cooperative. There appears to be a number of economic advantages associated with this joint venture, and similar arrangements are rumored to be developing.

The organizational and institutional arrangements associated with cattle feeding in the United States will change. High risk in cattle feeding, concentration of production, and changing beef processing and marketing methods are conducive to further changes in the organization of production and marketing of fed beef. Too many possibilities exist to predict the structure of cattle feeding in the year 2000.

This analysis leads to the following conclusions regarding future adjustments in cattle feeding:

1. There is significant potential for further innovations in institutional and organizational arrangements in cattle feeding in the United States. Changes could occur rapidly because the technology for producing beef in large commercial cattle feedlots is well developed

and proven. Studies have shown that large commercial feedlot operations achieve economies of size and lower costs of production. The lower unit costs associated with large commercial feedlot operations are due mainly to lower fixed costs of production. Such fixed costs are associated directly with the higher utilization rates of commercial feedlot operations, compared with small seasonal feedlot operations (*10*).

However, even large commercial feedlots normally do not operate at 100-percent utilization—nor do they have perfect production information or control. The average annual utilization rate of large feedlots may be less than 75 percent. Lower production costs would be associated with higher rates of utilization. A significant proportion of the industry is characterized by feedlot operations that are closely held firms. These are high-risk firms that have problems in acquiring operating capital. The current organizational structure, with heavy dependence on custom feeding, may not be most conducive to higher average utilization rates or the best controls over production and investments. Put another way, other organizational and institutional arrangements may lead to higher utilization rates, lower production costs, and better production control. Thus, adjustments in cattle feeding will continue.

A substantial portion of the entrepreneurs now involved in cattle feeding are not bound or tied to the concept of total ownership, operation, and control of resources in production as are the more traditional types of farmers and farm producing units in the United States. Therefore, feeding cattle in large commercial feedlot operations may be restructured easily in ownership and linkages in different types of institutional arrangements.

The current concentration of cattle feeding is more conducive to organizational changes than would be a much larger number of small feedlots.

2. If trends of the last 30 years are projected into the future, one conclusion is that large feedlots will grow larger. However, within the next 20 to 30 years, most commercial feedlot operations may not increase in size much above the current size of the larger feedlots. Although studies have shown that economies of size exist, none have analyzed feedlot operations of 50,000 head and over. Little can be said regarding the specific optimum size of a feedlot larger than the 40,000- to 50,000-head size. Furthermore, the lower costs of production or advantages due to size decline rapidly when feedlot utilization rates are held constant (*2*). Thus, economies of size may be greatly influenced by vertical linkage situations with other firms in the beef industry that result in high rates of feedlot utilization.

There probably is considerable latitude in the optimum size of cattle feedlot operations, once a fairly large size and full utilization rates are obtained. This situation would facilitate the existence of a number of different types of linkage alternatives between feedlots and other firms in the beef industry.

3. The future location of cattle feeding will be influenced by adjustments in feed production. Relative to other input factors, an adequate supply of feed is of primary importance in determining the optimum location of cattle feeding. Total feeding costs are influenced by the transportation cost of the input factors, especially feed and feeder cattle. The distance that feed is transported has the most influence on production costs, because the total weight of feed utilized is much higher than the total weight of feeder calves. Other things equal, the optimum location of cattle feeding and lowest cost of production is where an adequate feed supply exists.

Cattle feeding in the Southern Plains developed in connection with surplus feed grain supplies, much of which came about as a result of expanded irrigation. Irrigation water is being depleted in this area, and high energy costs are tending to increase the rate of economic depletion of the irrigation water supply. These matters will affect production costs and induce production adjustments. The impact of this on cattle feeding in the Southern Plains is not clear, because the dryer climate of the area is an important factor facilitating large-scale cattle feeding technology. There is some question whether this technology could be duplicated in the Corn Belt or other high-rainfall areas. One possibility is that future regional concentration could occur in the central Great Plains. This would be closer to the Corn Belt, but still in a dryer climate.

Cattle Raising

Structural changes in cattle raising will occur at a much slower rate than changes in cattle feeding. This conclusion is based upon the assumption that production technology in cattle raising will change slowly. If so, several important characteristics of cattle raising limit the innovative organizational possibility that leads to structural changes, as discussed below:

1. The resources used in cattle raising are widely scattered, both in location and ownership. This is due to the fact that cattle raising is a land-based, forage-utilizing activity. Improvement in forage production and increases in the quantity of forage available for grazing were important factors leading to increasing the production of feeder cattle. However, forage is utilized mainly in connection with the land that produces it. The land resource cannot be concentrated easily into new institutional arrangements.

2. Compared with cattle feeding, there is relatively little concentration and specialization of production associated with cattle

raising. Cattle raising can be a profitable enterprise in combination with crop production. A significant proportion of cattle raising is connected with crop production. Much crop production in the United States is associated with the traditional family farm situation. This characteristic limits the organizational possibilities of cattle raising.

3. Significant proportions of the cattle raised and the supply of nonfed beef are controlled by people who are interested primarily in landownership and by other persons who are not oriented to commercial cattle production. This may have contributed to relatively low average returns from cattle raising. The magnitude of this impact is not known. However, low returns probably influence the slow adoption of technology. More profitable enterprises, in a competitive situation, lead to rapid development and adoption of new technology and innovation.

Structural changes in cattle feeding will influence changes and adjustments in cattle raising. With the increase in cattle feeding, increasing demand for feeder cattle has brought about a situation where almost all younger cattle not needed for replacements in breeding herds now enter the feedlot before slaughter. Increased fed beef production is now more directly dependent upon the growth and development of cattle raising. This is a structural interrelationship of increasing importance, and this condition may act as a catalyst for new technology in cattle raising. There should be more current incentives for innovations and improvements to fulfill the increasing demand for feeder cattle.

4. The different rates of increase in cattle raising among regions probably will continue. Forage crop and livestock production technologies are important determinants of beef cow numbers and feeder cattle production. Some of the most important current technology is associated with forage production. The widespread application of available forage production technologies such as fertilization, weed control, and the introduction of improved species of forage would increase production and cattle raising in regions where rainfall is not a limiting factor. Thus, greater increases in cattle raising should be expected in the eastern half of the United States.

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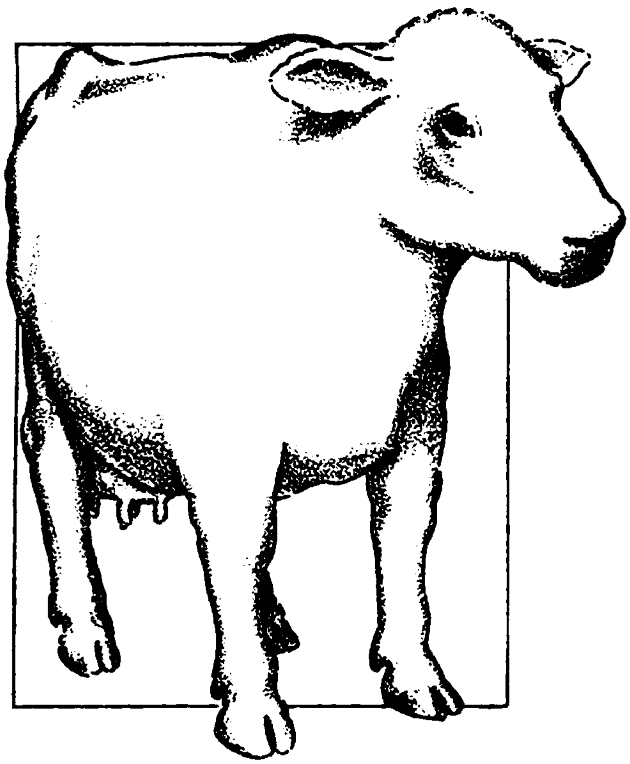


Dairy

Robert H. Forste &
George Frick

SUMMARY

Dairy farming has become a specialized form of commercial farming. Significant changes in the production, economic, and marketing characteristics of the dairy industry have occurred since the end of World War II, and the rate of change has become more pronounced and accelerated since the late sixties.

The number of farms with milk cows declined from over 1.8 million in 1959 to 380,000 in 1978. More significantly, the number of commercial dairy farms declined from 602,000 in 1950 to an estimated 205,000 farms in 1979. Conversely, average herd size on commercial farms more than doubled during the same period.

While milk production in the United States declined by only 2 percent during 1965-78, production shifted in the various regions. The greatest increases occurred in the Pacific Southwest and Mountain regions; the Corn Belt and Northern Plains experienced sharp decreases in milk production. Regional shares of dairy product receipts remained the same during 1960-77, with the exception of the Northeast (a decrease of 4 percent) and the Southwest (an increase of 4 percent). These shifts are attributable to population increases and changes in comparative advantage, such as relative costs of production and milk production per cow. Large-scale drylot operations, with herds of over 2,000 and as many as 10,000 cows, have been established in California, Arizona, and Florida.

Rapid development and adoption of new technology have been

major factors in the high degree of specialization and substitution of capital for labor in dairy farming. Job functions are specialized, and while capital investment varies by region, all farms have bulk milk storage tanks—and many have pipeline milkers, barn cleaners, silo unloaders, and similar labor-saving equipment.

While sole proprietorship is still the dominant form of dairy farm organization, corporate dairy farms have gained in importance since 1969, particularly in the Northeast, Lake States, Southwest, and North Central regions. The number of dairy farms earning less than $20,000 a year has decreased markedly, while farms in all other income classes are earning higher incomes. The trend toward larger and fewer dairy farms with higher incomes will continue.

Technological advances and mechanization have been paramount in causing changes in dairy farming in the last 20 years. One glaring contrast is the large dairies in Florida and California, relative to dairies in the Northeast and Lake States. A crucial question is: Will entrepreneurs develop large size—5,000- to 10,000-cow—dairies in the Northeast and Lake States?

In addition to technology and mechanization, three other factors are noted as causal elements in the changes in dairy farming:

1. Alternative employment and nonfarm opportunities have affected the exodus from dairy farming at varying rates in the regions. For example, there has been a shift to crop production in the Corn Belt, and opportunities for nonfarm employment in the Northeast have fostered the exit from dairy farming.

2. Urbanization and environmental quality have spurred the exodus from dairy farming and raised barriers to entry, particularly in the Northeast. High land costs and increased requirements/costs of pollution control also have and will continue to reinforce the trend toward fewer and larger farms.

3. The trend toward dairy product changes, in terms of consumer demands for low-fat products, will continue. The possibilities of "tailoring" milk production for the low-fat market, manufacture/sale of reconstituted milk, and sterilizing milk to reduce transportation costs and eliminate refrigeration requirements will receive increased attention.

INTRODUCTION

Milk production, which was once almost universal on farms in the United States, has become a specialized form of commercial farming. As with beef, hog, and poultry production, dairy farming has undergone the "scientific industrialization of the food and fiber system" described by Shaffer (*5*).[1] The three major factors that have

[1] Italicized numbers in parentheses indicate references listed at the end of this chapter.

caused changes in the organization of and process of production in dairy (and other) farming are:

1. The transfer of many work elements from the farm to specialized nonfarm firms where the activity can be performed more efficiently. The transportation of milk by bulk tank trucks for complete processing is an example.
2. The substitution of mechanical power for labor on the farm. Examples include barn cleaners and silo unloaders.
3. The specialization of production knowlege and the substitution of such knowledge for other inputs. An example is the use of electronic data processing services dairy farmers use for accounting and record analyses.

These three elements become evident when associated causes of changes in dairy farming are examined, such as the differences in regions over the country, nonfarm opportunities, urbanization trends, and the regulations that affect dairy production and prices. This chapter examines the past and present structure of dairy farming in the United States, describes the changes that have occurred, and speculates on the future characteristics of dairying.

PAST AND PRESENT

The production, economic, and marketing characteristics of dairy farming in the United States remained relatively stable until the end of World War II. At that time, the rate of change in the factors characterizing dairying increased at an increasing rate. Examples of the speed with which a few of these changes took place are shown in figure 1. Dairying as a sideline activity has virtually disappeared, along with milk produced only for home use, the number of commercial dairy farms has decreased by a half, and there has been a comparable rapid decline in the percentage of farms with milk cows.

Production Characteristics

Producers, Cows, and Production

Dairy production in the United States has been characterized by a large number of farm units and a wide range in herd size. While there were an estimated 380,000 farms with milk cows in 1978, the number of commercial dairy farms with sales of $2,500 or more declined from 602,000 in 1950 to an estimated 205,000 farms in 1979. During the same period, average herd size on commercial farms more than doubled to an estimated 53 cows. Farms with milk cows and number of cows are shown in table 1.

The percentage distribution, by size of dairy herd and milk cows on farms, changed markedly during 1959-74 (figure 2). The number

Table 1—Farms with milk cows and number of cows, United States, 1959 and 1974

All farms	Farms				Milk cows			
	1959[1]		1974		1959[1]		1974	
	Number	Percent	Number	Percent	Number (1,000)	Percent	Number (1,000)	Percent
Milk cows per farm:								
Under 30	1,712,884	93.2	271,634	67.3	10,584	62.9	2,202	20.7
30 to 49	89,338	4.9	71,349	17.7	3,247	19.3	2,664	25.0
50 to 99	27,969	1.5	46,266	11.4	1,784	10.6	2,972	27.9
100 to 199	4,900	.3	10,836	2.7	1,208	7.2	1,369	12.8
200 and over	1,694	.1	3,669	.9			1,448	13.6
All farms	1,836,785	100.0	403,754	100.0	16,823	100.0	10,655	100.0

[1] Data are based on reports for only a sample of farms.

of farms with fewer than 30 cows declined by 26 percent. Those with more than 30 to 200 or more cows increased substantially. Percentage distribution of milk cows followed a comparable trend.

There were 121.9 billion pounds of milk produced in the United States in 1978. Over one-fourth of this supply was produced in the Lake States (Wisconsin and Minnesota). Milk production by regions and changes in regional production during 1965-78 are shown in table 2. Some milk production for the fluid market occurs in every region; in those regions where supplies exceed fluid requirements, milk is processed for manufactured dairy product markets. Shifts in regional milk production during 1959-78 can be attributed to: (1) population growth in specific regions (e.g., the Southwest), which has increased the demand for milk in higher valued fluid milk product uses and made increased milk production for fluid uses feasible; and (2) comparative advantages in the production of other agricultural commodities in regions where milk production has declined (e.g., the Corn Belt and Northern Plains). The comparisons

FIGURE 1
FARMS PRODUCING MILK, 1929-78

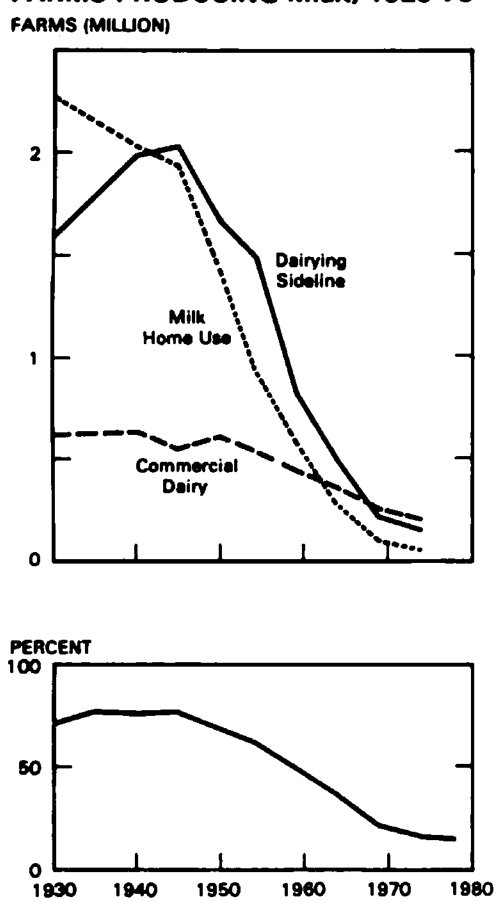


FIGURE 2
SIZE OF HERD, PERCENTAGE DISTRIBUTION OF FARMS AND MILK COWS, 1959 AND 1974

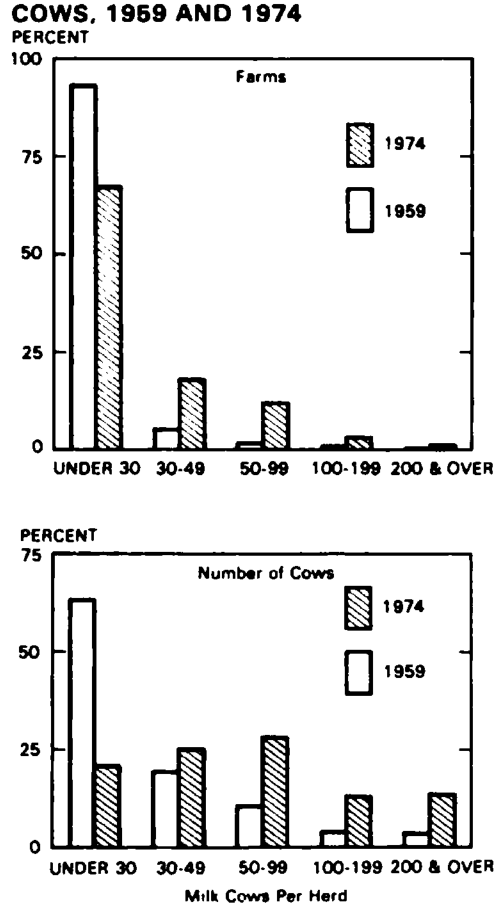


Table 2—Milk production and cash receipts from farm sales of milk, United States and regions, 1965 and 1978

Region	Milk production				Cash receipts from farm marketings of milk and cream			
	1965	1978	Pct. change from 1965,	1978 as pct. of U.S.	1965	1978	Pct. change from 1965	1978 as pct. of U.S.
	Billion pounds				*Million dollars*			
Northeast	25.7	25.0	−2.7	20.5	1,242.3	2,703.7	+118	21.3
Lake States	35.1	35.1	0	28.8	1,255.4	3,504.6	+179	27.6
Corn Belt	21.2	15.6	−26.4	12.8	826.1	1,598.4	+93	12.6
Northern Plains	6.6	5.2	−21.2	4.3	217.1	505.2	+133	4.0
Appalachian	8.6	8.3	−3.5	6.8	404.8	854.1	+111	6.7
Southeast	3.7	4.4	+18.9	3.6	228.9	528.8	+131	4.2
Delta States	2.9	2.6	−10.3	2.1	149.0	287.5	+93	2.2
Southern Plains	4.3	4.5	+4.6	3.7	212.7	516.2	+143	4.0
Mountain	4.6	5.4	+17.4	4.4	199.1	565.4	+184	4.4
Pacific	11.4	15.6	+36.8	12.8	545.9	1,632.7	+199	12.8
Alaska/Hawaii	.2	.2	0	.2	15.0	26.2	+75	.2
U.S. total	124.2	121.9	−1.9	100.0	5,296.4	12,722.4	+140	100.0

between the regional production and income shares also are shown in table 2. The distribution of dairy farm cash receipts is roughly comparable to the distribution of milk production.

The regional location of milk cows in 1974 is shown in figure 3. The percentage of regional shares of dairy product receipts as a total of U.S. receipts has remained stable in all regions since 1960, with two exceptions: the Northeast and Southwest, as shown below:

Percentage of regional shares of dairy product receipts

Region	1960	1977
	Percent	
Northeast	25	21
North Central	39	40
Southeast	14	13
Plains	9	9
Northwest	4	4
Southwest	9	13
Total	100	100

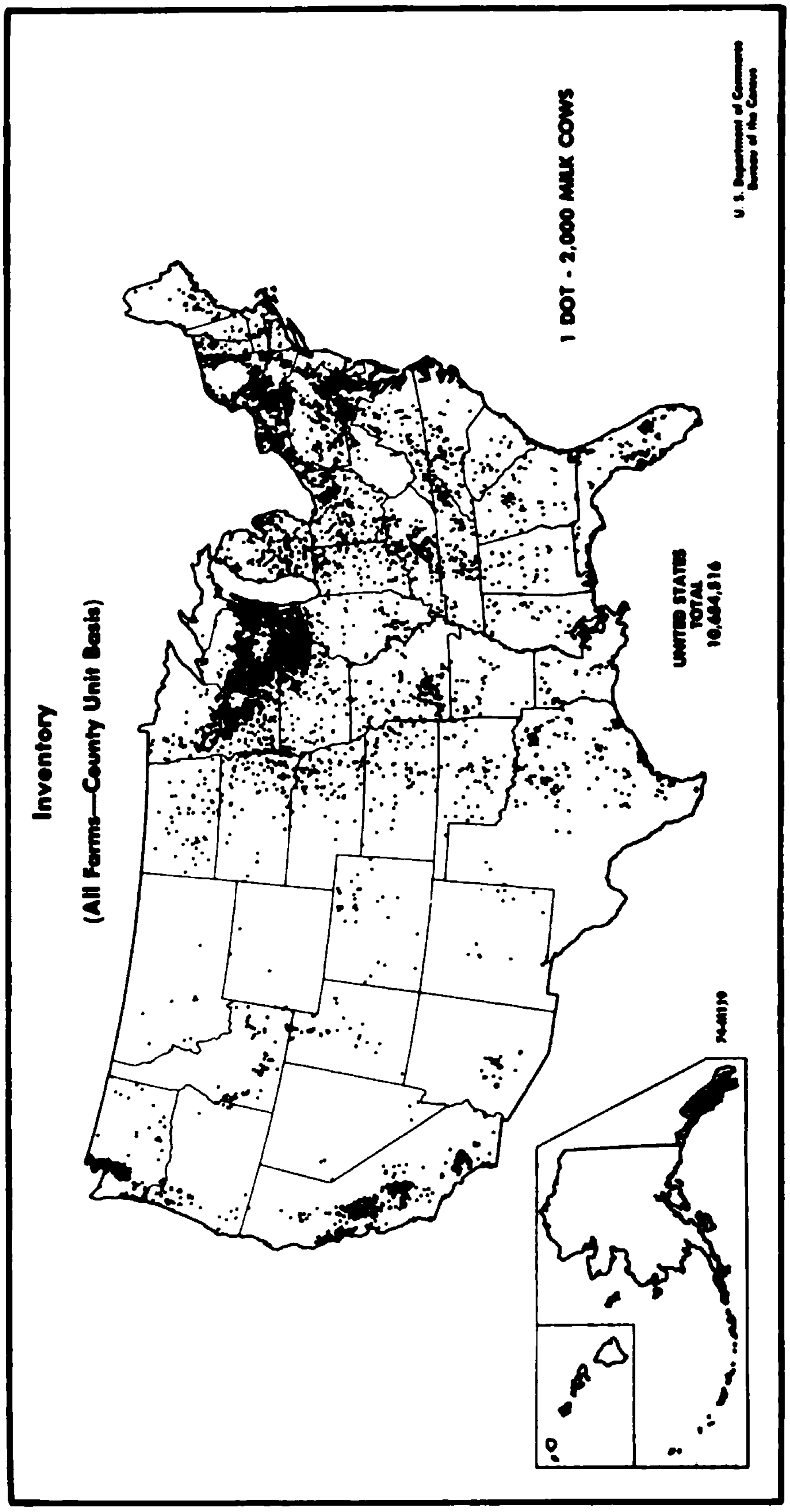
When the production of milk in the various regions since 1960 is examined on a subregional basis, several striking changes are apparent, as indicated in the following:

Regional milk production as percentage of national output

Region	1960	1974
	Percent	
Northeast	20.0	20.0
Lake States	27.0	28.1
Corn Belt	18.0	13.9
Appalachian	7.2	6.9
Delta States	2.5	2.3
Southeast	3.1	3.7
Plains	10.5	9.8
Northwest	3.8	4.2
Southwest	7.9	11.1
Total	100.0	100.0

While the Northeast maintained its share of national production, its share of receipts for dairy products declined by 4 percent. The

FIGURE 3
MILK COWS NUMBERS, 1974



Lake States experienced a slight increase in their share of total production; the share of Corn Belt production fell by over 4 percent. The most consistent increase in both receipts and production shares occurred in the Southwest, where the shares of national production increased by over 3 percent and that of receipts by 4 percent.

These shifts are attributable to the aforementioned population increases and changes in comparative advantage, such as relative costs of production and milk production per cow. Production costs per hundredweight of milk vary among regions, primarily reflecting differences in milk production per cow and feed costs. For example, most of the Southwest had the highest milk production per cow in 1977 and 1978 (and estimated for 1979). Conversely, this region had the lowest costs of production per hundredweight in 1977 and 1978 and the lowest projected for 1979.

Changes in the production (or physical) characteristics of dairy farming in the various regions (which become translated into economic characteristics) also have occurred because of the opportunity for, and realization of, expansion in the physical size of the milking operation. Land availability and climate also are factors that have fostered the establishment of large-scale drylot operations in California, Arizona, and Florida with herds of 2,000 and as many as 10,000 cows.

Farm Labor and Operator Characteristics

Total hours of farm work used for milk cows in the 10 U.S. farm production regions have declined steadily since 1960 (table 3). This trend is attributed to both fewer cow numbers and to technological innovations, such as milking parlors and dairy equipment. Automatic bulk milk tank cleaning, pipeline milkers, silo unloaders, and barn cleaners are a few examples of technologies that have been adopted rapidly by farm operators in the last 10 years.

While the declining number of total hours used for milk cows in each region is impressive (indicative of the adoption of new technology, fewer cows, and more production per cow), the rapid increases in indexes of farm production per hour for milk cows are startling (table 4). The dramatic difference between the Northeast and Pacific (i.e., primarily California/Southwest) regions illustrates the adoption of technology in the growing drylot dairy industry in the Southwest. From an index of productivity comparable to that in the Northeast in 1960, the Pacific region index rose to 164 points above the Northeast index in 1977 (and 175 points over the U.S. index). The adoption of technology and substitution of capital for labor in dairy farming in the Pacific/Southwest has been the underlying force in the emergence of this regional industry.

Table 3—Total hours of farm work used for milk cows, by farm production region, 1960-77

Year	Region									
	Northeast	Lake States	Corn Belt	Northern Plains	Appalachian	Southeast	Delta States	Southern Plains	Mountain	Pacific
	Million hours									
1960	280	370	327	127	203	85	92	92	65	104
1965	206	290	218	89	147	57	63	59	49	73
1970	132	185	130	56	102	43	44	41	37	48
1975	89	126	86	39	75	31	33	30	32	29
1977	74	106	75	35	70	27	31	26	29	21

Table 4—Labor: Indices of farm production per hour for milk cows, by farm production region and United States, 1960-77

Year	Region										U.S.
	Northeast	Lake States	Corn Belt	Northern Plains	Appalachian	Southeast	Delta States	Southern Plains	Mountain	Pacific	
1960	60	63	58	53	65	55	62	52	65	56	60
1965	87	87	87	81	88	82	86	82	88	84	87
1970	127	127	123	132	122	122	122	122	124	142	125
1975	187	185	166	172	161	179	152	165	158	260	178
1977	230	245	205	204	184	208	167	200	179	394	219

Although all regions experienced an increase in the indices shown in table 4, the 1977 Corn Belt index is less than the indices for the Lake States, Northeast, and United States as a whole. As noted earlier, the share of national production in the Corn Belt decreased by 7 percent during 1950-74. Associated with the decline in relative importance of dairying in the Corn Belt has been an increase in productivity significantly less than in the Lake States, Northeast, and Pacific regions.

The stable and specialized nature of dairy farm labor is illustrated by data in the 1974 Census of Agriculture. It shows that only 19 percent of U.S. dairy farmers reported some days of off-farm work. The dairy operation was their primary concern; only 7 percent of them worked 200 or more days off the farm, and 93 percent of all operators listed farming as their principal occupation.

The average age of dairy farmers in 1974 was 49 years, slightly younger than other farm operators. The age distribution was as follows:

Age of dairy farmers in 1974

	Percent
Under 25 years	2.1
25-34 years	11.7
35-44 years	20.7
45-54 years	29.8
55-64 years	25.6
65 years and over	10.0

Types and Mix of Dairy Enterprises

The conventional/typical dairy farm is one which is proprietor-operated and has acreage sufficient to raise most of the feed supply and dairy herd replacements. Almost 100 percent of the farms have bulk milk storage tanks. About two-thirds have pipeline milkers, and more than half have barn cleaners and silo unloaders. Half of the farms own four or more tractors. Herd housing styles and, therefore, investment varies with region and particularly climate. A dairy farm in Oklahoma typically has a milking parlor with no formal barn. A farm in New York might have an insulated barn to house the herd during the severe winter months.

In certain areas of the United States, particularly in Florida and California, the size of farm is quite large, and the feed supply is not necessarily produced on the farm. Job functions are specialized; for example, milkers are separated from crop and general labor.

As reported in the 1974 Census of Agriculture, the average U.S. dairy farm receives 80 percent of its cash receipts from the sale of dairy products and 10 percent from the joint products of cull cows and calves. Other livestock products are fairly insignificant, accounting for 2.3 percent of the cash receipts. Crops sold provide 7.7 percent of the cash receipts, with grain and forage sales accounting for most of this (6.2 percent). While there are some regional differences in the proportion of income of dairy farmers from milk sales—for example, 88 percent in New York and 78 percent in Wisconsin in 1978—the general conclusion is that dairying is specialized.

Farm-related and off-farm income provides additional income for farm families. It amounts to about 5 percent of the total income received by dairy farmers. Over half of the off-farm income is in the form of wages and salaries. Table 5 shows cash receipts from farm marketings—their percentage distribution as well as farm-related and off-farm income components.

Economic Characteristics of Dairy Farming

Legal and Economic Organization

The 1974 Census of Agriculture reported that 88 percent of the dairy farms were operated by individuals or families; 11 percent were operated as partnerships; and the remaining 1 percent were incorporated farms, including family-owned corporations. While these data are indicative of dairy farm organization in the United States as a whole, they tend to mask some rather interesting regional differences and changes in preferred forms of dairy farm organization that occurred during 1969-74.

The sole proprietorship is the dominant form of dairy farm organization (table 6). However, in the Corn Belt, Southwest, and Southeast, partnership arrangements have been relatively more important than in other regions, and remained so through 1974. Corporate dairy farms have gained in importance, particularly in the Northeast, Lake States, Southwest, and North Central regions. Tax advantages and ownership transfers associated with corporate farming have provided the incentives for many family dairy farms to adopt this form of organization. In the Southwest, the large-scale dairy operations found the corporate form of organization particularly suited to their capital-intensive, high technology, high investment requirements.

As previously noted, the number of dairy farms in the United

Table 5—Cash receipts from dairy farm marketings, farm-related and off-farm income, United States, 1974[1]

Item	Million dollars	Percent	Item	Million dollars	Percent
Livestock			**Farm-related income**		
Dairy	7,677	80.0	Custom work	34	6.6
Cattle & calves	965	10.0	Recreation	1	.2
Hogs & pigs	181	1.9	Govt. farm programs	24	4.6
Sheep & lambs	5	[2]	Rent	10	1.9
Other livestock	3	.2	Other	11	2.1
Poultry	23	.2	Total farm-related income	80	15.4
Total livestock	8,854	92.3			
Crops			**Off-farm income**		
Grain	474	4.9	Nonfarm-related business	79	15.2
Tobacco	55	.6	Wages, salaries	283	54.6
Cottonseed	15	.2	Interest, dividends	65	12.5
Hay, forage, silage	129	1.3	Rent	12	2.3
Other field crops	14	.1	Total off-farm income	439	84.6
Vegetables	24	.3			
Fruit & nuts	9	.1	Total farm-related and off-farm income	519	100.0
Nursery & greenhouse	1	[2]			
Forest products	16	.2	Total dairy farm & nonfarm		
Total crops	737	7.7	income	10,110	100.0
			Farm marketings	9,591	94.9
Total	9,591	100.0	Off-farm & farm-related	519	5.1

[1] Derived from Census of Agriculture, 1974.
[2] Less than 0.1 percent.

Table 6—Dairy farm organization, percentage by selected regions, 1969 and 1974

Organization	Region and year											
	Northeast		Corn Belt		Lake States		Southwest		North Central		Southeast	
	1969	1974	1969	1974	1969	1974	1969	1974	1969	1974	1969	1974
	Percent											
Sole proprietorship	87.4	88.8	82.6	86.3	87.0	90.1	80.2	79.1	85.7	89.1	80.9	83.5
Partnership	11.7	9.9	16.6	12.8	12.4	6.3	17.4	16.8	13.6	8.1	17.7	14.5
Corporation	0.6	1.2	0.3	0.7	0.2	2.8	1.9	3.9	0.3	2.2	1.0	1.9
Other	0.3	0.1	0.4	0.1	0.3	0.7	0.5	0.2	0.4	0.6	0.4	0.2
Total[1]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] May not add to 100 percent due to rounding.

States declined during 1969-74. The different rates of decline in all types of dairy farms, by region, are shown in the following tabulation:

Percentage decrease in number of dairy farms, selected regions, 1969-74

Region	Percent
Northeast	−20.1
Corn Belt	−31.6
Lake States	−20.6
Southwest	−19.5
North Central	−24.0
Southeast	−39.6

Of the six regions, the number of farms in the Southeast and Corn Belt declined most significantly. As noted previously, relative factor prices and alternative opportunities appear to be major elements in the varying rates of exodus from dairy farming in the different regions.

Table 7 depicts shifts that occurred in different dairy farm income classes during 1969-74 in six selected regions. During the 5 years, the number of all farms in the < $20,000 income class decreased drastically, and the number of farms remaining in every income class—including "newcomers" to the $100,000 or more category—shifted to the high side of the income curve.

Although these data do not reflect the effects of inflation, they reinforce projections of the future structure and income distribution in dairy farming: fewer and larger operators with higher incomes in the years to come.

Type of U.S. dairy farm organization is related to size. For example, distribution of over 500 New York dairy farms by form of business organization in 1978 was as follows: 81 percent were individually owned and averaged 65 cows; 17 percent were partnership arrangements and averaged 92 cows; and 2 percent were incorporated farms averaging 147 cows. Investment per cow averaged $4,500 for the individual and partnership farms and about $5,000 per cow for the incorporated farms. These distributions are similar to others in the United States. Business factor measures such as milk sold per cow, forage yields per acre, and cows per person also were comparable. The major advantages of shifting from a single proprietorship to a partnership or corporation appears to be to facilitate ownership transfer and continuity and for tax considerations.

Table 7—Number of dairy farms by type, income class, and organization, selected regions, 1969 and 1974

Region and income class	Sole proprietorship		Partnership		Corporation		Other		Totals	
	1969	1974	1969	1974	1969	1974	1969	1974	1969	1974
					Number					
Northeast:										
< $20,000	20,845	7,696	1,859	372	18	25	84	16	22,806	8,109
$20-39,999	18,936	13,193	2,490	906	64	50	64	18	21,554	14,167
$40-99,999[1]	7,180	14,837	1,947	2,078	242	155	27	13	9,396	17,083
$100,000 or more		2,382		878		302		11		3,573
Corn Belt:										
< $20,000	20,456	7,699	3,064	611	34	25	90	5	23,644	8,340
$20-39,999	11,661	8,189	2,655	977	41	13	68	13	14,425	9,192
$40-99,999[1]	3,190	8,371	1,392	1,681	77	76	19	12	4,678	10,140
$100,000 or more		974		471		103		2		1,550
Lake States:										
< $20,000	58,367	25,889	6,624	1,643	83	2,044	207	129	65,281	27,605
$20-39,999	23,694	26,368	4,053	2,132	56	63	95	38	27,898	28,601
$40-99,999[1]	3,963	17,142	1,575	2,836	82	155	30	23	5,650	20,156
$100,000 or more		1,302		649		125		9		2,085
Southwest:										
< $20,000	1,483	505	116	26	3		6		1,608	531
$20-39,999	918	603	150	47	4	5	7		1,079	655
$40-999,999[1]	2,000	833	687	122	98	24	13	5	2,798	984
$100,000 or more		1,551		548		141		3		2,243
North Central:										
< $20,000	78,823	33,588	9,688	2,254	117	2,069	297	134	88,925	35,945
$20-39,999	35,355	34,557	6,708	3,109	97	76	163	151	42,323	37,793
$40-99,999[1]	7,153	25,513	2,967	4,517	159	231	49	35	10,328	30,298
$100,000 or more		2,276		1,120		228		211		3,635
Southeast:										
< $20,000	1,129	330	125	16	4		17	1	1,275	347
$20-39,999	762	253	167	18	2		4		935	271
$40-99,999[1]	1,327	584	429	100	161	12	8	3	1,925	699
$100,000 or more		746		254		175		4		1,179

[1] Farms with sales of $40,000 or more in 1969. There was no $100,000 category that year.
Source: Census of Agriculture, 1974.

Most dairy farmers had some ownership in their farms. Only 8 percent were classified as tenants in the 1974 census. For all types of farms, 13 percent were classified as tenants.

Costs of Production and Price

Since 1974, the U.S. Department of Agriculture has been conducting cost-of-production studies of various agricultural commodities, including milk. The dairy studies have been done on a regional basis; costs of production and milk prices during 1974-79 are shown in table 8. During 1974-76, costs per hundredweight generally exceeded the milk price per hundredweight. During 1977-79, costs generally were lower than the milk price.

The cost of production is closely related to the price in each region. The differences between these two measures are very consistent by region within a given year. For example, in 1974, the milk price of \$8.68 in the Northeast exceeded the North Central price of \$7.93 by \$.75. The Northeast cost of production of \$9.39 exceeded the North Central cost of production of \$8.59 by \$.80. The net difference between the two regions was only 5 cents.

These relationships between cost of production and milk price are further amplified by the regional summarizations of costs and prices shown in table 9. The regional and U.S. averages for 1974-79 illustrate the economic axiom that in the long run the price of the commodity is equal to the cost of production. Indexing regional prices and costs (where the average U.S. prices and costs = 100) facilities comparisons. There are 24 production regions in the cost-of-production analysis: 5 in the Northeast, 9 in the North Central, 6 in the South, 2 in the Plains, and only 1 in each of the 2 western regions. As a result, data on the western regions should be interpreted with some care. Of the more adequately represented regions, the Northeast has both average costs and prices for 1974-79 three to four points higher than the U.S. average. The North Central region, which has roughly 44 percent of all U.S. cows, has below-average costs and prices. The South has higher than average costs and prices, and the Plains have lower than average. The Southwest, which is represented only by California, is atypical, since the costs and prices do not move together.

The important conclusion is that regional differences in prices received for milk become reflected in the production structure, hence into the cost of production and eventually back into the prices of milk.

Economies of Size

Classical economic theory depicts a declining longrun average cost curve for most industries. Supposedly, dairying is no exception;

Table 8—Cost of production and milk price, United States and regions, 1974-79[1]

Region	Year					
	1974	1975	1976	1977	1978	1979
			Dollars			
Northeast						
Milk price	8.68	8.97	10.17	10.13	10.93	12.53
Cost of production	9.39	9.42	9.74	10.34	10.23	10.96
Difference	−.71	−.45	+.43	−.21	+.70	+1.57
North Central						
Milk price	7.93	8.20	9.21	9.40	10.22	11.71
Cost of production	8.59	9.55	10.25	9.48	9.07	10.05
Difference	−.66	−1.35	−1.04	−.08	+1.15	+1.66
South						
Milk price	9.04	9.18	10.23	10.47	10.98	12.67
Cost of production	9.41	9.92	10.64	10.76	10.80	12.38
Difference	−.37	−.74	−.41	−.29	+.18	+.29
Plains						
Milk price	7.65	8.18	9.16	9.64	10.24	11.76
Cost of production	8.29	9.31	9.98	9.06	9.12	10.34
Difference	−.64	−1.13	−.82	+.58	+1.12	+1.42
Southwest						
Milk price	8.37	9.03	9.27	9.80	10.25	11.76
Cost of production	9.14	8.63	9.36	8.47	8.76	9.91
Difference	−.77	+.40	−.09	+1.33	+1.49	+1.85
Northwest						
Milk price	8.20	8.70	9.71	9.80	10.56	12.12
Cost of production	8.55	10.14	10.62	9.94	9.63	10.84
Difference	−.35	−1.44	−.91	−.14	+.93	+1.28
United States						
Milk price	8.39	8.59	9.60	9.77	10.49	12.10
Cost of production	8.93	9.48	10.03	9.70	9.53	10.53
Difference	−.54	−.89	−.43	+.07	+.96	+1.57

[1] *Cost of Producing Milk in the United States—Final 1977, Preliminary 1978 and Projection for 1979*, Committee Print 48-946, Senate Committee on Agriculture, Nutrition, and Forestry, August 1979.

numerous studies have demonstrated a declining average cost curve movement from one- to two- to three-worker farms. However, empirical data from farm record systems do not support the classical decreasing unit cost with increasing size construct. Instead, farm accounting data show that cash operating expenses per hundredweight increase with an increase in size of dairy operations. New York and Wisconsin farm record programs provide some data; summaries of these by size of farm during 1973-77 and 1973-78, respectively, are shown in tables 10 and 11. The larger herds have higher costs per hundredweight of milk produced than do the smaller herds.

This apparent conflict between classical theory and empirical data is explainable through an examination of net operating incomes (also included in tables 10 and 11). The smaller farms have lower gross and net operating incomes; income is so low that there is very little discretionary income available for above-subsistence technology in the farm operation. The farmers with smaller herds have similar living expenses and demands for family sustenance as do the larger farmers. The larger farmers with net operating incomes of $30,000 to $60,000 can entertain and implement decisions associated with a higher consumption level in the farm business. For example, they can purchase tractors with cabs and climate controls instead of tractors with roll bars; self-propelled windrowers instead of sickle mowers; and a gutter cleaner as a substitute for a wheelbarrow. In essence, the consumption standard of farming increases, substituting capital or amenities for physical labor or discomfort. Not all changes in technology are cost-increasing, but many of the refinements are, as reflected in the costs of the recordkeeping farms.

The per unit cost increases in operating expenses per hundredweight (see table 11, for example) are attributable to the cost of hired labor. On farms with fewer than 40 cows, the annual hired wage rate in 1978 was $2,400; on farms with 150 or more cows, the comparable wage rate was $10,400. The annual wage paid hired labor increased consistently with increases in herd size, reflecting the greater demand for managerial ability, experience, and full-time help on the larger farms.

Table 9—Average costs of production and milk prices, with indices relative to U.S. average, by region, 1974-79[1]

Region	Average 1974-79		Index, U.S.	
	Cost of production	Milk prices	Cost of production	Milk prices
	Dollars		*1974-79 = 100*	
Northeast	10.01	10.23	103.2	104.2
North Central	9.50	9.44	97.9	96.1
South	10.65	10.43	109.8	106.2
Plains	9.35	9.44	96.4	96.1
Southwest	9.04	9.75	93.2	99.3
Northwest	9.95	9.86	102.6	100.4
United States	9.70	9.82	100.0	100.0

[1] *Costs of Producing Milk in the United States—Final 1977, Preliminary 1978 and Projection for 1979,* Committee Print 48-946, Senate Committee on Agriculture, Nutrition, and Forestry, August 1979.

Table 10—Operating expense per hundredweight and net operating income, by size of herd, dairy farms in Wisconsin Records Program, 1973-77[1]

Herd size and item	Year				
	1973	1974	1975	1976	1977
Less than 30 cows					
Average number of cows	26	26	24	24	–
Operating expense per cwt. (dol.)[2]	5.51	6.99	7.26	7.08	–
Net operating income (dol.)[3]	10,260	13,596	7,660	11,308	–
30 to 49 cows					
Average number of cows	40	41	41	41	41
Operating expense per cwt. (dol.)	5.38	6.03	6.45	7.21	7.43
Net operating income (dol.)	17,250	18,654	17,208	22,897	20,673
50 to 74 cows					
Average number of cows	60	59	61	61	62
Operating expense per cwt. (dol.)	5.52	6.41	6.53	7.22	7.49
Net operating income (dol.)	24,820	24,946	26,789	32,308	32,489
75 to 99 cows					
Average number of cows	86	86	84	86	86
Operating expense per cwt. (dol.)	5.48	6.96	7.37	7.80	7.86
Net operating income (dol.)	33,490	35,516	30,677	40,391	44,530
99 and over cows					
Average number of cows	134	137	134	142	142
Operating expense per cwt. (dol.)	5.95	7.26	7.74	7.97	8.04
Net operating income (dol.)	46,410	44,776	38,457	59,927	59,261

[1] *Wisconsin Farm Business Summary, 1974-1978,* Cooperative Extension Service, University of Wisconsin, Madison.
[2] Operating expense per hundredweight is total cash expense divided by hundredweight of milk produced per year.
[3] Operating income is difference between total cash receipts and total cash expenses.

Table 11—Operating expense per hundredweight and net operating income, by size of herd, dairy farms in New York Records Program, 1973-78[1]

Herd size and item	Year					
	1973	1974	1975	1976	1977	1978
Less than 40 cows						
Average number of cows	32	32	31	31	32	33
Operating expense per cwt. (dol.)[2]	6.30	6.85	7.06	7.98	8.21	8.87
Net operating income (dol.)[3]	9,580	10,020	9,370	10,840	10,380	13,370
40 to 54 cows						
Average number of cows	46	46	46	46	46	46
Operating expense per cwt. (dol.)	6.31	6.89	7.09	7.74	8.11	8.94
Net operating income (dol.)	13,450	14,490	13,660	18,230	15,060	17,700
55 to 69 cows						
Average number of cows	60	61	61	61	61	61
Operating expense per cwt. (dol.)	6.14	7.08	7.19	8.18	8.13	8.51
Net operating income (dol.)	17,630	17,970	17,350	21,400	21,460	26,080
70 to 84 cows						
Average number of cows	75	75	75	75	75	75
Operating expense per cwt. (dol.)	6.52	7.20	7.65	8.04	8.18	9.00
Net operating income (dol.)	18,870	20,690	17,730	28,480	28,320	30,730
85 to 99 cows						
Average number of cows	91	91	91	91	91	91
Operating expense per cwt. (dol.)	6.39	6.77	7.34	8.22	8.45	9.48
Net operating income (dol.)	21,800	30,990	24,850	31,140	28,000	34,260
100 to 149 cows						
Average number of cows	118	118	118	121	118	119
Operating expense per cwt. (dol.)	6.79	7.63	7.51	8.29	8.61	9.22
Net operating income (dol.)	29,480	31,240	34,690	44,520	37,240	43,860
150 and over						
Average number of cows	199	197	191	200	193	196
Operating expense per cwt. (dol.)	7.26	7.63	7.32	8.56	8.76	10.04
Net operating income (dol.)	39,360	55,470	46,840	66,360	60,830	64,580

[1] *Dairy Farm Management Business Summary, New York, 1978,* A.E. Res. 79-6, C.A. Bratton, Department of Agricultural Economics, Cornell University Agricultural Experiment Station, Ithaca, N.Y., 1979.
[2] Operating expense per hundredweight is total cash expense divided by hundredweight of milk produced per year.
[3] Operating income is difference between total cash receipts and total cash expenses.

Figures 4-7 show the relationship of size to operating expenses per hundredweight of milk and net operating income during 1973-78. On these farms, costs reflect income levels rather than factor input prices exclusively, in the desire of farmers to make farming as attractive and convenient as possible. The implications are for a further decline in smaller dairy farms.

One other aspect of size merits attention. While the gross income

FIGURE 4
OPERATING EXPENSES PER HUNDREDWEIGHT, WISCONSIN RECORDS PROGRAM

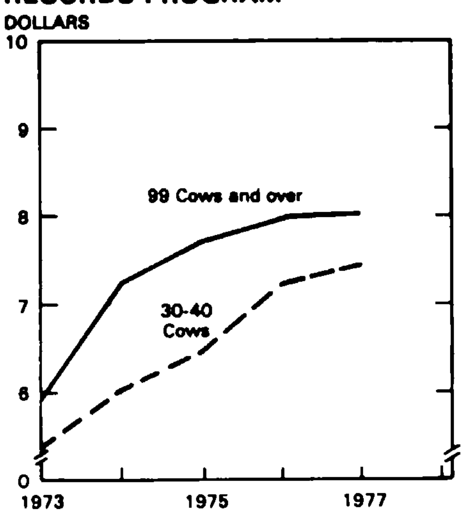


FIGURE 5
NET OPERATING INCOME, WISCONSIN DAIRY FARMS

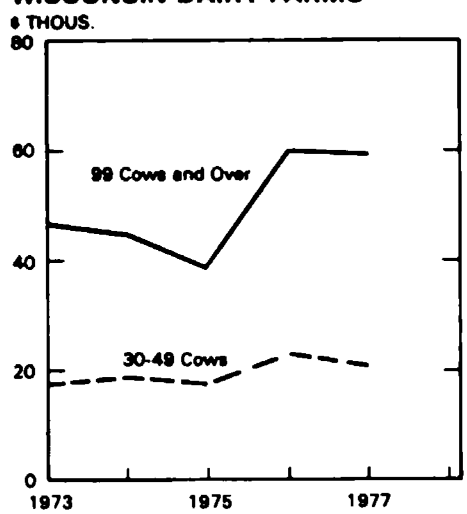


FIGURE 6
OPERATING EXPENSES PER HUNDREDWEIGHT, NEW YORK RECORDS PROGRAM

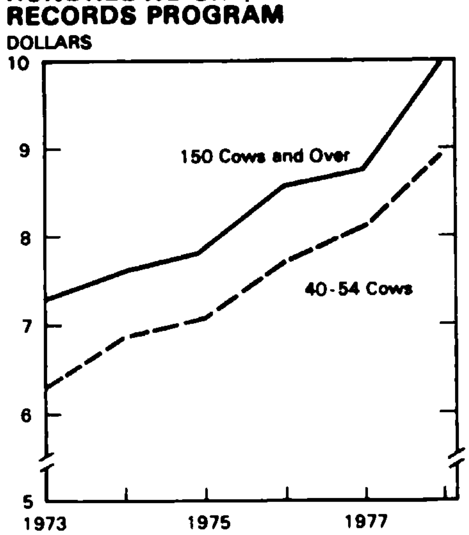
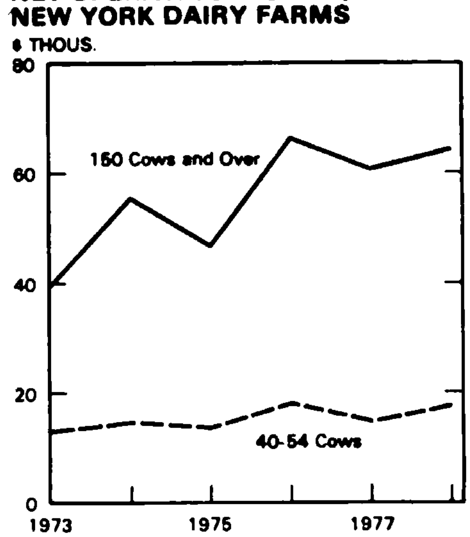


FIGURE 7
NET OPERATING INCOME, NEW YORK DAIRY FARMS



of dairy farmers is derived from several sources (table 12), one additional source of wealth or unrealized income is the capital appreciation that has occurred on dairy farms (particularly large dairy farms). Table 12 shows the growth that occurred in both total capital investment and net operating income on New York dairy farms during 1970-78. The average growth of $27,500 in capital investment compares with the average net operating income of $28,800 over the 9-year period. The data are limited in that they do not enable a determination of what portion of the increase in capital investment per year is attributable to real growth in physical capital and how much is pure capital appreciation. Additionally, these data have not been adjusted for inflation. However, the herd size (91 cows) on these farms remained constant during the 9 years, and the conclusion is that these established dairy farmers are receiving relatively high rates of return on funds that were invested in prior years. Moreover, the larger the farm, the greater the return.

Marketing Characteristics of the Dairy Industry

Except for forward integration into dairy marketing cooperatives, dairy farmers do not exert extensive control over the marketing and consumption of dairy products. Consumption trends and market preferences for these products, as well as governmental marketing orders and price supports, ultimately affect the structure of dairy farming.

Table 12—Total capital investment, annual capital change, and net operating income, 91-cow New York dairy farm, 1970-78[1]

Year	Total capital investment	Change in capital investment	Investment per cow	Equity	Net operating income[2]
	Dollars	*Dollars*	*Dollars*	*Percent*	*Dollars*
1970	190,360	–	2,092	NA[3]	33,530
1971	210,890	+20,530	2,317	NA	27,060
1972	243,780	+32,890	2,679	NA	27,740
1973	263,100	+19,320	2,891	NA	21,800
1974	283,560	+20,460	3,116	NA	30,990
1975	291,760	+8,200	3,206	69	24,850
1976	317,170	+25,410	3,485	63	31,140
1977	345,440	+28,270	3,796	65	28,000
1978	410,100	+64,660	4,506	67	34,250

[1] *Dairy Farm Management Business Summary, New York, 1978,* A.E. Res. 79-6, C.A. Bratton, Agricultural Economics, Cornell University Agricultural Experiment Station, Ithaca, N.Y., 1979.

[2] Net operating income is difference between total cash receipts and total cash expenses.

[3] NA = not available.

Milk and Dairy Product Consumption

Fluid products have accounted for 40 to 45 percent of the utilization of U.S. milk production since 1960. However, the components of fluid milk consumed per capita have changed since 1955 (table 13). Per capita consumption of fresh whole milk declined by 40 percent during 1955-78, while per capita consumption of skim and/or low-fat milk rose by about 390 percent. Per capita consumption of cream and butter fell by 35 percent and 45 percent, respectively, in the same period.

These data indicate the substantial shift that has occurred in the tastes and preferences of American consumers. The emphasis placed on low cholesterol intake by the medical profession several years ago and the dietary desires of consumers have augmented the increase in milk used for low-fat products and the decrease in the proportion used for whole fresh milk and cream production.

While the declining per capita consumption of milk and dairy products depicted in table 13 has occurred, aggregate demand for milk and dairy products has been relatively stable because of population growth during 1955-78. The demand for dairy products with low-fat levels has become a factor of increasing concern in the dairy industry.

Hammond, Buxton, and Thraen (*2*) analyzed the potential impacts of reconstituted milk on regional prices, utilization, and production, should current regulations that restrict/prevent the production and sale of reconstituted milk be eliminated. While relaxing all restrictions on the use of reconstituted milk would not result in its becoming a significant part of total fluid milk supply in any region of the United States, economic adjustments would occur in regions because reconstituted milk would alter the fluid-manufacturing price

Table 13—Per capita consumption of dairy products, selected years, 1955-78

Year	Fluid products				Butter	Cheese	Manufactured products [1]	Frozen products [2]
	Fresh whole milk	Skim/low-fat milk	Cream	Totals				
	Quarts				*Pounds*			
1955	125.2	8.7	4.0	137.9	7.5	7.3	30.2	49.7
1960	119.2	10.0	3.8	133.0	6.8	8.2	29.0	52.5
1965	113.2	14.8	3.2	131.2	5.8	9.1	25.6	54.6
1970	99.7	23.9	2.5	126.1	4.4	11.2	21.7	54.4
1975	84.4	36.4	2.6	123.4	4.4	14.2	16.6	55.6
1978	75.1	42.5	2.6	120.2	4.1	16.9	16.2	55.0

[1] Includes cottage cheese, dry whole milk, nonfat dry milk, evaporated and condensed whole milk, and skim milk.

[2] Net milk used for ice cream and ice milk products.

differentials that are based, in part, on the transport cost for fluid milk. This technology could enable some consumers to obtain milk at lower costs. Roberts (*4*) estimated that cost reductions of 5 to 33 cents per gallon for reconstituted milk over fresh milk would be the benefit to consumers, primarily due to transportation differentials that are reflected in variations of the fresh fluid milk price among regions. As indicated (*2*), there would be less milk produced in high-cost areas (e.g., the Southeast and Northeast) and more milk produced in lower cost areas (e.g., the upper Midwest).

Research at the University of Maryland on milk sterilization (as a substitute for pasteurization) indicates a potential saving of an estimated 12 million barrels of petroleum per year, if sterilized milk is acceptable to consumers (*6*). The need for refrigeration is eliminated, transportation costs are reduced, and shelf life of the milk is extended. Thus, milk sterilization could lead to expanded markets for some regions of the country, with associated structural changes.

Marketing Institutions

Market orders, cooperatives, pooling procedures, and price supports have been important features of milk marketing for many years (*3*). In combination they lead to:

- Development of cooperative activities among producers, in that members of cooperatives must approve proposed Federal milk orders before they can be implemented.
- Handlers of fluid milk paying higher prices for milk supplies than manufacturers of products such as butter and cheese.
- Producers receiving a "pool" price, which reflects the combination of prices paid for fluid milk and manufactured milk.
- Producers receiving the same "pool" price, regardless of size of milk sales.
- Government purchases of dairy products such as cheese and butter, when necessary to maintain the announced support price for manufactured milk.

There is some question as to whether these institutions have slowed the exodus from dairy production in the Northeast, vis-á-vis other regions such as the Lake States, because of maintaining prices higher in some regions of the country than would be expected in the absence of regulation. Should these institutions be radically changed, the location and structure of the dairy industry would be affected. Fallert and Buxton (*1*) have estimated that significant regional shifts in milk production would occur if price differentials between fluid and nonfluid milk were eliminated. The Corn Belt, Lake States, and Plains would increase production, while the Northeast, South, Mountain States, and West would decrease production. The trend toward fewer and larger producers would be accelerated in the Northeast and South and slowed in the Lake States.

Similarly, radical changes in the dairy price support program might give larger producers an advantage. At present, the support level is 75 to 90 percent of parity for manufacturing-grade milk to ensure an adequate supply. In periods of excess milk production, the price support program prevents precipitous declines in market prices. In the absence of price supports, large producers might be better able to withstand lower prices in the short run than would small dairy operators, due to higher total revenues received.

FACTORS CAUSING CHANGE AND THE FUTURE

Throughout the preceding discussion of the past and present characteristics of dairy farming, four factors emerged as the causal elements of change:

- Technology and mechanization.
- Alternative employment and nonfarm opportunities.
- Urbanization, population growth, and environmental quality.
- Dairy production and market preferences.

Technology and Mechanization

The impact of technological advances and mechanization has been paramount in the changes that dairy farming has undergone in the last 20 years. The substitution of capital for labor on dairy farms proceeded rapidly, and has increased the size of dairy farms because of both the high investments required (necessitating larger units to spread fixed production costs for capital equipment) and the economies of scale inherent in the adoption of technology. The number, size, and degree of specialization of dairy farms all have been affected by the advances in technology. Bulk handling of milk, barn cleaners, silo unloaders, and other innovations promoted the reduction in farm numbers, increases in farm size, and greater specialization.

The trend toward fewer but larger dairy farms and advanced technology that has been described will continue at varying rates in the regions of the United States. In the Northeast, for example, small farms with fewer than 30 cows will become a rarity during the next 20 years. The diseconomies of small size and pressures of urbanization will be primary factors causing this change. Small farms cannot take advantage of sophisticated accounting and management systems, nor can their operators afford to invest the capital required for new technology and mechanization.

Investments per farm and per cow can be expected to increase because of appreciation in land values and improvements in mechanization and housing (e.g., milking and manure-handling systems and greater storage capacity for silage).

The size question is closely related to technology and mechanization. But it also undoubtedly involves attitudes of operators and availability of credit. For example, an obvious question is: Why have producers in California, Arizona, and Florida found it profitable to organize dairying into drylot enterprises involving as many as 10,000 cows, while producers in the Northeast or Lake States have not developed enterprises of comparable size? For a long time, many people suggested that the very large dairy farms were phenomena peculiar to California, Arizona, Florida, and Hawaii and that they would not develop in other areas of the country. But informal reports indicate that they are being developed in Oregon and Washington. Thus, a crucial question is: Will entrepreneurs develop large size—5,000- to 10,000-cow—dairies in the Northeast and Lake States?

Alternative Employment and Nonfarm Opportunities

It was noted that the number of dairy farms in the Corn Belt had decreased by almost 40 percent during 1969-74, compared with a 20-percent decrease in other regions such as the Northeast. Part of these differentials in the rate of exit from dairy farming is attributable to nonfarm employment opportunities, as well as grain prices relative to the price of milk and the alternative uses to which land in dairy production can be shifted. There has been considerable land consolidation in areas of the Corn Belt, and a shift to crop production—such as corn and soybeans. If a farmer can earn $50,000 or $60,000 per year by producing crops, the alternative of having to tend cows or hogs year-round, for a comparable or perhaps a higher income, becomes less attractive. In more urbanized regions, such as the Northeast, opportunities for nonfarm employment have fostered the exit from dairying. Dairying is not as well suited to part-time farming as are other livestock and crop enterprises.

Urbanization, Population Growth, and Environmental Quality

The loss of productive dairy farms to urbanization and population growth has been especially notable in the Northeast. The high cost of land has prompted many farmers to rent portions of the land necessary for forage production, which has affected tenure in many regions. High land costs—along with high capital requirements for buildings, equipment, and machinery—have spurred the exodus from dairy farming and raised barriers to entry for all but large (farmer and nonfarmer) investors.

Population growth and urbanization will require land for housing that is presently used for small dairy farms, and will engender environmental pressures that will make the operation of such farms even more costly. Farmers adjacent to nonfarm neighbors will experience requirements and costs for drainage control from barnyards, nonpoint runoff from fields that are fertilized with chemicals and manure, odor control, and various other environmental problems. In other regions, such as the South and West, the cost of control measures for environmental quality will inhibit open-lot housing facilities for cows and favor covered housing—particularly near population centers. Finally, property taxes and real estate values under continued urbanization will place additional pressures on small dairy farms near urbanized areas.

Dairy Production and Market Preferences

The consumer trend to low-fat milk products and the potential effect on dairy farming that technological and production practices (e.g., breeding and feeding programs) may have were noted earlier.

In a similar way, product substitution by both "filled" dairy substitutes (fat substitution) and imitation/synthetic products may affect dairy farming. For example, per capita consumption of margarine presently is about 12 pounds versus about 4 pounds per year of butter. The possibility of producing synthetic cheese could dampen the increase that has occurred in consumption of natural cheese.

At the present time, government regulations prohibit the sale of reconstituted milk at prices lower than for fresh fluid milk. Were this restriction eliminated, regions such as the Lake States that produce milk in excess of their regional requirements could process milk into powder and ship it to areas of high consumption at a lower cost than for transporting fluid milk. This would effectively widen their market and impinge on sales of fresh fluid milk in the receiving areas, given comparable taste and quality of milk.

The supply of milk in the year 2000 will be influenced by cost-price relationships in production and by consumer demands and tastes with respect to milk quality and characteristics. An increase in input costs could adversely affect production in any given region. For example, difficulties experienced by Maryland farmers due to the discontinuation of rail service on the Eastern Shore and the projected loss of rail service in several Western States could lead to comparative disadvantages in factor supplies and prices in these areas.

The declining per capita consumption of milk that the industry has experienced could be reinforced due to shifting consumer tastes. For example, the influence of dietary standards for milk with low butterfat content may cause a problem in the utilization of milk fat. The potential for producing milk and dairy products with acceptable fat content via feeding and breeding programs will receive increasing attention.

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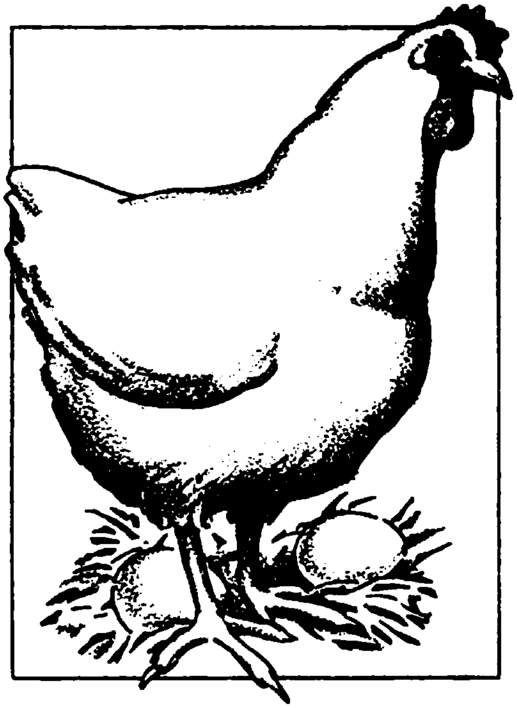

Poultry and Eggs

George B. Rogers

SUMMARY

Major changes have occurred in the U.S. poultry and egg industries. Their main characteristics are:

- *Production on fewer and larger farms.*
- *Expanding total output.*
- *Integration of production with input-supplying and marketing.*
- *Production decisions heavily influenced by off-farm factors.*
- *High quality and uniformity of output.*
- *Regular supplies and variety of end-products.*
- *Declining real costs and consumer prices.*

While market eggs are produced on about 300,000 farms, over 93 percent of total output comes from only 5½ percent of the farms. Half of the 33,000 broiler farms produce 90 percent of the volume, and 40 percent of the 4,400 turkey farms produce 90 percent of the volume. Average farm sizes have been increasing sharply in recent years. The number of farms producing eggs declined 70 percent during the last decade. Relatively, the number of turkey farms declined nearly as much, but the number of broiler farms declined only a few thousand in the last decade.

Thus, typical commercial poultry farms are large, and many exceed one-man size. Depending on the degree of mechanization and production practices, one man-year of labor is required per 20,000 to 25,000 laying hens, each 4½ to 5 batches of 30,000 to 50,000 broilers, or each 10,000 to 30,000 turkeys per year in several

batches. These ratios increased severalfold in the last few decades. In part, the increases represent the achievement of eonomies of scale and the introduction of new labor-saving technology. Economies of scale exist not only with respect to labor efficiency, but also in input purchasing, energy use, and overhead costs. Growing mechanization and rising building and equipment prices mean a high investment cost for a large and modern poultry farm. Depending on the type of housing, equipment, unit size, and climate, investment costs per bird capacity may be $4 to $10 per layer, $2 to $4 per broiler, and $3 to $8 per turkey.

Today's poultry and egg industries involve an extensive network of linkages which have developed between production units and input-supplying and marketing functions. Coordinating systems cover virtually all commercial broiler production and four-fifths or more of all egg and turkey production. In these systems, much production is under contract to marketing firms or carried out as only one phase within vertically integrated firms. A highly integrated firm can involve all or most of the following: breeding flocks, hatchery, feed mill, production units, assembly of live birds or eggs, poultry slaughtering or packing plants, further processing units, delivery vehicles, and distributing centers. Hence, most production decisions are not made independently of other considerations. Moreover, coordinated systems can induce not only more rapid adoption of improved production technology, but also may develop new advances and quickly respond to changing consumer needs.

Achievement of regular large-volume supplies which are of uniform and high quality has been accomplished through rapid and centrally directed adoption of technology, standardization of inputs, and scheduling of production. Motivations for improved and standardized quality and regular supplies came from expressed consumer demands. Volume operations were attuned to satisfying growing demands as well as achieving sustained lower operating costs per unit of product. Mass-market prices to consumers have been successively reduced. A small segment of the poultry and egg industries still is involved with direct marketing to satisfy the special demands of some consumers. In the mass-merchandising area, a greater variety of end-products are being offered in home and away-from-home markets. Poultry prices have been more affected by red meat prices in recent years than formerly.

Feed is the largest and one of the most critical inputs in poultry and egg production, accounting for two-thirds to three-fourths of the cost per dozen eggs or per pound of live broiler or turkey. Bird costs, i.e. hen depreciation or chick and poult costs, are the second largest cost item. Labor costs and overhead costs are about equal in importance; the former have been declining in importance and the *latter are tending to increase. Energy costs are of minor importance in relation to total costs, but now are more critical because of the supply/price situation.*

Poultry and egg producers can adjust output during the year through the number of chicks or poults started, changing the frequency of batches raised, adjusting market weights, or culling or recycling layers. Ultimate limits to increases exist, however, in terms of housing capacity and chick or poult supplies from breeding flocks. Year-to-year production responses are affected by past net returns, but there often are several-year lags before large responses occur.

Major shifts in the location of poultry and egg production occurred during the last several decades. Some of these shifts were a result of changing comparative advantages in producing various agricultural commodities, the need for new enterprises to use available resources, or the efforts of innovative entrepreneurs. Others resulted from absolute cost advantages associated with new production systems. More recently, production systems have become more alike in various regions, and locational changes have slowed down. Integrated poultry and egg industries similar to those in the United States have been adopted widely in developed and developing countries. Many countries are seeking more protein for consumers from domestic production and imports.

Extensive coordination of production, input-supplying, and marketing are likely to continue in the future. Further growth of typical production unit sizes is expected. The number of farms producing eggs may decline the most. Little change is expected in numbers of farms producing broilers and turkeys. Further gains in production efficiency can be realized.

Problems that will concern poultry and egg producers in the future are:

- *Maintaining cost competitiveness vs. competing protein foods.*
- *Adequate returns to producers to permit continuity in production.*
- *Access to substantial investment capital.*
- *Extent of producer involvement in decisionmaking.*
- *Sustaining rates of gain in technology.*
- *Reconciliation of environmental enhancement, energy conservation, and other public goals with low-cost operation.*
- *Continued access to small but important foreign markets.*

INTRODUCTION

Poultry and egg production has some unique and inherent characteristics that facilitate the development of particular structural forms. Eggs are essentially a continuous flow commodity, like milk, and broilers and turkeys are produced by the batch, like hogs. Differences from other products occur because of the shortness of the reproductive cycle for poultry, because hatching is a year-round activity, and because the numbers of birds are large in relation to poundage. Thus, all of the activities related to poultry, whether basic breeding programs or production volume, can be accelerated or decelerated at a much more rapid rate than for other livestock species. Poultry also are readily adaptable to confinement in large units and assembly-line methods, given adequate technology.

Poultry and eggs produced by many small individual farmers exercising complete freedom of choice of breeds, feeds, management practices, and marketing methods likely would be of highly variable quality and available in uneven quantities. Standardization of practices and scheduling can eliminate many such problems to consumers. Coordination of production with input-supplying and marketing may, thus, have been more necessary for eggs and poultry than other commodities—for mass markets to be regularly served with growing volumes at favorable prices.

Decentralized decisionmaking in poultry and egg production often led to uneven adoption of technology and slow, if gradual, gains in production efficiency and product uniformity. With the ascendancy of vertical integration, technological adoption has been more rapid and greater gains in production efficiency have been realized. New methods and practices can be adopted in mass and mistakes just as quickly corrected. With regard to the timing of the spread of vertical integration, suitable and improved technology, superior to existing technology, had to be available as a precondition. The subsequent flow of technology has promoted "and facilitated further organizational changes as well as physical production changes" (*32*).[1]

It would be a fundamental mistake to assume the broiler industry, for example, as a structural prototype for other commodities. This would ignore specific commodity characteristics, on-line technology, timing, or changes in particular product forms sought or preferred by consumers. But it is virtually impossible to describe the structure of poultry and egg production today without recognition of the major interrelationships which exist between production and other functions (*4, 10, 18, 26, 31*).

HISTORICAL CHANGES IN PRODUCTION SYSTEMS

Numbers and Output

Over the last few decades, the average sizes of poultry farms have increased. The remaining smaller units have supplied a rapidly

[1] Italicized numbers in parentheses indicate references listed at the end of this chapter.

shrinking share of total output. More recently, declining numbers of units of intermediate size have reduced their relative contribution to total output. Today, a relatively few very large poultry farms produce the bulk of poultry and egg supplies (table 1).

Numbers of farms producing specific poultry products would be expected to decline along with the increase in average size, where total output has not increased substantially. This is, in fact, clearly the case with laying hens and miscellaneous poultry (ducks, geese, guineas, pheasants, etc.), where farm numbers have dropped materially. Numbers of farms producing young chickens (mainly commercial broilers) declined some in earlier years but now are somewhat stabilized; total output has increased fourteenfold during the last three decades. The number of farms with turkeys has declined relatively more than the number with young chickens, despite a fivefold increase in total output in the same period. For many decades, larger units have produced an important share of total output. The definition of "large" has persistently changed, increasing along with the expanding share of output such units produced (table 2).

Agricultural census designations and details reported by species have been changed many times, and uniform historical comparisons are unobtainable. Nevertheless, some generalizations can be made about changes in the last century or more. Numbers of farms producing various species have declined. Meat chickens and turkeys have increased greatly in importance, relative to other species of

Table 1—Importance of poultry farm sizes and share of volume, United States, 1969 and 1974[1]

Item and flock size	1969		1974	
	Percent of farms	Percent of birds	Percent of farms	Percent of birds
Eggs				
Under 3,200 hens	94.6	14.0	94.5	6.6
3,200-19,999 hens	4.3	33.5	3.8	25.7
20,000 hens and over	1.1	52.5	1.7	67.7
Broilers				
Under 60,000 sold per year	54.1	29.1	49.5	10.3
60,000 and over sold per year	45.9	80.9	50.5	89.7
Turkeys				
Under 16,000 sold per year	68.5	14.8	60.0	8.4
16,000-59,999 sold per year	24.9	38.2	27.9	31.0
60,000 and over sold per year	6.6	47.0	12.1	60.6

[1] Farms with sales of $2,500 and over.

Table 2—Changes in farm numbers and sizes, poultry and egg production, United States, selected years

Year and category	Number of farms	Total number of head (mil.)	Average number per farm	Number of farms accounting for specific shares of output
Egg production				
	Chickens on farms. 4 months or older			
1949	4,218,857	348	81	88,059 farms had 400 or more birds
1954	3,418,204	376	110	10,255 farms with 3,200 birds or more accounted for 12.1% of total number
1959	2,207,809	370	168	2,501 farms with 10,000 birds or more accounted for 12.4% of total number
	Hens and pullets of laying age on farms			
1964	1,146,031	309	270	5,444 farms with 10,000 birds or more accounted for 39.6% of total number
1969	445,328	298	668	4,899 farms with 20,000 birds or more accounted for 52.5% of total number
1974	303,923	285	937	5,167 farms with 20,000 birds or more accounted for 67.7% of total number
Commercial broiler production				
	Produced on farms			
1954	48,931	792	1,194	1,687 farms sold 60,000 broilers or more
1959	42,185	1,419	33,647	6,110 farms selling 60,000 or more broilers accounted for 48% of output
1964	35,128	1,915	54,526	10,290 farms selling 60,000 or more broilers accounted for 66.2% of output
1969	33,688	2,429	72,098	15,829 farms selling 60,000 or more broilers accounted for 80.9% of output
1974	32,744	2,551	76,915	16,534 farms selling 60,000 or more broilers accounted for 89.7% of output

(Continued)

Table 2—Changes in farm numbers and sizes, poultry and egg production United States, selected years (*Continued*)

Year and category	Number of farms	Total number of head (mil.)	Average number per farm	Number of farms accounting for specific shares of output
Turkey production				
	All turkeys raised on farms			
1949	162,401	36	225	6,143 farms raised 1,600 or more turkeys
1954	169,807	63	370	9,197 farms raising 1,600 or more accounted for 83.7% of output
1959	86,838	83	950	5,120 farms raising 3,200 or more turkeys accounted for 88.9% of output
	Turkeys sold from farms selling $2,500 or more			
1964	23,274	104	4,467	4,531 farms producing 5,000 or more turkeys accounted for 94.5% of output
1969	5,425	103	19,070	2,616 farms selling 8,000 or more turkeys accounted for 95% of output
1974	4,407	125	28,305	1,763 farms selling 16,000 or more turkeys accounted for 91.6% of output

poultry. Specialization has largely replaced general farm production in relative importance for all species. Actual numbers of various species produced may have decreased in some periods and increased in others. For example, turkey output fell earlier in this century because of disease problems and the relocation of the industry as a consequence. In recent years, duck and geese production has been increasing as consumers sought more variety in poultry. Production by large, specialized enterprises has been growing.

For many decades, chicken meat was produced as a byproduct of laying flock replacement rearing and sale of old hens no longer useful for laying purposes. The commercial broiler industry is by far the most recent segment of the poultry meat industry to develop. While winter broiler production began in the late 1920's, it was not until 1948 that liveweight pounds of commercial broilers produced exceeded sales of young farm chickens that were largely a byproduct of raising laying flock replacements. Two years later, broiler sales exceeded total sales of young and mature farm chickens together.

From that point on, broilers rapidly became the major source of chicken meat. Broilers generally are sold in fresh form, a form preferred over the frozen storage chickens which dominated in earlier decades.

Structural Evolution

In earlier times, chickens and other poultry were "kept" on most farms. Output was used variously to supply family needs, furnish "pin money" for the farm housewife from selling small surpluses, supply nearby consumers, and/or supply larger surpluses to country assembly channels accumulating loads for shipment to distant markets. In that type of production environment, many functions relating to input-supplying and marketing also were performed on or near individual farms. Home-grown grains were sometimes fed or combined with premixes at local mills, or some feed mixing was done on farms. Home hatchings were supplemented with mail orders or visits to local hatcheries. Much equipment and many buildings were homemade. Diseases were treated by the flockowner with made or purchased remedies and advice from extension specialists. Eggs were sorted and packed and poultry often killed and dressed for local customers. Quality and quantity varied widely.

Specialization appeared much sooner in some regions and in some functions than others. In the Northeast and California, for example, specialized egg production units that were larger than average developed several decades ago, along with a supporting infrastructure. But specialized breeding units emerged at about the same time in all regions. Commercial feed mixes were more extensively provided by larger mills and frequently delivered to farms. Larger and specialized hatcheries replaced widespread farm hatchings. Commercial disease treatments and vaccines were widely prescribed and used. Equipment manufacturers and specialized builders replaced do-it-yourself methods. Egg packing and poultry slaughtering plants at country points assumed more of the marketing functions. Many of the single specialized functions were performed by firms which were independent of each other. Yet, the quantity and quality of output entering the marketing system often was irregular, diverse, and lacking in uniformity, though some efforts to standardize were achieved through persuasion, price, and central handling.

Vertical integration emerged as an important organizational feature of the poultry and egg industries during the 1950's and now dominates most of the commercial segment. It links the production, input-supply, and marketing segments. Contract growers or large-scale company-owned facilities may be served by a company hatchery and feed mill. Output is sometimes assembled and processed by company plant personnel, sometimes converted into further-processed products, and often transported to distributors, institutions, or retailers in company-owned trucks. Recently, some large broiler firms have begun their own primary breeding operations. Under integrated systems, inputs are standardized by direction or agreement, much decisionmaking is centralized, and output is highly standardized.

As much of the poultry and egg industries came under the influence of vertical integration, horizontal integration became more common. Currently, integrated firms (some public) may operate in more than one area, State, or region, owning several input-supplying and/or processing units. With each, there may be an associated growing complex or a set of contract growers. Area differences in type and quality of production may exist, along with different growing specifications and terms, but many decisions which affect the production segment are influenced by broad company policies.

Increasingly, poultry producers have become segmented mainly into three groups. By far the largest in terms of volume, if not numbers of units, produce for mass markets nearby and at distant points and are closely associated organizationally or by agreement with marketing firms. A smaller volume group, though often large numbers of units, produce for home use or local customers through direct marketing efforts. Part of the in-between group consists of a shrinking and residual category of producers who sell into commercial channels, but are marginal and often unwanted suppliers who are penalized pricewise. Some other units of intermediate size market locally or over limited areas, often directly to consumers or retailers and institutions, and at premium prices. Both the small and intermediate groups retain much decisionmaking autonomy but face limited markets. The mass-market producer group surrenders much decisionmaking authority, but its output is in greatest demand and opportunities for expansion exist within competitive but prescribed dimensions.

Interregional Shifts

Interregional shifts in the location of poultry and egg production have occurred extensively in the past. But in recent years, there has been more stability in regional shares of total output (table 3). Some of the past gains in regional shares of output were accomplished in part through the building of new and more vertically integrated industry structures (as with broilers in the South), where little commercial output previously existed and alternative agricultural enterprises were sought. In other instances, existing larger scale production units were able to build on the established base (as with

Table 3—Regional shares of poultry and egg production, United States, selected years

Category and year	North Atlantic	East North-Central	West North-Central	South Atlantic	South Central	Mountain	Pacific
	Percentages of U.S. production						
Egg production							
1925	13	23	28	9	17	3	7
1930	13	21	29	8	16	4	9
1935	15	23	25	9	16	3	9
1940	16	21	26	9	17	3	8
1945	15	20	30	8	17	3	7
1950	17	20	28	9	15	3	8
1955	18	20	28	9	12	3	10
1959	17	18	26	12	14	2	11
1964	15	15	19	17	18	2	14
1969	14	14	14	21	21	2	14
1974	15	13	12	22	21	2	15
1978	14	14	11	22	21	3	15
Commercial broiler production							
1934	19	17	5	39	16	—	4
1940	12	9	4	54	16	[1]	5
1945	12	8	3	56	12	[1]	9
1950	12	8	4	47	20	1	8
1955	13	7	3	43	27	1	6
1959	9	5	3	42	36	[1]	5
1964	6	3	2	43	42	[1]	4
1969	6	2	1	43	44	[1]	4
1974	5	1	1	42	47	[1]	4
1978	5	1	1	42	47	[1]	4
Turkey production							
1929	3	5	24	9	31	14	14
1940	6	9	34	6	17	8	20
1945	8	10	27	7	11	10	27
1950	9	12	26	11	10	7	25
1955	8	14	28	13	9	6	22
1959	4	16	34	14	9	5	18
1964	3	15	33	14	12	5	18
1969	3	12	30	17	15	6	17
1974	3	12	31	20	14	5	15
1978	3	10	30	24	15	5	13

[1] Less than 0.5 percent.

turkeys in the Midwest and West and eggs in the Northeast and California).

The kind of industry structure that existed at the time when accelerated changes began had much to do with the kind of new production segment that first evolved. In the new and surplus southern broiler industry, a relatively tight contract production system developed. This rapidly replaced financing or profit-sharing systems which had been widely used in broiler deficit regions. Production on company-owned farms also expanded as broiler companies set up test units, took over financially troubled contract farms, or even decided on totally owned production units for efficiency reasons or to forestall bargaining problems with contract growers.

With eggs and turkeys, contract production had a much greater early role in the South. In most other areas, a combination of owner-integrated and contract systems developed in parallel. Owner-integrated operations have been more important with eggs and turkeys than broilers and have expanded rapidly in all regions since the mid-1970's. Contract marketing (in which traditional cooperatives were important) formerly was a major, but less effective system of coordination for eggs and turkeys. It has been rapidly dwarfed and supplanted by other systems of coordination. The development and expansion of contract production systems generally offers a quicker and more controllable alternative for growth, and thus, innovators have turned to it in all regions at various times.

Foreign Developments

Success of the integrated U.S. poultry and egg industries in reducing costs and prices, and in increasing output and demand, did not go unnoticed abroad. Many of the structural developments in the U.S. poultry and egg industries have had their counterparts in foreign countries, but with timing and cultural differences causing some variations from the U.S. experience. U.S. firms and technology have been important in developing foreign poultry industries.

Japan and western Europe were among the earliest to follow developments in the United States. In Japan, the poultry and egg industries were transformed in three decades from the unintegrated stage with backyard and sideline flocks to integrated systems including large and specialized flocks (*37*). This kind of evolution took much longer in the United States. In postwar western Europe, integrated systems soon emerged, with commercial production developing in both the large owner-integrated and contract production forms. But in the latter type, there often tends to be more cooperative participation and more militant grower organization and bargaining in the United States.

The examples of the United States and a few other countries were followed rapidly by other developed countries. More recently, the centrally planned economy and developing countries adopted these lessons to their own situations. Developing countries, in particular, see poultry and egg production as an aid to increased employment. And many countries see poultry and egg production as a feasible way to add animal protein to consumer diets, as many are demanding.

Despite the growth which has occurred in egg and poultry production in other countries, expanding U.S. exports by 1978 accounted for 2 percent of U.S. egg production, 4.5 percent of broiler output, and 2 percent of turkey output. The future for U.S. exports is uncertain, if more countries seek to satisfy most of their needs with domestic production. With the spread of government trading and the existence of trade barriers, U.S. firms increasingly are joining together in export activities. This cooperative activity, plus the integrated structure of the U.S. industries, facilitates the assembly of large standardized shipments and large-scale bargaining in areas that remain open to U.S. shipments.

IMPORTANCE AND SOURCES OF PRODUCTION INPUTS

Input Sources and Problems

Land quality and quantity are not critical for poultry and egg production, particularly where confinement rearing predominates. This is now the case with commercial broiler and egg production, most egg flock replacement rearing, and a growing proportion of turkey production. In some areas, range or semiconfinement rearing of turkeys (or pullets) would require additional well-drained land. However, land disposal of poultry manure and litter predominates with lagoon systems secondary but declining in importance. Disposal of manure and litter is not always done within representative farm arrangements (associated cropping), but more often by sale to crop farmers. Land slope and type perhaps are more critical than formerly, from the standpoint of environmental considerations. Many poultry units also face ultimate zoning conflicts due to spreading urbanization. Budget costs for land and waste disposal are not large, even where cropping is associated directly with poultry production. Land-associated production inputs are furnished entirely by the production unit, whether contract, independent, or company-owned.

Feed is by far the most important input in poultry and egg production. Precisely formulated complete rations, often pelleted, are used universally. Such mixed feeds often are varied by age of birds, sex, season, or climate, and typically programmed to use least-cost formulations. Advances in poultry nutrition in the last few decades have been tremendous, with major advances contributed both by university and government researchers and private feed firm laboratories. Aside from fortification of rations with required minerals and vitamins, and a move toward "high-energy" formulas, antibiotics and additives typically are included at subtherapeutic levels to prevent disease and stimulate growth. Feed is furnished to contract growers by integrators, usually from their own specialized poultry feed mills. Large owner-integrated firms also may operate feed mills or, either singly or together with other large producers, buy standardized formulations advantageously from feed companies. Good-quality feed rations are readily available to poultry and egg producers. Feed-related problems involve weather or strike disruptions to normal flows, poor or unreliable rail service, surges in feed exports, and the potential of future government restrictions on antibiotics and additives.

Under contract production, chicks, pullets, or poults are furnished to contract growers by integrators. Chicks and poults typically are from integrator-owned hatcheries, and pullets may be reared on integrator-owned farms or on contract. Integrators often maintain breeding flocks for the production of hatching eggs, or they may use contract flocks. Primary breeding stock usually comes from the now very limited number of large-scale poultry breeding firms that maintain and multiply the progeny for multistage crosses. With a few exceptions, breeding firms have not integrated forward into market production. Hatchery numbers have declined drastically in recent decades. And a group of specialized pullet-growing firms have evolved. Although the average quality of poultry strains is good, "genetic drift" may occur in some instances and cause sudden drops in strain performance. Complex modern breeding programs seem more vulnerable to such occasional events. This can disrupt normal supply sources until suitable alternatives emerge, particularly with fewer breeding firms existing.

For most medium-sized or smaller independent producers and contract growers, virtually all labor is furnished by the operator and family. Limited amounts of hired labor may be used seasonally—for cleaning houses, repair work, or where cropping practices or marketing functions are involved. Cleaning crews often are used. Larger units employ successively more hired labor until the owner eventually becomes almost a full-time manager. Integrators sometimes furnish company personnel for starting broods and/or house cleaning crews. And, in contract production, field supervisors and specialists are available to contract growers on a regular visit and on-call basis. On company-owned farms, hired resident managers are typical, supplemented by additional wage workers, maintenance, brooding, and clean-out crews. Company assembly personnel do most of the catching and loading of live birds on company-owned, contract, or even independent farms. Poultry farm employment generally has not been regarded as a preferred occupation, and this has tended to hasten mechanization.

Under contract production, many other variable-cost inputs may be furnished in part and sometimes in total by the integrator. These variously may include fuel, litter, bird insurance, and medication. Some recent contracts include expanded fuel and electricity allowances to offset grower-incurred costs. Energy has become a more critical input in recent years because of disruption in supplies and forecasts of tighter supplies in the future. These factors and, to a lesser extent, increasing energy prices have resulted in substantial energy conservation efforts at the farm level. Litter supplies become scarce on occasion, particularly where competing uses for wood and vegetable wastes become suddenly larger.

Fixed costs (depreciation, interest, repairs and maintenance, taxes, property insurance) are borne by the producer (contract or independent). Integrators frequently aid contract growers to secure loans for buildings and equipment, and sometimes cosign these loans. Some integrators offer package deals to contract producers. The integrators finance the investment and deduct charges regularly from contract payments. Although fixed costs account for a relatively small share of production costs per pound of poultry or per dozen eggs, capital investment needs for a large and modern production unit are substantial.

Changes in Importance of Inputs

Technological adoption and relative price changes have resulted in substantial shifts in the proportions of total costs accounted for by various inputs. Table 4 illustrates some of the changes between the mid-1960's and mid-1970's.

From the mid-1950's until the early 1970's, feed costs continued to account for three-fifths or more of egg production costs, and a somewhat higher percentage of broiler and turkey production costs. Per ton feed prices, despite some year-to-year variations, were relatively stable. Improved feed conversion tended to lower feed costs per dozen eggs or per pound of poultry, somewhat in parallel with other gains in efficiency and declining costs. Beginning in 1973, feed prices rose sharply and substantially increased the proportional importance of feed cost per unit of output. Some reduction in relative importance occurred later in this decade, as other input prices rose.

Increased productivity factors–higher egg production per bird, better feed conversion, more rapid growth, reduced mortality–have tended to reduce the share of "bird" costs as a proportion of total

Table 4—Changes in relative importance of production input costs, United States, selected periods

Item	Eggs		Broilers		Turkeys	
	Mid-1960's	Mid-1970's	Mid-1960's	Mid-1970's	Mid-1960's	Mid-1970's
	Percent					
Feed	59	66	64	73	69	72
Hen depreciation	21	19	–	–	–	–
Chicks	–	–	18	12	–	–
Poults	–	–	–	–	15	11
Labor/mgt.	9	6	7	6.5	8	6
Energy	1	1	2	2	1	2
Other variable	3	2	4	2	3	2
Overhead	7	6	5	4.5	4	7
Total	100	100	100	100	100	100

production costs. Economies in breeding and hatching also have helped hold down prices for chicks or poults. Hen depreciation costs represent the costs of ready-to-lay pullets minus returns for birds culled during the production period or when the flock is finally sold. Fowl price fluctuations often cause substantial year-to-year changes in the salvage value of hens.

Labor/management costs per unit of output have declined substantially over time. The effects of larger units, increased mechanization, some labor specialization, confinement rearing, and technology which reduced space per bird have much more than offset rising wage and salary rates. The proportions of total production costs accounted for by labor/management costs together (or separately) have, thus, declined. Other variable costs–such as medication, litter, communication, etc.–also have declined as a share of total production costs due to economies of scale.

Despite increased mechanization, energy costs as a percent of total production costs remained relatively stable for many years. More recently, sharply rising energy prices and more environmentally controlled housing, plus year-around turkey production, have tended to increase energy's share of total production costs. Even with more mechanization, achievement of economies of scale has tended to hold down or decrease the overhead share of production costs. Such factors as year-around confinement turkey production, more environmentally controlled housing, high recent construction and repair costs, and rising interest rates, taxes, and insurance premiums may be reversing this trend.

Input Pricing

Prices for various inputs to the production process are affected materially by production structure. Economies of scale have a major role in determining input prices, but some institutional forces also are involved.

The typical structure of mixed feed prices involves discounts for quantity, delivery costs related to distance, cash vs. credit, and bagged vs. bulk differentials. This is the situation facing smaller independent producers who buy at list prices either from local dealers or feed mills. But larger producers may be able to negotiate special deals at less-than-list prices. Integrated firms might do even better but may elect instead to own and operate their own specialized feed mills. They can, thus, eliminate sales and service costs, and realize both economies of scale and a high rate of utilization of mill capacity. A parallel price-cost situation also exists with respect to chicks, poults, or pullets obtained from hatcheries/growers or produced by a unit of an integrated firm. But, where contract production systems exist and returns over costs are a settlement feature on production contracts, integrators do not always carry bottom-line costs on furnished inputs. They can build in varying spreads over costs which reduce potential production system savings and transfer earnings to other functions.

Typically, prices of other purchased inputs also vary according to quantity. Sufficient storage capacity may enable producers or firms to take advantage of large-quantity discounts. And many poultry and egg producers purchase inputs through supply cooperatives. Recently, quantity discount structures for energy seem to be dissolving by design or as a "crisis" byproduct.

Prices paid for hired labor may be on a largely nonunion competitive wage basis, or somewhat obscured by perquisites furnished. A somewhat unique feature is the heavy use of transient or immigrant help on California egg ranches, where housing customarily is provided. With contract production, the payment covers all inputs and services provided by the contract grower, including owner and hired labor, and the value of labor is a calculated residual. With company-owned production facilities, wage rates often are compounded with managerial functions and conceivably could be under unionization arrangements.

On investment capital (and the resulting depreciation), interest, and perhaps insurance, integrated firms probably have a major advantage because of widespread access to sources of capital and more favorable terms. These can arise not only from more direct dealing with head offices, but because the associated input-supplying and marketing activities of the integrated firm widen contacts and provide additional securities. Frequently, development loan funding also is available to the integrated firm. Contract growers probably do not receive the benefits which integrated firms possess, but certainly company-owned farms reflect these benefits. Independent growers (often smaller), on the other hand, may be able to borrow favorably through government and cooperative sources. But the willingness of these lenders often is distorted by a few unsatisfactory experiences and a resulting bias against expanding poultry and egg operations in areas where none exist, are declining, or are less important than other farming alternatives. For many years, traditional and government lenders in many areas of the Midwest were reluctant to lend for poultry operations. In other areas, such as Maine and much of the South, such lenders were more receptive.

ECONOMIC CAUSES OF STRUCTURAL CHANGE

Some of the reasons for extensive changes in poultry and egg production involve the substantial cost savings achievable through size and supply area density, the technological base and its rate of development and adoption, consumer demands, tax options, and inter-regional competition factors.

Economies of Scale and Location

Much Federal-State research during the mid-1950's to mid-1960's focused on documentation of the potential economies of scale which existed in production, processing and packing, hatchery operation, and feed milling. A corollary aspect was the demonstration of the cost-reducing effects in performing input-supplying and marketing functions at a high degree of utilization of plant capacity. Additional work beginning in the 1960's focused on the assembly and distribution functions, and the combination of these with processing and input production. In assembly and distribution studies, the potential cost-reducing advantages of large loads, few stops, short hauls, and high supply area density were large. Moreover, the savings from matching optimum-sized units within an integrated system could be additive.

Cost differences in production or in processing and packing between a small to medium-sized and large unit typically may amount to several cents per dozen eggs or per pound of poultry. In hatchery operations, savings can be several cents per chick or per poult, and in feed milling, several dollars per ton. In transfer functions, savings of 1 to 2 cents per dozen or per pound are obtainable when distances and stops are minimized and load sizes maximized.

In a fully competitive market situation, potential gains from lowering costs in the face of reflected market prices would provide sufficient incentive for many producers to enlarge unit sizes to realize economies of scale in production. This was clearly possible by the 1950's since many of the technological problems, such as disease control, had been sufficiently solved to reduce many large unit production risks. Larger units alone led to material gains in labor productivity, which were augmented further by various forms of automation, including feeders, waterers, bulk feed, materials handling, egg collection, and live poultry loading. Thus contract producers, independent producers, and integrated producers all were induced to some extent to expand farm unit sizes. Additionally, this made possible more economical onsite processing and packing.

The achievement of efficiencies available to independent input-supplying and marketing units through farm volume and spatial adjustments were obtainable through persuasion, selectivity, or offered producer price advantages. Pursuit of these gains led firms to structure producer premium/discount incentives for volume and/or quality, but captured only a share of potential cost savings. Hence, another major thrust toward larger and more favorably located production units came from feed companies and processors interested in realizing economies of scale, high use of capacity, and minimum delivery and pickup costs. Farm locations could be made a condition of participation, "captive" volume was created, and growers offered a guarantee against most shortrun market price risks and the opportunity to invest in additional capacity if the integrator furnished major cash inputs. Thus, contract production emerged as a major feature of the poultry and egg industries during the mid-1950's and spread rapidly in the 1960's and 1970's.

Unsatisfied Market Demands

During many decades, consumers complained about varying egg quality, lack of uniformity of meat chickens and turkeys, and irregular supplies. But the progress made by the egg and poultry industries toward reducing consumer dissatisfaction was slow and irregular under older systems.

Mass production methods offered an opportunity for the improved standardization and quality control which users desired. This was most easily accomplished under closely integrated systems. Ultimately, such output became large enough to deny some mass market opportunities to wholly independent producers for quality or scheduling reasons. Standardization of inputs and output also had secondary efficiency benefits for input-supplying and marketing units.

Consumers and institutional users readily took expanding volumes of higher quality eggs and larger total volumes of more uniform broilers and turkeys. With turkeys, seasonal consumption was less even until the advent of further-processed products and cut-up parts. But the meeting of expanding year-around demands led rapidly to a tightening of controls over production scheduling on top of input specifications.

Per capita consumption and deflated retail price data for 1955-78 indicate that demand for poultry and eggs has changed appreciably. During the last two decades, demand for eggs has decreased persistently with fewer eggs per capita being used, even at decreasing relative prices. The egg industry, under legislation, is operating a national producer check-off program to fund advertising, promotion, consumer education, and research activities to stimulate increases in demand. In contrast, demand for broilers and turkeys appears to have increased over time, as per capita use now is greater at any given relative price.

Changes in egg industry structure, resulting in lower relative costs, may have helped the egg industry to forestall even larger adjustments in output. Increased demands for broilers and turkeys were, on the other hand, met more readily by integrated systems at lower costs than would have been possible otherwise.

Some criticisms about mass-merchandised product quality, including taste, have come from consumer groups in recent years. While some of these issues deserve attention, others may be strictly personal preference. The kinds of products some consumers seek might be provided more easily, but probably at a higher cost, by the localized and specialized portions of the production segment.

Hence, despite the recently renewed interest in direct marketing, the poultry and egg industries may have little reason to make much more extensive use of this alternative. Direct marketing (from producer/huckster to consumer) probably involves 4 percent of market egg production, a small fraction of 1 percent of commercial broiler and other young chicken production, and only a small percentage of turkey production. While direct marketing affords a good living for successful practitioners servicing a limited clientele, there are fewer following this course now than in previous decades. For one thing, urbanization has been a growing obstacle to easy access to consumers by producer/hucksters and general cost competitiveness.

Development and Adoption of Technology

Federal-State research has been important in developing the technological base which supports modern poultry and egg production. Numerous examples exist in poultry genetics, breeding, disease control, management, and materials handling. While much basic research continues in the public domain, many major breakthroughs now often originate in the private sector. Moreover, the private sector now develops most of the commercial applications. Such areas encompass vaccines, antibiotics and additives, machinery, least-cost ration programming, and computerized breeding programs. Development costs and often innovator returns are a part of the price of such inputs.

Improvements in breeding, feeding, management, and disease control have been reflected in higher performance efficiency in production (*27, 32*). In the last two decades, the number of eggs produced per year per average layer on hand has increased nearly 25 percent to over 240 eggs per bird. Feed use per unit of product has been cut more than 25 percent for eggs and nearly 30 percent for broilers and turkeys since 1955. Mortality in pullet raising and laying flocks is somewhat lower now than in the 1950's, despite some higher inbetween rates until Marek's disease vaccine was developed in the late 1960's. Mortality in broiler growing has been reduced by 60 to 75 percent since the mid-1950's, and mortality in turkey growing is down by a third. The time needed to produce a live broiler has been cut from 12 to 14 weeks to 7 to 8 weeks during a 25-year period, and faster growing strains of turkeys similarly have shortened the time needed to reach given market weights. Large-scale confinement operations have employed mechanization to an increasing extent. Thus, output per hour of labor for all poultry and egg production has increased nearly sevenfold in 25 years, and as much as twelvefold on broilers.

It is doubtful that the rate of technological adoption and resulting gains in performance in the production sector would have been as rapid in the absence of vertical integration. It also is argued—with some justification—that the average quality of husbandry has declined materially over time, and that this has required building into the production system more performance standards and the means for supervising their achievement. Table 5 compares integration and selected technical measurements.

The inability of many smaller producers, or more traditional cooperatives as an extension of producers, to survive and grow during the period of structural evolution and expansion has been many-faceted. Aside from some financing disadvantages, the independent decisions of producers did not seem to provide rapid enough adoption of technology or uniformity of output. Moreover, management of many traditional operating cooperatives did not move rapidly enough to develop parallel competitive structures for their members. Today's most successful cooperatives in the broiler, turkey, and egg businesses largely resemble their private integrated counterparts. Others have withdrawn from production into input selling; a few survive—mainly in deficit areas—as small localized sellers of poultry and eggs. Other kinds of cooperative organizations

Table 5—Changes in integration of production and technical efficiency gains in egg and poultry production, United States, selected years

	1955	1960	1965	1970	1975	1977
Market eggs						
Percentage of:						
Contract production	0.5	7.0	18.0	20.0	37.0	44.0
Owner-integrated production	1.5	5.5	12.5	20.0	32.0	37.0
Contract marketing	12.5	13.5	13.5	15.0	10.0	8.0
Total	14.5	26.0	44.0	55.0	79.0	89.0
Pounds of feed/doz.	5.50	5.20	4.95	4.55	4.25	4.25
Commercial broilers						
Percentage of:						
Contract production	87.0	90.0	90.0	90.0	90.0	88.0
Owner-integrated production	2.0	5.0	5.5	7.0	8.0	10.0
Contract marketing	1.0	1.0	1.5	2.0	1.0	1.0
Total	90.0	96.0	97.0	99.0	99.0	99.0
Pounds of feed/lb. live wt.	2.85	2.48	2.28	2.10	2.10	2.10
Market turkeys						
Percentage of:						
Contract production	21.0	30.0	35.0	42.0	47.0	52.0
Owner-integrated production	4.0	4.0	8.0	12.0	20.0	28.0
Contract marketing	11.0	16.0	13.0	18.0	14.0	10.0
Total	36.0	50.0	56.0	72.0	81.0	90.0
Pounds of feed/lb. live wt.	4.40	3.90	3.50	3.25	3.10	3.10
Output per man-hour of labor in pultry production (1967 = 100)	32	55	87	120	175	215

have emerged with a paramount interest in affecting pricing systems, exporting, and semitrade association roles, with their members largely sizeable owner-integrated producers.

Other Factors

Development of new poultry and egg production in particular places and at particular times has been affected importantly by a lack of alternative employment opportunities, decline of existing activities, and efforts of innovative entrepreneurs. Much of the growth of the broiler and egg industries in several States of the South and in Maine can be explained by these factors. Expansion from a beginning base is easier once a supporting infrastructure is in place, or a prototype system exists. Thus, development of egg production followed broilers in the South, with turkeys a third development.

Units in other regions observe and borrow from existing visible developments. In one respect, they may be aided by the "threshold" effect. Because of it, an established industry may have useable but undepreciated capacity and not yet be ready to invest heavily in new capacity and techniques. A newer region may, thus, develop more rapidly for a time. Moreover, with the passage of time, changes occur between regions in the relative costs of inputs. For example, wage rates have tended to rise faster in the South in recent years as economic expansion and population growth have accelerated. This has limited the growth of poultry and egg production near growth centers, and may ultimately influence the existing base to relocate within a State or region or outside a region. Production structure in new areas may not follow older precedents.

In a region where expansion occurs with contract production having a major role, the need for contract growers often draws in many new participants. Terms are relatively favorable in the beginning. But integrators soon become more selective with respect to contract growers as cost differences based on size and performance appear. The demand for new entrants may even slacken. And a sorting-out process begins as integrators make performance standards and housing requirements progressively more stringent. Contract payment rates also can begin to lag behind rising grower costs, particularly where local monopsony exists or there emerges an "oversupply" of contract growers. Recently, energy considerations have developed additional pressures for insulated and environmentally controlled housing. Growers who could not or did not attempt to meet new requirements have been paid less or dropped.

There has been extensive use made within the poultry and egg industries of the cash accounting option under Federal income tax laws. In the egg industry, for example, it was long contended that the cash method "provided a tremendous incentive for expansion of production during and after years of good prices" (*40*). What might also have been said was that size and modernization were likely to go together. The relative use of cash vs. accrual options recently was summarized (*7*), as follows:

Broilers—72 percent of the production of 36 companies producing 80 percent of the total is under cash accounting; cooperatives apparently use an accrual system. After the 1976 Act, 22 percent using cash accounting were expected to shift to accrual, resulting in 53 percent under accrual and 47 percent using cash accounting.

Eggs—For the 36 largest firms with 22 percent of the production, 46 percent of their output is under the accrual system, but with 78 percent of the production by smaller firms, the industry is predominantly on a cash basis.

Turkeys—32 percent of the 32 largest firms' production of turkeys is under the accrual system, with the cash system predominating overall.

RESULTS AND PROBLEMS

Changes in the structure of the poultry and egg industries over time—including larger units, integration, and technology—have resulted in major decreases in costs and prices. Typical production units require much capital and are mechanized, production-line systems closely tied to input-supplying and marketing activities. The line between production and marketing (for example, in the old "farm gate" sense) is obscure and almost meaningless. Problems emerging from current or future production systems are not clearly defined nor are optimum solutions readily apparent. For example, the definition of who is a farmer or producer remains unsettled in both the structural and legal dimensions.

Production Costs

In a little more than two decades after World War II, egg production costs were reduced by nearly 30 percent. Broiler production costs were reduced by almost half, and turkey production costs by over 40 percent. Since costs of items used in production trended upward during this period, deflated production costs fell even more, amounting on eggs to over 50 percent, on broilers to about 65 percent, and on turkeys to over 60 percent.

Actual production costs for all poultry rose sharply, beginning in 1973, averaging more than 50 percent higher for 1973-75 than for 1969-72. Deflated production costs rose about 7 percent during the same period. By 1976-78, both actual and deflated production costs were lower than in 1973-75 (table 6). Changes in costs were reflected substantially in farm and retail prices.

Consumer Effects

Over a long period of years corresponding to the extensive development of vertical integration in the poultry and egg industries, consumers reaped substantial benefits from gains in efficiency. One study (*25*) showed that growing degrees of vertical integration in the egg industry during 1955-69 were related to gains in regional shares of output. Other evidence showed many producers in these regions to be among the most efficient. Thus, consumer gains might be attributed to a large extent to growing vertical integration.

During much of the last three decades, farm prices for eggs, broilers, and turkeys declined in actual terms. Deflated prices showed an even greater relative decline. Following the disruptive effects of price controls, inflation, and energy impacts by 1973, deflated price

Table 6—Average market egg, broiler, and turkey production costs, United States, selected periods

Period	Eggs			Broilers			Turkeys		
	Actual ¢/doz.	Deflated[1] ¢/doz.	Index (1963-68 = 100)	Actual ¢/lb. live	Deflated[1] ¢/lb. live	Index (1963-68 = 100)	Actual ¢/lb. live	Deflated[1] ¢/lb. live	Index (1963-68 = 100)
1947-52	39.1	51.2	177	27.1	35.6	239	34.7	45.5	211
1953-57	33.0	40.5	140	20.6	25.3	170	27.6	33.9	157
1958-62	29.1	33.2	115	16.0	18.2	122	22.2	25.3	117
1963-68	27.7	28.9	100	14.4	14.9	100	20.8	21.6	100
1969-72	28.1	24.4	84	14.2	12.3	83	20.4	17.8	82
1973-75	43.5	26.1	90	21.8	13.1	88	31.5	19.0	88
1976-78	41.1	19.6	68	21.3	10.1	68	31.2	14.9	69

[1] Deflated or "real" cost equals actual cost divided by index of items used in production, including interest, taxes, and wage rates, 1967 = 100.

values have tended to return to late 1960's and early 1970's levels (table 7).

Comparison of actual and deflated retail prices since the mid-1950's shows much the same pattern as farm prices. Actual prices declined from the mid-1950's to the mid-1960's and have trended upward in the last decade. As with farm prices, deflated retail prices declined into the early 1970's, but at a lower rate than farm prices. Compared with the deflated farm prices, deflated retail prices have risen relatively less in recent years than did farm prices (table 7). This is consistent with the more substantial efficiencies realized in production up to the late 1960's and early 1970's, and the greater relative efficiencies achieved in the marketing system since that time, compared with the production system.

During the last three decades, per capita consumption of eggs has trended downward from nearly 390 to about 275. Most of this decline–about 70 eggs–occurred from the late 1940's to the mid-1960's, and much of the remainder during the 1970's. Total yearly market egg production was relatively stable during 1950-66, varying from over 5 billion to under 5.3 billion dozen, and averaging 5.1 billion dozen.

Output averaged about 0.2 billion dozen more during 1967-72, dropping thereafter to under 5 billion dozen until turning up again in 1978. Despite these changes in total output and some lags in production response, yearly production typically has varied by an average of only ± 1 to 2 percent over period averages or from trend values. Average yearly variations in farm prices from period averages or trend values have been less than ± 10 percent and less than half that at retail. These relationships are indicative of the highly inelastic demand for eggs.

Per capita consumption of broilers has trended upward over the last three decades, from 14 to 15 pounds in the late 1940's to 44.7 pounds ready-to-cook weight in 1978. Liveweight production of broilers rose from about 1 billion to over 14 billion pounds. The average percentage variation of annual quantity from trend values declined from over ± 6 percent to about ± 2 percent from the late 1940's to the 1970's. Average variations in farm prices from period averages declined from about ± 10 percent to about ± 4 percent, and retail prices from about ± 7 percent to ± 3 percent. In recent years, both farm and retail prices seem to have become more variable than in the early 1970's, probably because, as relative broiler use rises, prices are affected more than formerly by red meat supply/price changes.

Per capita consumption of turkeys rose from about 3.5 pounds ready-to-cook weight in the late 1940's to nearly 9.5 pounds by 1978. Liveweight production rose during the same period from about

Table 7—Farm and retail prices for eggs and poultry, United States, selected periods

Level and period	Eggs, all			Broilers, live			Turkeys, live		
	Actual ¢/doz.	Deflated[1] ¢/doz.	Index (1963-67 = 100)	Actual ¢/lb. live	Deflated[1] ¢/lb. live	Index (1963-67 = 100)	Actual ¢/lb. live	Deflated[1] ¢/lb. live	Index (1963-67 = 100)
Farm									
1948-52	38.8	52.1	178	29.8	40.0	263	37.2	50.1	221
1953-57	34.6	42.6	145	22.8	29.1	191	28.7	35.4	156
1958-62	30.0	33.9	116	16.1	18.2	120	22.7	25.7	113
1963-67	27.8	29.3	100	14.5	15.2	100	21.6	22.7	100
1968-72	28.6	25.0	85	14.2	12.4	82	22.0	19.1	84
1973-75	46.1	31.6	108	23.9	16.3	107	33.7	23.1	102
1976-78	45.4	25.1	86	24.5	13.4	88	36.9	20.2	89
	Eggs, Grade A large			Broilers, ready-to-cook			Turkeys, ready-to-cook		
	Actual ¢/doz.	Deflated[1] ¢/doz.	Index (1963-67 = 100)	Actual ¢/lb.	Deflated[1] ¢/lb.	Index (1963-67 = 100)	Actual ¢/lb.	Deflated[1] ¢/lb.	Index (1963-67 = 100)
Retail									
1955-57	59.1	72.2	128	49.2	60.1	147	54.0	66.1	135
1958-62	56.0	63.3	112	40.9	46.3	113	48.9	55.3	113
1963-67	53.8	56.6	100	38.9	40.9	100	46.6	49.0	100
1968-72	56.2	49.0	87	41.0	35.6	87	49.5	42.9	88
1973-75	77.8	53.1	94	59.6	40.6	99	70.2	48.0	98
1976-78	81.6	44.9	79	62.1	34.0	83	73.5	40.3	82

[1] Price divided by consumer price index.

0.6 billion to nearly 2.7 billion pounds. The average percentage variation of annual quantity from trend values declined from ± 4 to 6 percent in the period up to the late 1960's to ± 2 to 3 percent in the period since that time. Average variations in farm prices for these periods declined from ± 9.5 percent to ± 6 percent, and retail prices from about ± 6.5 percent to ± 4.5 percent. However, during recent years, both farm and retail prices have been more variable than they were a decade earlier. This may reflect the growing effects of red meat supply/price changes, as well as the market price impacts of a growing variety of turkey product forms.

Production Responses

Poultry and egg producers have a number of ways to increase or decrease output in the short run. Usually, the supply of breeders, chicks, or poults is adequate to permit a modest increase. Broiler and turkey producers can adjust by changing the number started per square foot of housing space, adjusting the number of days in the growout period, or varying the number of batches raised per year. Ultimately, increases can be limited by the useable housing capacity available or supply of breeders, chicks, or poults. Egg producers can practice lighter or heavier culling, sell spent hen flocks earlier or later, practice forced molting, or vary space per bird. But housing capacity and breeder flock size or chick or pullet availability ultimately can limit increases.

Producers frequently make adjustments within a year in response to prices and costs, or expectations of future conditions. Batches of broilers can be produced about every 8 weeks, with an additional 1 to 3 weeks often allowed for cleanup between batches. Two or more flocks of turkeys may be produced per year. Pullets can be grown in 5 to 6 months from chicks or eggs set. And culling and forced molting practices often are varied.

Several studies have illustrated within-year variations in production response and the reasons for these. O'Mara (*21*) demonstrated the significance of a capital accumulation variable (wholesale prices less cost of production) in the previous 5 months on a current month's production of broilers. On eggs, Schrader and Engle (*34*) used production of egg-type chicks as an indicator of producers' plans to increase or decrease egg production, with hatch being affected by egg and feed prices in the preceding 3 months.

In peak periods, such as in 1978 and 1979, there are indications that housing and/or processing capacity for broilers might be getting tight. Usually, however, there are some idle facilities that could be drawn into production if the need is prolonged. During the 1960's and 1970's, for example, there may have been 10 to 20 percent more laying hen capacity than was used (*31*). But much of this may have been in smaller units or those technologically obsolete and, if used, might result in higher cost operations. These considerations also probably exist for broilers and turkeys. Thus, useable excess capacity may be small, and there are some operating units which are marginal at any point in time, compared with prevailing sizes and technology. Current needs to conserve energy could make additional units marginal.

Longer run production response is increasingly concerned with covering fixed costs and the alternatives for using operator and family inputs. Decisions on whether to renovate existing poultry housing, install new equipment, build new capacity, or exit from production are conditioned by past earning capacity and financial resources. At such a point, other considerations—such as the owner's age, inheritance matters, and future land use and zoning patterns—also are pertinent.

Year-to-year production response is not as clearly pertinent for the poultry and egg industries as for many other crop and livestock enterprises. Certain fixed cost obligations must, of course, be met and do enter into plans—if not yearly, then certainly over a several-year period. These are relatively more important for contract growers, since fixed costs can amount to half or more of what contract growers receive. But feed costs account for two-thirds to three-fourths of total production costs and are a major consideration, both for integrators and independent producers. And many within-year adjustments may well detract from year-to-year patterns. Hence, relationships between average prices in a current year and quantities produced in the following year are highly imperfect. While annual net return-quantity relationships are somewhat better, they are, likewise, not totally consistent.

For broilers and turkeys, a long-time upward trend in per capita consumption also has occurred, and this often has obscured the effects of current-year net returns on the next year's output. Moreover, aggregate adjustments in the level of output may show a lagged response. If the net returns experience in recent years has not been particularly good, a "good" year may not bring forth a typical increase in the following year. If the net returns experience in recent years has been good, a "poor" year may not cause much decrease in the following year. Over a long period of time, each egg price cycle was believed to last 3 to 4 years. In terms of net returns, full response delays often can be noted for eggs and sometimes for broilers and turkeys.

Over periods of several years, egg production has been the least responsive of the three commodities to relative changes in net returns. Since the late 1940's, a ± 6 to 7 percent average ratio of prices to costs has been necessary to change quantity by ± 1 percent in the following year. For broilers, a ± 1 percent in earlier years to about a ± 2.5 percent in recent years in the ratio of prices to costs has been necessary to change quantity by ± 1 percent in the following year. For turkeys, price-cost ratios have increased from ± 0.6 percent to over ± 1.8 percent for a ± 1 percent change in output in the following year. Thus, as the broiler and turkey industries have expanded and changed, output has become less responsive to changes in the ratio of prices to production costs (table 8).

Inflation and deflation exert some common effects on prices and costs, though not necessarily at the same rates. But it is conceivable that prices and costs can move in different directions. Income effects and competing commodity prices often distort poultry and egg prices—and, unless producers anticipate that price shifts are semi-permanent, they may discount them. Feed prices can move opposite to other input costs or price effects. Recognition is general throughout the egg industry that demand is highly inelastic, or, inversely, small quantity changes produce large price changes. So the response of egg producers may be tempered by this characteristic. Broiler and turkey price changes may be more relevant to decisionmaking, since demand is more elastic.

It is alleged commonly that integrated firms pay much more attention to fixed cost, scale, and capacity considerations. Thus, they may tend to hold production levels somewhat even in the face of minimum-to-negative net returns. Additionally, a one-profit concept

Table 8—Prices, costs, and average price/quantity change ratios, United States

Period and commodity	Ratio of price to costs, farm level	Average production cost	Period	Average percent price/cost ratio equal to 1% change in output in following year
	Ratio	*¢/doz.*		*Ratio*
Eggs				
1947-57	102.36	36.3	1948-58	7.3
1958-68	101.53	28.4	1959-69	6.2
1969-78	106.17	36.6	1970-79	6.8
Broilers		*¢/lb.*		
1947-57	110.70	24.2	1948-58	1.0
1958-68	100.68	15.1	1959-69	2.2
1969-78	107.78	18.6	1970-79	2.6
Turkeys				
1947-57	105.30	31.5	1948-58	0.6
1958-68	102.92	21.4	1959-69	0.6
1969-78	111.03	27.0	1970-79	1.8

for an integrated firm, plus an effective market price beyond the farm level, affords the integrated firm opportunities to realize income on functions other than production. Thus, price-cost relationships at the production level may be only one factor to be considered in production decisions (*3*). As firms become large, they may become increasingly concerned with holding or expanding their market shares and practice sales maximization rather than profit maximization, thus further obscuring precise and timely production response. Many firms in the poultry and egg industries now fit in this category.

Typical Production Units

The units described in this section may correspond roughly to some existing unit, but the units were developed from published studies or typical farm budgets. For comparative purposes, a "before" and "after" sequence is employed to illustrate the kinds of changes that may have occurred in size, functions, investment, and resource requirements.

Several illustrations are included for each commodity. For market eggs, broilers, and turkeys, average commercial unit sizes have increased substantially during the last few decades. Labor efficiency increases due to size and mechanization have increased the number of birds one man can handle, and many units have grown well beyond one-man equivalents. Growth in unit sizes has tended to decrease average investment required per bird—until recently, when construction and equipment costs rose sharply. Egg production units increasingly have been converted from floor to cage operations, and cage production now predominates. More closed and environmentally controlled housing has increased building costs and increased electricity needs. But brooder heat costs are reduced, feed efficiency often is improved, and labor efficiency increased. More batches of broilers and turkeys are being raised per year in a given house capacity, and space per bird has been reduced. Confinement and semiconfinement systems are replacing range-rearing of turkeys, although year-around turkey production increases fuel needs in colder months.

Market Eggs

Some of the changes which have occurred in pricing and farm packing may be as significant as changes in size of production units. An article oriented primarily to pricing system aspects (*8*) contains descriptions of two typical (if hypothetical) farms and changes over time.

In the first instance, the writer states: "For example, maybe in the mid-1960's, you were an independent producer in Georgia selling to an independent receiver or cooperative association on a grade yield basis with cases exchanged or returned. You were being paid 1-3 cents under the New York fancy heavyweight mixed color quotes. The eggs from your 6,500 hens were being picked up at the farm by the buyer, but he wouldn't accept cracks and checks, and only recently you were also required to clean and size your eggs. You were getting 23.5 cents per dozen for large eggs in June, 1967, the lowest for several years.

"By 1977, you've built your capacity to 25,000 layers and you're a contract producer with the birds and feed furnished by the contractor. Your return is about a nickel a dozen Nest Run eggs produced. The contractor runs a packing plant and sells 70% of his eggs cartoned to nearby retailers or ships them North. He's also involved in egg breaking, selling to other plants, and ECI trading."

Three Georgia reports (*30, 13, 15*) furnish some elaboration. A 1960 survey of 40 commercial egg producers showed an average of 5,520 layers per farm. Investment per layer was $3.75, and 1.32 hours of labor were required per layer. By 1969, commercial layer flocks in Georgia averaged 17,187 layers. Most flocks were still in floor housing, but newer units built were all of the cage type, requiring less investment per bird. Investment ranged from $1.51 per bird for open housing to over $2 for cage units with mechanical feeding and more structure or floor houses. Contract production had become very important. Hens per man averaged close to 10,000 or nearly 19,000 with mechanical feeding and egg belts. Some mid-1970's budgets were standardized at 30,000 layers per unit, labor requirements (without cleaning) ranged from 3,650 to 3,962 man-hours per year, and investment costs ranged from $2.17 per hen for manual operation, open-cage houses to $3.80 for mechanized controlled-environment houses.

In the second example (*8*), the author notes: "Ten years ago you were an egg producer with 20,000 hens located two hours out of New York City. You were selling ungraded eggs to a packer-wholesaler. Your net on large eggs ran almost 4 cents under the Urner-Barry quotation for fancy large whites, cases exchanged. The quotation in June, 1967, was about 28 cents.

"Today you are a producer-packer, using the eggs from your 80,000 hens plus some from other nearby farms you get on a Nest Run basis. You're cartoning about 75% of your eggs for retail stores and distributors and averaging a bit more than the Urner-Barry cartoned quotes. Most of the rest of your eggs are sold loose graded to the institutional trade and other cartoning plants.

"You also sell a few loads to breakers or on ECI. Cartoned large eggs (in mid-June, 1977) were bringing about 13 cents over the No. 1 Nest Run price of EMEC of 42 cents, delivered nearby chain warehouses."

Northern housing for commercial flocks long has been of the closed or semienvironmental type, with more recent changes toward more fully environmental housing and cage operations having rapidly replaced older floor units. Some 1975 budgets developed in New Jersey (*17*) indicated investment costs for buildings, equipment, and egg room at $5.73 per bird for a 30,000 unit and $4.92 for a 60,000 unit, both fully automated. Labor requirements were 1.2- and 2.2-man equivalents. A Connecticut study, based on 1977 costs, examined the economies of scale for floor and cage units ranging from 9,728 to 72,000 birds (*36*). Investment costs varied widely with size and alternative cage and manure handling systems (from $4.78 to $10.53 per bird), but the cost per bird for the largest units was two-thirds to three-fourths that for the smallest units. In fact, in every cost category, per dozen costs declined with size, accumulating in total to 3 to 5 cents per dozen over the size ranges studied.

A 1978 summary of cost records of specialized egg ranches in San Diego County, Calif., reported an average of 78,530 laying hens per ranch, and a range of 20,000 to 200,000 (*1*). During the nearly 30 years such records have been analyzed, average flock size has increased from 2,000 in 1949-50 to 8,000 in 1959-60, 46,500 in 1969-70, and about 80,000 at present. Another 1978 analysis suggests 100,000 layers as the most representative and smallest economically feasible unit for most of California at present costs (*6*). Such an open-housing unit—on 10 acres of land, with egg-holding operations, and buying all of its 65,000 replacement pullets annually—would involve a nonbird investment of about $400,000 and require about 4 man-years of hired labor plus a manager.

There is a sizeable number of one-site operations with 500,000 to several million layers. Examples exist in all major regions. Large one-site units, with associated egg-packing plants, have no assembly costs. Against this advantage must be balanced the management problems with birds of various ages and the possible disease risks with very large concentrations of birds.

As the most recent entrant into widespread commercial-sized unit production, the Midwest exhibits a diversity of typical sizes. Some 1978 Purdue budgets (*24*) included: a 5,000- to 10,000-bird farm flock, a 15,000- to 20,000-bird semiautomated contract or independent flock, and a 30,000 bird fully automated, independent flock. Investment costs for buildings and equipment per 1,000 birds were specified as $5,000, $5,500, and $6,190, respectively. Labor requirements per 1,000 birds were estimated at 240 hours for the farm flock, 90 hours for the semiautomated unit, and 65 hours for the automated unit. Other Purdue budgets (*33*) for fully automated layer units of 40,320 and 79,448 birds showed building and equipment costs of $6.42 and $6.19 per bird, respectively. A summary of cost studies for the period during the late 1950's to the early 1960's (*19*) showed average Midwest commercial flock sizes ranging from a few hundred to about 10,000.

Broilers

Several recent budgets (*11, 16, 35*) suggest that today's typical broiler farm has a capacity of 30,000 or more birds and raises five batches per year. Investment in buildings and equipment at current costs would be nearly $60,000 for a pole house in the South with side curtains, dirt floor, individual brooders, manual feeding system, and some ceiling insulation. Further north, or with fully environmentally controlled housing and more automation, investment costs might be more than 50 percent higher. Many farms in all regions are moving toward environmentally controlled housing systems. Additionally, today's typical broiler farm is likely to be considering or using partial house brooding to save energy, and, in some areas, central heating may supplant individual brooders. A 30,000-bird broiler unit would require nearly 0.9 man-year of labor. This probably would be all family labor. Many broiler farms also may have associated crop or cattle enterprises, and some family members may hold off-farm jobs. A USDA report includes a full profile of a typical Mississippi broiler farm (*39*), including other sources of income.

Two surveys in Georgia illustrate increasing flock sizes during the last two decades (*20*). Average flock size was 10,375 birds in 1961-62 and 17,443 birds in early 1967. In the latter instance, this required about 0.7 man-year of family (and hired) labor for 4.5 lots per year.

Two California reports (*22, 23*) illustrate the rapidly rising investment costs in broiler production. Investment costs per 1,000 birds were estimated at $1.05 in 1970 and $1.77 in 1976. This included 5 acres of land for a 50,000-bird unit or 15 acres for a 200,000-bird unit. A 1978 budget for California (*6*) was based on a capacity of 100,000 broilers per batch, with 4.5 batches per year (compared with an earlier minimum unit of 50,000). Investment in an automated 100,000-bird unit was estimated at $259,000, including 15 acres of land. About 2 man-years of labor would be required.

A 1972-74 cost study in the Northeast (*5*) reflected an average flock size of 44,076 birds. Nearly five batches of 3.94-pound broilers were raised in 58.4 days per batch by 120 growers from Maine to Delmarva. Man-hours per 1,000 pounds of saleable chicken averaged

4.6. Pennsylvania and Maine growers had higher investment costs than those in Delmarva, due to more environmentally controlled housing and equipment. Flocks in the Northeast average larger than in the South.

A 1975 Louisiana study (*29*) projected units of 50,000-bird capacity with five or more batches per year as a supply system for an integrated complex. This indicates the direction in which the optimum size also is moving in the South.

Turkeys

What may be regarded as the typical size of a flock of turkeys probably varies more within and between regions than is true for broilers. Several reasons may account for this: units which sell fresh-killed turkeys locally, a relatively flat economies of scale curve for turkey production, and more association of turkey production with crop production on farms in such regions.

A 1978 California budget (*6*) established unit capacity at 30,000 birds per batch, with 2¾ to 3 batches raised per year. The system involves a brooder house for 8 weeks and range houses (semiconfinement or dry-lot) for growing. Investment including 40 acres of land ($80,000) would be about $260,000. About 1.8 man-years of labor would be required. Cost data for 1975-76 showed an average of 25,500 birds per ranch (*28*).

Purdue budgets for 1978 (*24*) showed two alternatives: a 5,000-bird-per-batch capacity range-rearing operation with 2 batches per year, and a confinement unit with a capacity of 10,000 birds at a time and 2.5 batches per year. Investment cost in buildings and equipment only for the range operation would total $8,750 and for the confinement unit $49,000. Labor requirements would be 110 hours per 1,000 birds for the range operation and 60 hours per 1,000 birds for the confinement operation. Power and fuel requirements for the confinement unit per 1,000 birds would be nearly double those for the range unit, but feed conversion per pound would be 10 percent lower.

A Georgia report (*14*) based on 1972 data estimated investment costs at nearly $23,000 for a 10,000-bird, 3-batch-per-year, brooder-range operation. This included 45 acres of rangeland. It also was estimated that one man could care for 50,000 to 60,000 turkeys (2,625 man-hours per year) provided some custom services could be hired for debeaking, vaccinating, moving to range, and loading-out.

The average capacity of commercial turkey farms surveyed in 1973-75 (*38*) exceeded 20,000, but ranged from under 10,000 to well over 100,000. Two economies-of-scale studies conducted during the late 1960's (*9, 12*) noted reductions in investment cost and labor requirements per bird with increasing size. While total costs per pound of turkey produced continued to decline through the 5,000- to 100,000-bird capacity range, about three-fourths of the ± 1-cent savings were realized between 5,000 and 50,000 capacities.

Changes in commercial turkey units in the last 25 years have been substantial. In 1954, a Utah study (*2*) reported costs of 85 commercial growers, averaging 4,896 birds per farm, with a range of 1,172 to 18,360. Investment in buildings and equipment averaged $4,236. One-third hour of labor was required for each turkey raised.

Producer Equity

An equity problem has been perceived in the contract broiler grower segment for many years. More recently, this has extended to market eggs. Recent accounts, for example, discussed the plight of contract broiler growers whose basic payment rates had stayed at the same level, pound equivalent, and egg producers whose payment rate per dozen for Grade A large eggs had remained constant for several years. In both accounts, the increased costs of growers during this period also were cited. Situations like these may represent isolated cases where growers had no options, older facilities, or were on the fringe of supply areas. Or these problems may be more general. Yet, reported contract payment rates vary widely within and between States. However, examples also have been noted where contract growers were large, highly efficient, and expanding. Moreover, contractors generally have been able to secure enough growing capacity under offered terms, since broiler production has been increased about 35 percent over the last 5 years.

Contract payment rates are not reported publicly, so it is difficult to judge the full extent of equity problems. Company-to-company variations also may be related to competitive position and practices followed. Companies with expanding market shares, differentiated and branded product lines, or preferred outlets potentially may be able to maintain contract grower returns at more acceptable levels. Active competition for growers in an area also might produce quite a different response than in an area where monopsony prevails.

Bargaining

Contract grower bargaining in an organized sense has not been particularly active, except in a few instances. The Farm Bureau tried bargaining on broilers during 1966-72. Contract terms now are spelled out more clearly, settlement sheets are more accurate and detailed, and there is monitoring by USDA's Packers and Stockyards program. General bargaining legislation which would compel bargaining association recognition never has been adopted.

New innovations whereby grower cooperatives would assume control over the supply function have been proposed, as has the formation of new integrated cooperatives or grower takeover of the industry. These proposals involve financial, organizational, and operational problems of a magnitude that may be beyond producer resources and capabilities.

Producer unrest is not confined entirely to the contract grower segment, but perhaps is most noticeable there because of the small share of the consumer's dollar their returns represent. But, also, their returns typically are oriented toward production performance standards bearing little shortrun connection to market prices. Other producers also have expressed concern about the farmer's share of the consumer's dollar in a period when inflation and rising product prices (due to improved demand) suggest higher profits for marketing efforts. Additionally, dissatisfactions exist in the poultry and egg industries with wholesale-process level base price quotations generated by existing pricing systems. If the base is too low, this is reflected in residual returns to producers. Hence, producer activism in various forms is growing, and has possible implications for future production structure and the institutions external to it.

Conflict remains between processors and large retailer organizations in both the broiler and egg subsectors. There may still be a disparity of market power between large retailers and sellers, as was noted in 1966 by the National Commission on Food Marketing (*32*). Countering this disparity is not easy. Yet, the ability of sellers and integrators to secure fair prices ultimately reflects on what independent producers and contract growers receive.

FUTURE DEVELOPMENTS

Continued integration of production with input-supplying and marketing, further technological and cost-reducing gains, minor shifts in the location of production, some reductions in farm numbers, and significant gains in unit sizes all are likely in the future.

Integration

There is little economic basis for assuming a dissolution of the operating linkages between input-supplying, production, and marketing. Integrated systems are cost-efficient, they can produce favorable prices for consumers, and guarantee good quality and timely supplies. Most consumers would prefer this choice to products with special attributes at substantially higher prices. But there also needs to be more understanding among consumer groups, legislators and regulators, environmentalists, and urban areas of what production and marketing involve and the costs and benefits from various systems.

Coordinating the various functions in a subsector does not rule out alternative approaches or recalculation of the shares of final price going to various participants. The producer's share must equate over time to providing a level of return adequate to reinvest in new methods and facilities. There are several ways by which producers could directly or indirectly have a more active role in the system: (1) more direct control of the system, with attendant capital, technical, managerial, and marketing problems; (2) bargaining legislation; (3) more cooperatives like some successful modern prototypes; (4) more flexible production contract returns; (5) better information and pricing systems; and (6) documented cost data for use in evaluating public programs and industry performance.

Technological Progress

Factors which produced gains in productivity into the 1970's still are operative, but relative gains in the future may not be as large. These factors include feed conversion, egg production per hen, time required for broilers and turkeys to reach market weight, mechanization and labor efficiency, and mortality. But positive, if smaller, percentage gains still are likely, and real production costs should decline further. Similar gains in marketing productivity could enhance real price declines at the consumer level.

Commercial and other research indicates that average feed conversion by broilers can decline to less than 2 pounds of feed per live pound, by turkeys to less than 3 pounds, and by layers to under 4 pounds of feed per dozen eggs. There has been increasing interest in minimizing feed cost per unit of output rather than achieving the best feed conversion. This suggests new ingredients, including wastes. Egg production increased more than 8 percent per hen during the 1970's, and similar gains from breeding, feeding, and management could be realized in the 1980's. Economies of scale in production can produce further gains in labor efficiency. And energy efficiency can be improved through larger unit sizes and conservation programs. Such savings may be offset partially by rising overhead costs.

Interregional and Locational Shifts

Several factors may cause changes in the relative shares of total output produced in various regions: input-cost levels, alternative economic opportunities, local consumer preferences and branding, and energy conservation. Not all of these operate in the same direction. On balance, some regions may become somewhat less surplus and others may remain deficit but produce a slightly larger share of their poultry and egg needs.

Output in the Pacific region, where feed ingredient costs are high, has been dropping from surplus to self-sufficiency levels of eggs and turkeys. In addition, local growers have been increasing broiler production as a share of regional needs, based on preferences and brands. Egg production has increased in the Mountain region, where there is less competition for resources. These trends will continue. Some further increases in egg, broiler, and turkey production in relation to local needs are likely in the Northeast. The Midwest will continue surplus production of turkeys and also expand output of eggs and broilers. The South will continue surplus production of all three commodities, but by a reduced degree. Local production and brands, plus specialty items, tend to promote a faster rate of growth for nearby products. But there are no major shifts in view. Transportation energy needs will not promote self-sufficiency; production will not all gravitate to feed supplies; lower brooding and space heating needs will not shift broiler and turkey production entirely to warmer regions.

Specific locations of production units (in dispersed systems), in relation to processing and packing plants, will be affected importantly by continued attention to the supply area radius of the plants. Energy conservation will boost this attention, and supply areas will be reduced further. Twenty years ago, broiler firms tried to achieve a 40- to 50-mile supply area radius; now 25 is more common. Disadvantaged growers may be among those who exit from production first.

Numbers, Sizes, and Types of Farms

By the mid- to late 1980's, per capita consumption of broilers could be as much as a fifth higher than in 1978, with a gain of 10 to 15 percent in per capita turkey consumption, and perhaps a gain of more than 4 percent in per capita egg consumption. Along with the expected growth in population, this could require 30 to 40 percent more broilers, 20 to 30 percent more turkeys, and 10 to 20 percent more eggs.

Average flock sizes by the mid- to late 1980's, compared with data in the 1974 Agricultural Census, may be at least 50 percent larger for broilers, 40 percent larger for turkeys, and more than 75 percent larger for laying flocks. This would mean the number of farms producing broilers and other meat chickens would be as large or even up to 10 percent larger than in 1974. Numbers of farms producing turkeys would be about the same or slightly less than in 1974. The number of farms producing eggs, however, would be only three-fifths to two-thirds the 1974 number.

Numbers of small broiler farms and those producing special meat chickens would be fewer than in 1974. The number of large broiler farms might increase slightly. Average sizes would increase generally. Size increases for both small and large turkey farms would be substantial, but there would be little change in the number of farms. The number of farms with small to medium-sized egg laying flocks would decline 30 to 50 percent, with flock size about doubling, while large flocks likely would decline about 15 percent in number, with average size increasing a third or more.

Projections of the numbers and sizes of commercial poultry and egg farms are not independent of input-supplying and marketing considerations. Coordination of live poultry and egg assembly and processing and packing operations with production units can be viewed in terms of minimizing the number of stops, hauling full loads, or obtaining a full day's run at a plant—or a major fraction thereof—from a given farm. For example, a 100,000-bird broiler unit is about equivalent to 14 to 20 trailer loads, and would furnish enough broilers to run a very large processing plant 8 hours (12,500 per hour). In the same way, 20,000 turkeys equal 8 to 14 loads or 8 hours of work for a 2,500 bird-per-hour plant. With twice-per-week pickup, it would take more than 100,000 hens to furnish enough eggs to run a 110-case-per-hour plant most of an 8-hour day.

Similar matches concerning full-load hauling of bulk feed to farms can be made more readily with egg flocks than broilers and turkeys, whose feed requirements vary much with age of bird. Nevertheless, these kinds of considerations are important to integrator planning, and may receive more attention than ever because of energy considerations. Hauling distance is, of course, also important.

One-site production complexes large enough to operate a plant processing 10,000 to 12,500 broilers 40 hours per week would require a capacity of 3.5 million to 4.5 million birds in a 9-week production cycle. Similarly, to operate a plant processing 2,500 turkeys an hour 40 hours per week for 20 weeks would require a 2-million bird production complex. Many plants also operate more than one shift. Given present technology, one-site broiler and turkey complexes may be rare and unlikely. Production units are likely to remain much smaller and dispersed, with hauling of live birds continued.

On the other hand, 350,000 to 500,000 layers at one location can supply eggs for a 110-case-per-hour packing plant operating 40 to 60 hours per week. However, there are many producer-packer complexes of smaller and much larger size already in existence, and more are likely in the future. Future egg production structure is expected, therefore, to consist of producer-packer complexes along with groups of dispersed units having eggs hauled to a central packing plant.

Many dispersed broiler production units in the future are likely to have one-batch capacities of 60,000 to 200,000 birds and grow 5½ to 6 batches per year. Many turkey production units are likely to have capacities of 20,000 to 200,000 birds and raise three batches per year. Many egg production units are likely to have layer capacities in the 60,000- to 300,000-bird range. Trends for all species are toward growth in farm size by adding more standard-sized houses per farm.

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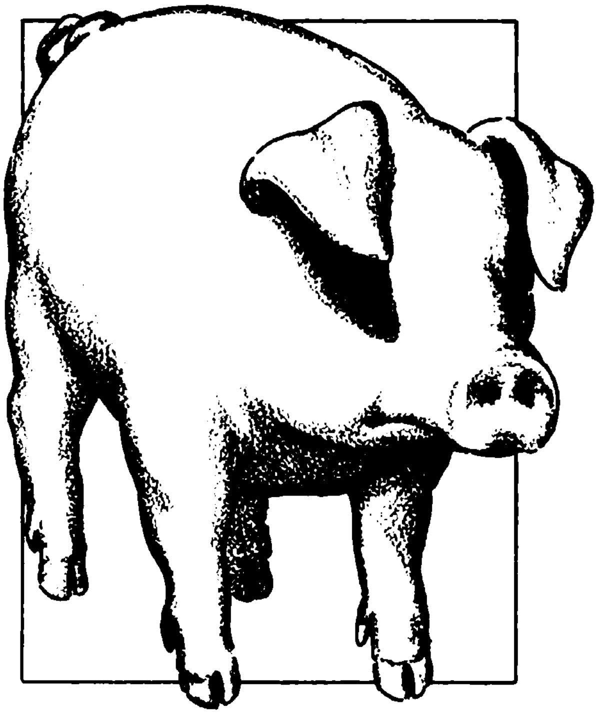

Pork

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SUMMARY

Hog production in the United States continues to be concentrated in the north-central region, and corn still is the chief feed. Crop-livestock farmers using a diversity of production systems account for most of total output. Otherwise, the present hog industry bears little resemblance to that of 30 years ago. Change has been especially rapid in the last 10 to 15 years.

Total annual production of pork has been 12 to 15 billion pounds (carcass weight) since 1950, when pork provided half the national supply of red meat. Now it provides only a third. Both yield and use of lard have declined substantially.

Hog production remains farm-based. Investment opportunities and the importance of corn for feed have kept it that way, but the tie to land is no longer essential. Advances in technology have permitted land to be cropped more intensively and hogs to be produced successfully without pasture. Hogs now are produced year-round in low-labor, capital-intensive systems conducive to large-scale production and the industrialization of output that already has occurred in some other farm enterprises.

The number and size of hog enterprises has shifted radically. There are more than 80 percent fewer producers marketing hogs now than in 1950, and size of enterprise has increased accordingly. Producers selling 1,000 or more hogs annually now account for about 40 percent of total production, compared with only 7 percent in 1964.

Units producing 5,000 head or more have at least a sixth of the market and have been growing rapidly. The future is uncertain at best for the many thousands of crop-livestock farmers for whom hog enterprises of a few hundred head have provided a major portion of gross farm income in years past.

A complex and interrelated set of forces have moved hog production into its present organization and continue to press for change. Some of the major factors are:

- *Technological developments in nutrition and control of diseases and parasites of hogs that have virtually freed hog production from the necessity of being associated with a sizeable land base.*
- *Technological developments in housing and materials-handling equipment that permit continuous year-round production and high production per unit of labor.*
- *Changes in crop production technologies that permit more intensive land use and specialization in crop production, with less need for the economic flexibility and extra income formerly contributed by hog enterprises.*
- *Availability of credit and willingness of producers to use it in the establishment of larger, capital-intensive hog production systems.*
- *Public policies fostering adoption of capital-intensive technologies and increasing size of businesses through research, preferential income taxes, pollution control regulations, and product price protection for grain producers.*
- *Economies of size of enterprise, especially in the use of labor-saving equipment.*
- *Continued inflation with the incentive to make investments as early and rapidly as possible.*

The forces of change that have brought the U.S. hog industry to its present status appear likely to prevail for the remainder of the 20th century. Barring the development of strong countervailing forces, the hog industry should continue present trends with only the rate of change subject to question. Future years should reveal:

- *Little change in consumer preference for pork, so total production will be constrained largely by growth in population.*
- *Fewer, larger, and more specialized hog-producing firms, with large family farm enterprises dominating the industry and supersized operations becoming of increasing importance.*
- *Some further division between pig production and pig finishing, which now occur mostly on the same farm.*
- *Near-complete use of confinement housing and specialized equipment for all phases of hog production.*

Higher prices for energy, and possibly uncertain supplies of it, will result in a reassessment of the total industry structure from regional *location to types of production facilities. Alternatives for management of wastes from hog production will continue to affect location, size of enterprise, and types of production facilities. Possible constraints imposed on the use of agents for control of diseases may affect degree of concentration and types of production facilities. The same holds for the ability to get and keep competent management and labor.*

Crop-livestock farmers have been able to make adjustments sufficient to exploit most new technologies as they become available. The extent to which this continues to be possible will determine whether hog production remains a part of diversified crop-livestock farming or moves largely into other hands.

INTRODUCTION

Hog production in the United States encompasses a wide range of sizes and systems of production units, old and new facilities, different types of hogs produced, various kinds and mixtures of feeds, single- and multiple-enterprise firms, and diverse geographic locations. Figure 1 shows the complete system of pork production.

Resources used in production still are largely farm-based, but there is some shifting away from the typical crop-livestock farm on which most hogs traditionally have been produced in small enterprises handled by the operator and his family to large-scale, specialized facilities.

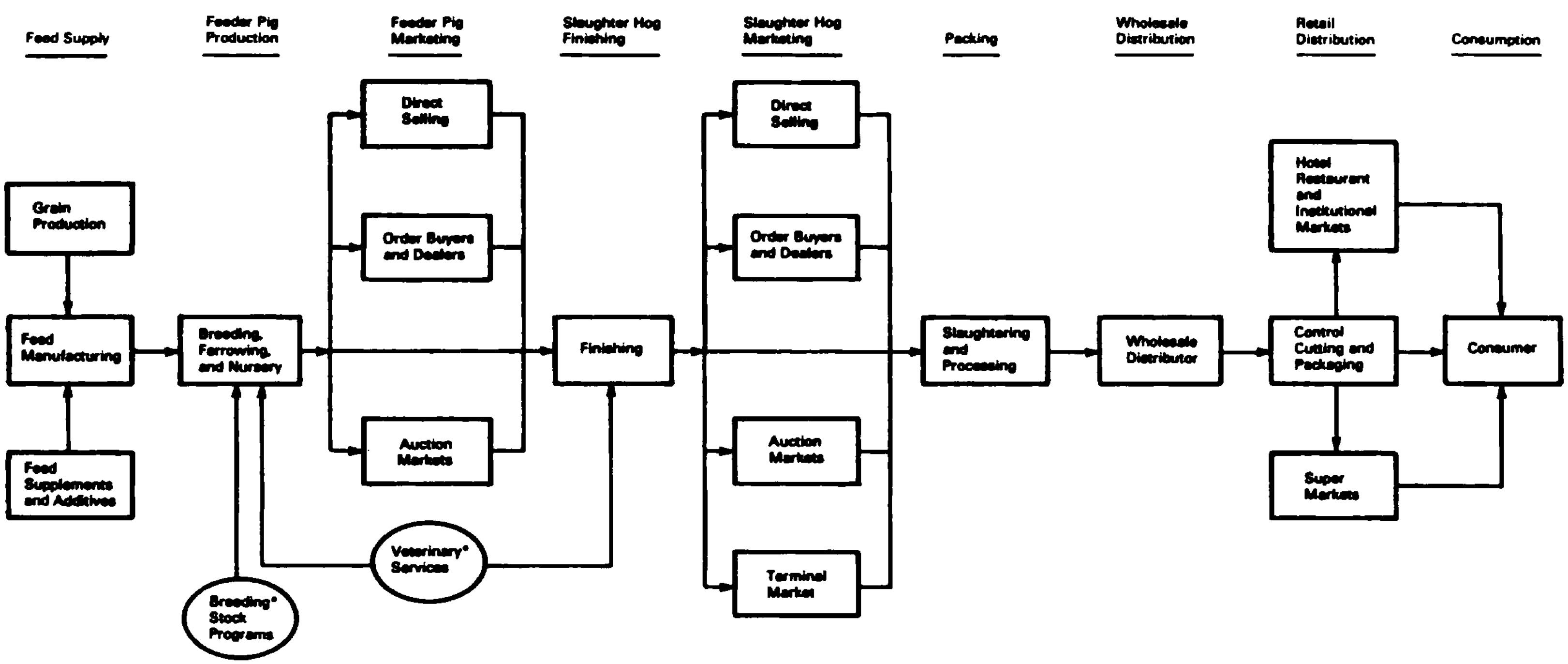
Recent developments in technology, the economics of production, public policies, tax regulations, availability and use of credit, and similar factors have had substantial and increasing impacts on the basic structure of U.S. agriculture. This has been especially true on farms that produce hogs—as well as on farms generally in major hog-producing regions, and the input and supply industries that serve hog producers, and the marketing, processing, and distribution firms that make pork available to consumers. A major result has been increasing specialization in who provides, controls, and benefits from the factors of production—the land, labor, capital, and management that go into hog production.

Change anywhere in the production system can affect all other parts of the system, so no part can be ignored—even though one part is examined in more detail than the others.

Objectives

The major objectives of this analysis are to: (1) trace the development of factor specialization in hog production over the last 30 years; (2) record the shifts that have occurred in resource

FIGURE 1
ELEMENTS OF PORK PRODUCTION



*Ancillary Services

organization; and (3) attempt to explain why these shifts have occurred and what the results have been in terms of efficiency of production, supply response, and the distribution of income and wealth.

Consequently, farm-based aspects of hog production are emphasized in this analysis—breeding, farrowing, raising of pigs, and finishing of hogs for the slaughter market. Based on past changes, the present structure of the industry, and forces pressing for further change, an estimate is made of the probable structure of U.S. hog production some 20 years in the future and the expected results of the change.

Sources of Data

Previously published data and analysis are the basis of the historical description of the U.S. hog industry and the way it operates. Projections into the future are based partly on the results of other studies and on the views of the author. The short time frame for this analysis did not permit the collection of primary data or additional analytical work.

HOG PRODUCTION 1950-78

The following discussion highlights some of the major characteristics of the hog industry during the last 28 years and provides a setting for examining the structural characteristics of the industry in 1979.

Resource Use in Hog Production

Changes in land, labor, capital, and management that have been used in hog production over the years cannot be measured precisely. Data are available on some of the major inputs, however, and there is enough evidence to indicate the direction and general magnitude of change on an overall basis. The mix of the major classes of resources used in hog production has changed more dramatically since 1965 than in the previous 50 years.

Land

Hog production remains farm-based but is not extensively land-based. By 1950, the shift from pasture to drylot production of hogs had already begun, but a high proportion of hogs were still managed on pasture. The equivalent of 4 to 6 million acres of productive cropland would have been used as hog pasture if the entire spring pig crop, which averaged about 60 million head at that time, had been carried on pasture at the usual stocking rate of 10 to 15 head per acre. Not all were produced on pasture, but extensive use was made of nontillable pastures and woodlands, so the actual acreage devoted to hog production undoubtedly was much greater.

Pastures still used in hog production no longer have the once essential dual role of supplementing the grain ration and providing a disease- and parasite-free environment. Only about half the farmers with feeder pig production and farrow-to-finish enterprises now use pasture of any kind. Those using pastures commonly do so only for the breeding herd. Such pastures usually are more of a holding area and exercise lot than a source of feed. No more than 10 percent of all hog producers maintain complete field production systems, and they account for a far smaller share of total production. Producers specializing in the purchase and finishing of feeder pigs operate almost exclusively without pasture (*12*).[1]

Several forces combined to shift hog production from extensive to intensive land use. Perhaps the most important single factor is that the value of land in the production of crops moved far beyond the economic contribution that land could make in the production of forages for hogs. In addition, technological developments in nutrition and disease and parasite control removed the need for clean, rotated pastures. Success was achieved in environmentally controlled housing. Mechanization, even automation, of materials handling became a reality, and this could be achieved only in centralized production units—not in extensive pasture production systems. As a result, increased productivity per unit of labor more than justified additional investments in specialized housing, as fencing and the labor associated with its maintenance became progressively more costly.

Now and in the future, the requirement for land in hog production is limited to that needed as a site for buildings and lots. New knowledge is permitting even the breeding herd to be moved from pasture into rather confined facilities.

Nevertheless, an association between hog production and cropland remains and probably will continue in the foreseeable future. Corn is the major component of hog rations, and there are economic advantages to the raising and feeding of corn on the same farm, especially in areas with high costs for moving corn or other feed grains into the cash market. Hog producers, even though they may start with only enough land for the hog enterprise, tend to invest earnings in farmland and add feed grain production.

The problems of waste management also encourage at least some form of control over cropland. Technically, there are several uses

[1] Italicized numbers in parentheses refer to references listed at the end of this chapter.

that can be made of hog manure, but its value as a fertilizer for crop production still outweighs other current uses.

Labor

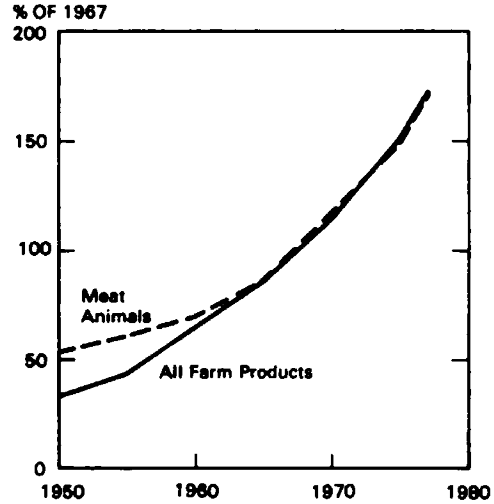
In 1950, meat animal production, of which hogs were a major part, took about 1.45 billion hours, or nearly 10 percent of the 15 billion hours of labor that went into the production of all farm products. Although total farm work declined rapidly after 1950, reaching 4.7 billion hours in 1977, the labor input into meat animal production actually increased during the early 1950's, because of an increase in animal production, without offsetting labor-saving innovations. Total labor for meat animal production did not decline appreciably until after 1960, but it then declined rapidly to only 0.65 billion hours by 1977—44 percent of the amount used in 1955 (*26*).

Changes in the use of farm labor reflect some changes in total output, but capital-labor substitution in the form of mechanization and other technologies that increase output per unit of labor are responsible for most of the reduction in use of labor. Meat animal production, especially hog production, lagged most other farm enterprises in the substitution of capital for labor. Even now, most hogs are produced in several hundred thousand relatively small enterprises that make limited use of specialized equipment. Nevertheless, the impact of recent production changes is apparent in meat animal production. Output per man-hour, which moved upward only gradually during the 1950's and 1960's, increased sharply during the 1970's as producers began to specialize, increase size of enterprise, and invest more heavily in labor-saving equipment (figure 2). Producers of hogs and fed cattle doubtless have made much greater increases in output per hour of labor than meat animal producers generally, because the mix includes cattle raising and sheep production, both of which remain extensive land-based operations benefiting much less from capital improvements.

The amount of labor presently used in hog production can only be estimated. Production of all meat animals required 654 million hours in 1977 (*28*). The estimated national average labor input (for all farms) was 1.77 hours per hundredweight of hogs produced in 1975 (*12*). On that basis, the 19.4 billion pounds of hogs produced in 1977 required about 343 million hours or about half the total for all meat animals.

Producers with annual sales of 2,500 or more hogs in 1975 used an average of only 0.72 hour per hundredweight produced (*12*). At that rate, total hog production in 1977 would have required 139 million hours; best recorded performances of 0.5 hour per hundredweight

FIGURE 2
INDEX OF U.S. PRODUCTION PER HOUR



would have required only 97 million hours. A much greater reduction can be expected in the amount of labor used in hog production as producers become fewer, larger, and invest more heavily in specialized facilities.

Capital

Financial resources are used in hog production for many purposes, ranging from cash outlays for inputs consumed in one production period to investments in durable facilities designed to last many years. An analysis of total costs of production provided in a later section treats the significance of capital in all of its many uses. There are three major aspects of capital investment of concern in this section. These are capital investments in: (1) durable facilities, which affect supply response and the flexibility of future choices; (2) breeding stock, inventory values of which change from year to year with market hog price levels, affecting producer net worth as well as production costs; and (3) feed, the major variable input in hog production.

Investments in facilities.—The number of farms selling hogs and pigs declined from 2.1 million in 1950 to 450,000 in 1974, and the number probably is well below 400,000 in 1979 (*29*). Though there is no record of the investment in facilities in earlier years, it is known that the typically small enterprises operated largely with general-purpose farm machinery and used a high proportion of relatively inexpensive portable housing units. The move toward fewer enterprises, increased size of enterprise, specialization, and confined rather than pasture systems of production was accompanied by a large increase in the capital invested in durable facilities.

Most hogs still are produced on multiple-enterprise, crop-livestock farms. Joint-enterprise use of some facilities occurs. Therefore, investments are best examined in three major categories: (1) buildings and equipment specific to hog production; (2) machinery useable in multiple livestock enterprises; and (3) tractors and trucks useable in all farm production activities. On this basis, hog production involved an estimated $2.1 billion undepreciated or "book" value of specific depreciable facilities in 1977, plus a large share of $0.7 billion in livestock machinery and the use of farm tractors and trucks in all enterprises with a remaining value of $2.4 billion. Replacement of all facilities at 1977 prices would have cost $7.3 billion for specific hog buildings and equipment, $1.9 billion for livestock machinery, and $6.9 billion for the tractors and trucks used for all enterprises on hog farms. A summary of the investment situation in 1977 appears below:

	Hog facility investments			
	Original acquisition cost	Estimated remaining value, 1977	1977 replacement cost	Comment
		Billion dollars		
Specific hog buildings and equipment	3.6	2.1	7.3	All chargeable to hogs
Livestock machinery	1.1	0.7	1.9	Shared with other livestock enterprises
Tractors and trucks	3.9	2.4	6.9	Used in all farm enterprises

Hog production will continue to be converted to larger and more specialized units in the future, but this will not necessarily result in a larger total investment for the industry. Small enterprises do not now employ capital-intensive systems; large ones do. Yet, replacement of facilities for small enterprises at 1977 prices would cost at least 50 percent more per unit of production than for large enterprises because of the seasonally interrupted production schedule and consequent underutilization of capacity of facilities associated with small enterprises. Estimates of the 1977 replacement cost of facilities per unit of production by size of enterprise in farrow-to-finish operations illustrate the cost relationships (*27*). These data also reveal one of the reasons why economic pressures have and will continue to force hog production into larger enterprises. The data follow:

Replacement cost of facilities, farrow-to-finish enterprises, U.S. average

Annual sales per farm (head)	Hog buildings and equipment	Livestock machinery
	Dollars per hundredweight of sales	
All sizes	48.94	11.96
40	64.34	24.41
140	67.43	30.65
300	43.70	16.80
650	39.33	7.11
1,000	58.10	3.58
5,000	40.12	1.17

Investments in facilities per unit of production generally decline as operations grow larger, but there are noticeable discontinuities as size of enterprise moves from small to large (*27*). The smallest enterprises do not include modern buildings and equipment. Unit investments are relatively high only because percent of capacity use is quite low. As producers enlarge their operations, newer technology is adopted. Investments per unit of production often increase because production occurs at less than capacity of the facilities, especially with respect to some fixed components that could serve much larger enterprises. Further expansion into the midsize range of enterprises reduces unit investments by allowing for more complete utilization of capacities. Finally, producers with the larger enterprises begin to install the most sophisticated technology. Unit investments undergo another discrete increase until still further expansion makes more complete use of the production potentials embodied in these newest of facilities. Producers with the largest enterprises tend to operate closest to the capacity of their facilities.

Unit investments in machinery are quite high in small enterprises, because such operations can use only a small fraction of the capacity of the machines in use. A small hog enterprise would have a heavy burden in the absence of other enterprises over which to spread these investments (*25*). Much of the machinery investment for the small- to medium-size hog enterprises often is chargeable to other livestock enterprises on the farm and, to some extent, even to cropping operations. Only with the largest hog enterprises are investments in machinery usually used solely for the hog enterprise.

Investments in breeding stock.—Breeding stock investments include the inventory values of boars, sows, and replacement gilts. Investments per hundredweight of production drop rapidly as the size of the enterprise increases, because systems producing only one litter from a sow each year are the smallest enterprises. The number of pigs produced per litter increases as enterprise size increases, except for the largest enterprise. Producers with the largest farrow-to-finish enterprises have slightly smaller litter averages and invest more heavily in quality boars than those with the next smaller size of enterprise.

Feed.—The major variable input in hog production is feed. The total value of all feedstuffs fed to hogs, which averaged $24.10 per hundredweight of hogs produced in farrow-to-finish enterprises in 1975, is about equally divided between feed grains that are produced on the same farm where they are fed and purchased ingredients.

Feed cost has been a declining part of the total cost of producing hogs. In 1950, the cost of feed typically was 65 to 70 percent of total cost. The proportion now stands near 50 percent in farrow-to-finish enterprises; somewhat more in finishing operations; and somewhat less in enterprises that produce only feeder pigs. This declining relative importance of feed as an input results to some extent from capital improvements that increase feed efficiency, but is primarily a result of the cost of nonfeed inputs, most of which are of nonfarm origin, rising much more rapidly than the cost of feed.

Hog production takes a substantial portion of the feed grains and other concentrate feeds fed to livestock and poultry, but it has been a declining share since 1950. At that time, hogs consumed 42 percent of the feed grains fed to livestock and poultry; 40 percent of all concentrates; and 18 percent of all feedstuffs with all ingredients, including forages, converted to a common energy base of corn equivalents. These shares have declined steadily, as noted on top of page 201 *(19, 30)*.

Small increases in feed efficiency occurred in hog production during this period, but the basic cause of the shift was relatively stable total hog production matched against steadily expanding fed cattle and poultry production. Study of demand for meats suggests relatively small future growth in hog and dairy production, with a much stronger potential for increased production of beef and poultry. The share of the total feed resource taken by hog production will continue to decline in the future.

Year	All feed grains fed	Total concentrates fed	Total feed units fed, including forages
	Percent of feedstuffs consumed by hogs		
		Percent	
1949-50	42.2	40.1	18.3
1954-55	40.4	39.0	16.7
1959-60	40.1	38.6	17.4
1964-65	34.3	32.2	15.4
1969-70	28.0	28.0	12.2
1974-75	26.0	25.9	9.2
1978-79	31.1	30.6	13.8

Feed conversion ratios have varied somewhat because of the market weight to which hogs were finished. When the price of hogs was favorable relative to the cost of feeds, farmers tended to feed hogs to heavier weights before sale. The reverse occurred when price-cost ratios were unfavorable. Feed efficiency tends to lessen with increases in weight. Thus, cyclical variations have obscured to some extent any changes in feed efficiency over time.

Several other changes that affect feed efficiency occurred between 1950-78. Antibiotics were introduced to improve animal health. Gains were achieved in knowledge of nutrition. The type of slaughter hog changed toward less fat relative to lean. All of these developments tended to decrease the feed required per unit of live weight.

Over this same period, however, production moved increasingly into less favorable seasons of extreme cold and extreme heat, both of which deviate from optimal conditions for hogs and adversely affect feed efficiency. Extra stress from close confinement, an increasing production practice over time, also can adversely affect animal performance.

On balance, the opposing forces appear to have largely cancelled each other during 1950-78. Data from Ilinois farmers with farrow-to-finish hog enterprises show almost exactly the same amount of concentrates used per hundredweight of hogs produced during the first half of the period as during the last half (*8*). (See tabulation on page 202.)

The use of grain declined, while commercial feed use doubled (*8*). The increase in use of commercial feeds reflected increasing use of high-protein feeds and more manufactured specialty feeds such as pig starters.

Feed per 100 pounds of hog produced		
Years	Concentrates	Pasture
	Lbs.	*No. days*
1950-54	431	2.0
1955-59	410	1.7
1960-64	417	1.1
1965-69	412	0.6
1970-74	427	0.3
1975-78	422	0.1

Cost in real terms trended upward because high-protein and other manufactured feeds always are higher priced than are grains. However, feed efficiency on a weight basis did not change. The effect on rate of gain is unknown.

The only indication of positive feed efficiency during 1950-78 was a drop from 2 pasture-days per hundredweight of hogs produced in 1950-54 to 0.1 pasture-day during 1975-78. One pasture-day is the feed value equivalent of approximately 25 pounds of legume hay. Moving from 50 to 2.5 pounds of hay equivalent per hundredweight of hogs produced is a significant change, but it probably is more important in terms of freeing land for other more profitable crops than as an indicator of increasing feed efficiency in hog production.

Volume of Output

The U.S. hog industry relies almost entirely on the domestic sector as a market outlet; U.S. consumers rely almost entirely on domestic production for their supply of pork. Only small amounts of pork are either imported or exported. Usually, about 300 million to 500 million pounds (dressed-weight equivalent) move into and out of the United States each year. This is the equivalent of 2 to 3 percent of domestic production (*5*). Thus, changes in output during 1950-78 are reflected in either production or consumption data.

Aggregate Production

In the early 1950's, hogs accounted for over half of total U.S. red meat production, fluctuating around 13 billion pounds (carcass weight). Beef production was below the output of hogs. Production of both beef and hogs fluctuated cyclically during 1950-78, but pork output remained mostly in the 12- to 15-billion-pound range, while beef production cycled upward, reaching an all-time high of nearly 26 billion pounds (carcass weight) in 1976, then dipping sharply to 24 billion pounds in 1978 due to herd liquidation following several years of low prices (figure 3). Recently, hog production has accounted for about a third of total red meat production (*12*).

Per Capita Consumption

Except for short periods, per capita consumption of pork ranged from 60 to 80 pounds during 1950-78 (*9*). In the early 1950's more pork was consumed per capita than beef and veal combined, but the rate of beef consumption is now nearly double that of pork (figure 4). Some of the decline in per capita consumption of pork since the early 1950's reflects the declining yield and use of lard, which is included in the packer-style carcass basis used to measure the consumption of pork.

Economic Importance

In 1977, hogs accounted for 8 percent of the $96 billion cash receipts from all farm marketings and 15 percent of the $48 billion receipts from marketings of livestock and livestock products. This was a decline from the position held by hogs in 1950, when they accounted for 11 percent of the $29 billion cash receipts from all farm marketings and 21 percent of the $16 billion receipts from marketings of livestock and livestock products (figure 5). The shift

FIGURE 3
AVERAGE ANNUAL U.S. PRODUCTION OF PORK, BEEF, AND ALL RED MEATS

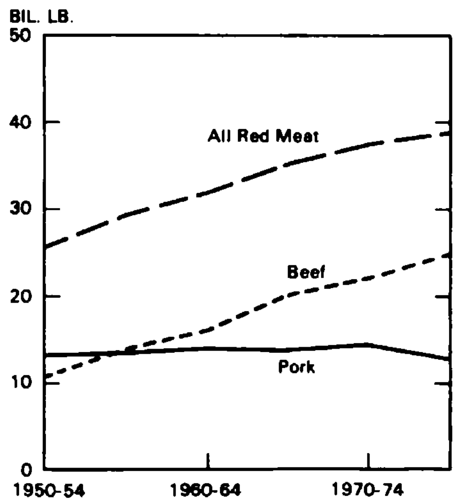
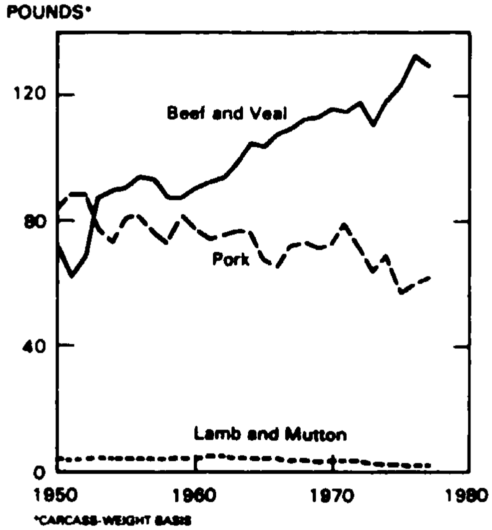


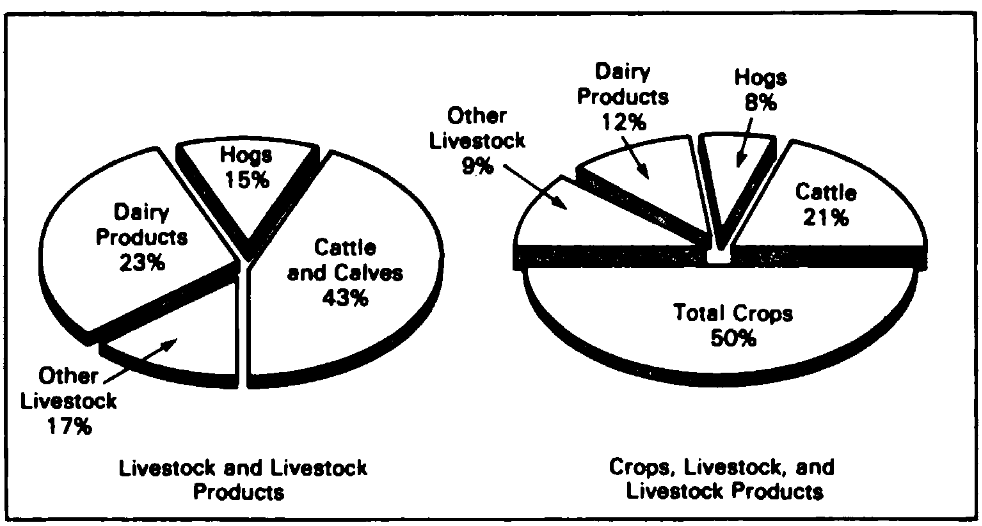
FIGURE 4
MEAT CONSUMPTION PER PERSON



was largely due to growth in the amount and value of beef cattle and crops, while production of hogs remained relatively stable.

Hogs have been and continue to be major contributors to the income of farms where they are produced. In the early 1970's, sales of hogs averaged only about 150 head per farm selling hogs for the entire United States. However, over four-fifths of all sales of hogs in the major hog-producing regions came from farms where sales of hogs amounted to $10,000 or more and equalled or exceeded 50 percent of the total value of sales of all products from the farm (*3*). Hog sales held an even more dominant position in such major hog-producing States as Iowa and Illinois. The percentage of hog

FIGURE 5
CASH RECEIPTS FROM FARM MARKETINGS, BY COMMODITY, 1977



sales coming from farms of different classifications in 1971, by major regions of the United States, (*3*) was as follows:

Region	Hog sales by region: Hog sales $10,000 or more and half or more of total farm sales	Hog sales $10,000 or more but less than half of total farm sales	Hog sales from farms with less than $10,000 of all sales
		Percent	
Corn Belt	81.4	9.0	9.6
Lake States	71.0	16.2	12.8
Northern Plains	83.6	7.3	9.1
Southeast	56.3	16.6	27.1
Southwest	64.2	8.3	27.5

Even small hog enterprises are important to the income of the farmers involved, because size of hog enterprise and size of farm business are rather closely related over a substantial range. In 1975, farmers with sales of 100-199 hogs got about a third of their gross farm income from such sales (*12*). The proportion of gross farm income from sale of hogs moved upward as size of hog enterprise increased, reaching four-fifths or more of the total as annual sales passed 2,500 head of hogs (*12*).

Resource Organization

Hog production has been undergoing rapid change since 1950, particularly in recent years. In many respects, however, hog production still retains many of the characteristics that have made this enterprise unique in meat production in the United States.

Number of Producers

Hogs were a common U.S. farm enterprise in 1950; 63 percent of the 2.9 million farms in the top 15 hog-producing States had hogs on hand at inventory time. Nearly half of all farms in these States sold some hogs, and sales averaged 38 head per farm. For the whole United States, 2.1 million farms (39 percent of all farms) had some hog sales during the year (figure 6).

In every census taken after 1950, both the total number of farms and the number in hog production declined (*29*). The proportion of all farms with hog sales trended downward, but rose and fell with the profitability of hogs, indicating the flexibility that farmers had for moving into and out of hog production. By 1974, the top 15 hog-producing States included only 1.4 million farms, less than half the number in 1950. Farms with hog sales had dropped to slightly less than a fourth of the total, compared with half in 1950. Over a million farms quit selling hogs with these States during this period, either because farms were combined into larger units or the hog enterprise was dropped. Nationally, farms selling hogs dropped from 2.1 million in 1950 to 450,000 in 1974. Hog sales came from about 325,000 farms in the top 15 States. When the census becomes available for 1979, it probably will reveal a substantial further decline in the number of producers. This trend is expected to continue for the next 10 to 20 years.

Size of Enterprise

Nearly all hogs were produced by small enterprises in 1950. In 1964, 46 percent of sales still came from farms selling fewer than 200 head. Only a little more than 7 percent of total hog sales were from farms selling 1,000 or more a year. By 1974, the proportion of sales had shifted at an accelerating rate toward the larger enterprises. Hogs coming from operations selling fewer than 200 head had dropped by nearly half, accounting for only 24 percent of the total. The proportion of hog sales originating on farms selling 1,000 head or more a year had advanced to 25 percent of the total (figure 7). Approximately 10,000 farms accounted for a fourth of all sales in 1974. It is estimated that farmers selling 1,000 head or more

FIGURE 6
FARMS AND SALES OF HOGS AND PIGS

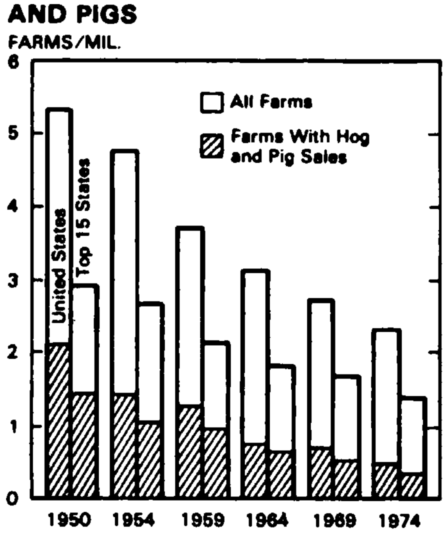
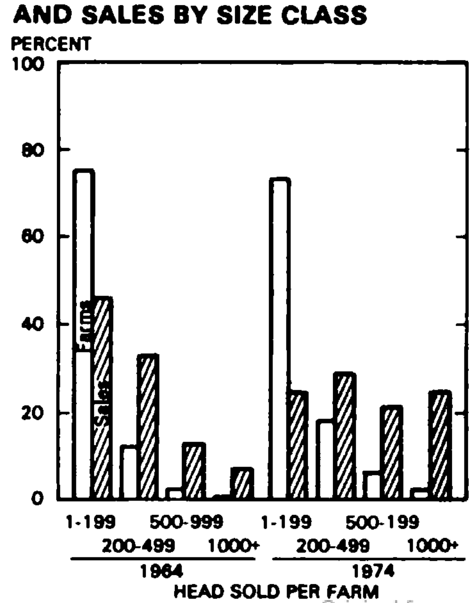


FIGURE 7
PERCENTAGE OF U.S. FARMS SELLING HOGS AND PIGS AND SALES BY SIZE CLASS



annually will account for about 40 percent of total production in 1979.

Large-volume producers (those marketing 5,000 head or more annually) have been accounting for a rapidly increasing share of total production. An estimated 1,340 large-volume operations marketed 13.7 million hogs in the United States in 1978 (*20*). That is approaching one-sixth of national production, with about a 17-percent annual rate of growth in such large operations in recent years. This growth in large operations has resulted both from new entry of large enterprises and rapid expansion of existing units, as indicated below:

Annual marketings of large-volume hog producers

Year	Total marketings	Operations reporting	Average marketings per operation
	Thou. head	*No.*	*No.*
1975	8,241	1,168	7,053
1977	11,212	1,336	8,392
1978	13,666	1,340	10,192

Large hog enterprises occupy a more dominant role in the Southeast and Southwest than in the North-Central region (*27, 29*). Many producers in the southern areas are relatively new entrants to commercial hog production and started with hog enterprises of substantial size. Diversified farming, established production patterns, and existing facilities still tend to constrain the average size of enterprise in the North-Central region.

In years past, attempts have been made to establish and operate extremely large hog production units. Many have failed largely from lack of necessary managerial abilities and skilled labor. Control of disease and the associated risk of high losses have been major constraints on successful development of supersized operations. Presently, however, probably there are at least 15 or 20 firms in the United States with annual marketings in the range of 50,000 to 200,000 head. Their success at the managerial level and ability to operate economically will largely determine their future survival and the proliferation of firms of similar size. Little exists in the area of technology and production practices, existing or foreseeable, that has not or cannot be successfully and economically adapted by producers with enterprises that can be handled by one or two workers.

The rapid increase in size of hog enterprise parallels the general trend in farm size, enterprise specialization, adoption of new production technology, and producer attitudes. As sufficient land or additional productive capacity in terms of other enterprises is acquired to make a full-time farm business, there is less economic pressure for farmers to maintain small hog enterprises. Many believe that the marginal income a small hog enterprise generates is not of sufficient importance to justify the effort and expense of maintaining the enterprise. The proportion of production coming from the larger units is likely to continue to increase rapidly. The extent of growth in size of hog enterprises will depend on the relative profitability of hog production and other farm enterprises, ability to control hog diseases, availability of managerial talent, and other factors.

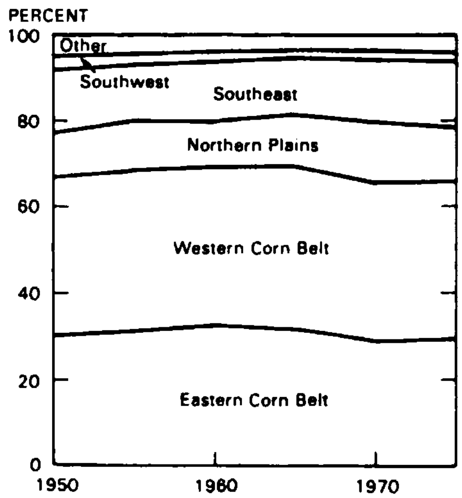
Location of Production

Since 1950, some small interregional shifts in hog production have occurred, but no dominant change is apparent. The major change has been within regions, as farmers in areas with the most productive soils have specialized in cash crop production and ceased hog production. Farmers in adjacent areas have expanded hog production.

The Corn Belt-Lake States produced 66 percent of the total liveweight of hogs in 1975, a percentage point less than in 1950 (figure 8). There is some indication of an east-to-west movement of production within the region, but it is not strong.

Iowa and Illinois remained the first and second most important

FIGURE 8
PERCENTAGE DISTRIBUTION OF U.S. HOG PRODUCTION BY MAJOR REGION, 1950-75



hog-producing States, accounting for 37 percent of U.S. production between them, over 3 percentage points more than in 1950 (*5, 9*). The Northern Plains increased its share of output from 10.4 to 12.8 percent of the total.

The Southeast gained little in importance in hog production, producing 14 percent of the total in 1950 and 14.8 percent in 1975. Increases in production in some States, notably North Carolina and Georgia, were offset largely by declines in several others. The Southwest dropped from 3.5 to 2.4 percent of total U.S. production, while all other States not included in the regions listed above fell from 5 percent of the total in 1950 to 4.2 percent in 1975. This overall geographic distribution is unlikely to undergo significant change in the future because of the economic advantages of having the production of feedgrains and hogs relatively close to each other.

Types of Hog Enterprises

Hogs are produced in three basic types of enterprises: (1) farrow-to-finish, where all activities for producing slaughter hogs are carried out on the same farm; (2) feeder pig finishing, where pigs are bought and fattened for slaughter; and (3) feeder pig production, where pigs are raised for sale to other producers for finishing.

Slaughter hogs dominated sales in all regions in 1971, accounting for 85 percent of the total number sold in the Corn Belt, 82 percent in the Northern Plains, and 78 to 79 percent in all other regions (*3*). The major difference in market hog production among States and regions was in the source of the pigs. In the major hog-producing States, farrow-to-finish enterprises produced four of every five market hogs; the remainder were purchased as feeder pigs from other farms. Purchased feeder pigs were a more important source of market hogs produced in the Southeast and Southwest regions, but the ratio seldom dropped below 2 to 1 in favor of farrow-to-finish production in any State.

Feeder pigs were sold by one-fourth of all farmers with hog and pig sales in both 1969 and 1974 (*24*). In 1971, feeder pigs accounted for an eighth of the number of hogs sold in the Corn Belt and a fifth of the total in the Southeast. Feeder pigs generally were a higher proportion of total hog sales in States where feed grain production was relatively low.

The present division of slaughter hog production, with about 80 percent from the complete enterprise (farrow-to-finish) and 20 percent from split-phase operations (pigs produced on one farm and finished on another), reflects a shift from earlier years, when a higher proportion of all hogs were produced in complete operations.

Split-phase production may increase in the future (*21*). Some farmers who produce feed grains want to finish hogs but do not have the labor or willingness to invest heavily in pig production facilities. Demand from such producers lends strength to the market for feeder pigs. Also, some feeder pig production cooperatives have developed. Farmers purchase shares in proportion to the number of pigs they wish to get from the cooperative and feed to slaughter weight on their own farms.

However, extensive growth in split-phase production appears unlikely. Though pig production-pig finishing may go as high as 30 percent of total slaughter hog production, near-complete division as between production of beef calves and finishing of slaughter cattle will not occur. The most rigorous demands on management and labor occur in producing pigs. Once that process is effectively under control, it is relatively simple to move into the finishing phase. Many producers now managing complete systems of production started with pig production only.

Legal-Economic Organization

Approximately 90 percent of all farms producing hogs in 1975 were under the direction of a sole proprietor. Full partnerships, most commonly composed of family members, generally accounted for between 1 and 2 percent of the total. All other forms of business organization combined accounted for about 1 percent (*12*).

Alternatives to sole proprietorship become important on larger farms. Individuals operated only two-thirds of the farms with farrow-to-finish enterprises in the 1,000- to 2,499-size class. The percentage fell to less than half for farms selling 2,500 or more hogs a year. Various corporate forms of business organization were significant with these larger enterprises—especially in the Southwest, where other enterprises often greatly exceeded hogs in importance.

Large-volume producers (those marketing 5,000 head or more a year) generally are controlled under some form of business organization other than the sole proprietorship which dominates smaller business. In 1977, some type of corporate structure was employed in 58 percent of all large hog operations (*20*). Forty-one percent of these corporations, however, were exclusively family-owned. Approximately 10 percent of these large-volume producers and almost all with annual sales of 50,000 or more hogs were part of agribusiness operations such as feed manufacturing, meat packing, and poultry producing firms. The structure was as shown on top of page 211.

As enterprises continue to increase in size in the future, the sole proprietorship probably will continue to give way to other forms of business organization, with various corporate forms of business control increasing in importance. Family corporations should

Legal-economic organization	Operations marketing 5,000 hogs or more, 1977
	Percent
Corporate	57.9
Sub-chapter S	(21.4)
Regular	(21.4)
Cooperative	(3.4)
Undetermined	(11.7)
Individual	22.9
Partnership	18.4
Undetermined and other	0.8
All operations	100.0

continue to control a substantial proportion of large-volume production, generally in the range of 5,000- 20,000-head annual sales, except for those enterprises which become associated with the production of a large volume of products other than hogs.

Tenure Status

Relatively few hogs are produced on rented land, and 80 percent or more of the farms producing hogs in 1975 were partly or fully owned by the operator (*12*). Owned land accounted for half or more of the total acreage. Ownership, both in terms of number of farms and acreage of land, generally was highest for farms with feeder pig enterprises and least on farms that finished feeder pigs for the slaughter market. Farms with feeder pig enterprises commonly involve the less productive and lower valued land. Finishing operations usually are associated with heavy production of feed grains and relatively costly land. The setup in 1975 was:

	Tenure status of hog enterprises		
Tenure category	Feeder pig production	Farrow-to-finish	Feeder pig finishing
		Percent of acres	
Owned	60.4	56.6	50.8
Cash rent	23.5	17.2	12.5
Share rent	15.7	26.1	36.5
Managed	.4	.1	.2

Cash renting is the most important method of renting land on farms producing feeder pigs. Share renting increases with the importance of feed grain production.

On partly owned farms, however, the hog production unit usually is kept on the owned portion of the land, and the landlord seldom has a financial interest in the hog enterprise. Even on fully rented farms, the operator commonly maintains full interest in feeder pig enterprises, either through cash rental of the farm or some type of crop-share lease that excludes hogs (*12*). Livestock share leases are common on rented farms producing slaughter hogs only in the North-Central region. Where share rental is practiced, the landlord commonly receives the same share of income from both crops and hogs. Overall, however, only 5 to 10 percent of all farms have any landlord participation in hog production. This pattern of ownership and control of hog production is unlikely to change in the future, except in hog production units that become exceptionally large and move outside the crop-livestock farm setting that is dominant now.

Enterprise Mix

Most hogs still are produced on multiple-enterprise farms. In 1975, hog sales accounted for 37 percent of gross farm sales (less the cost of purchased feeder animals) on farms producing feeder pigs, 52 percent on farms with farrow-to-finish operations, and 40 percent where feeder pigs were purchased and fed to slaughter weight (*12*).

The sizes of the hog enterprises in 1975 were related to the sizes of whole farm businesses. Therefore, even the smallest hog enterprises made important contributions to total farm sales. As the size of hog enterprise increased, however, the relative importance of the enterprise grew. Hog sales generally accounted for two-thirds or more of total farm sales, except for feeder pig finishing, when annual sales exceeded 1,000 head per farm.

Sales of other livestock and poultry were significant in all regions and exceeded the value of hog sales in some situations. Typically, 60 percent or more of all farms had livestock or poultry enterprises in addition to hogs. Beef cows or cattle feeding enterprises were present in over 90 percent of the cases where other livestock, in addition to hogs, were produced. Feed grains, wheat, and soybeans also were major contributors to farm sales in the North-Central region; peanuts, cotton, and tobacco were important in the South (*12*).

Hogs accounted for a relatively higher proportion of adjusted gross farm sales in 1975 than they likely would over a period of several years. Hog prices were relatively favorable, while prices for beef cattle were exceptionally low. Further, sales of feed grains and wheat, especially the former, greatly understate the importance of these enterprises on farms on which hogs are produced. The existence of any sales of feed grains usually indicates that grain has been produced in excess of livestock feed requirements. Feed grain production may therefore be the major enterprise on many farms, even though hogs account for most of the sales.

The multiple-enterprise character of farms producing hogs provides some risk protection through diversification. Use of general-purpose farm machinery, especially tractors and trucks, helps to reduce unit overhead costs. Special livestock equipment such as water systems, feed mills, and waste-handling equipment may be used economically in a small hog enterprise when it is operated in conjunction with other livestock or poultry enterprises. Overall, some of the size economies pertaining to volume purchases of inputs are possible, even for small hog enterprises, when the volume of business conducted by the farm as a whole is relatively large.

Diversification and smallness of enterprises, however, may have a negative impact on efficiency in hog production, compared with the potential level of achievement in large, highly specialized operations. As producers become more proficient as managers of hog enterprises, find ways to employ and keep a competent labor force, and reduce the risk of disease, they will continue to specialize and to expand their hog enterprises. In the future, hog production will continue a strong association with farms having a substantial base for the production of feed grains, but fewer farms will maintain other types of livestock enterprise.

Source of Labor

Most of the work done in connection with hog production is performed by unpaid operator and family labor, especially in feeder pig production (*12*). Nationally, only 7 percent of the total hours of labor used in feeder pig production was hired in 1975. About 18 percent was hired for farrow-to-finish operations; 11 percent was hired for feeder pig finishing. The high use of operator and family labor results from the relative smallness of most enterprises, the demanding routine of hog production, and the general crop-livestock family farms on which most hog production still occurs. The data is shown on page 214.

The use of operator and family labor was greatest in the North-Central region, where family farming and grain-livestock enterprises are dominant. Hired labor was more important in the Southeast and Southwest, approaching a third of the total labor input, except in feeder pig production. Substantial field labor is necessary for some crop enterprises in these regions. Employees often are kept on a year-round basis so they will be available for peak labor needs in crop

Region and source of labor	Labor in pig production: Feeder pig production	Farrow-to-finish	Feeder pig finishing
		Percent of hours	
All regions:			
Hired	6.9	17.5	10.8
Operator	74.4	59.9	72.6
Family	18.7	22.6	16.6
North-Central:			
Hired	4.2	20.8	7.0
Operator	76.5	57.5	77.2
Family	19.3	21.7	15.8
Southeast:			
Hired	15.2	32.4	30.9
Operator	68.5	51.0	54.9
Family	16.3	16.6	14.2
Southwest:			
Hired	0	33.4	24.6
Operator	65.0	46.7	42.3
Family	35.0	19.9	33.1

production. More hired labor was therefore used in hog production in these regions, partly because it was available. Larger hog enterprises also required the use of more hired labor.

Operator and family labor remained the major source of labor for hog production until annual sales surpassed 1,000 head. Unpaid labor did not drop below half the total labor input until the size of enterprise exceeded 2,500 head of annual sales, except in feeder pig finishing.

As the size of hog enterprises increases in the future, the reliance on hired labor will increase accordingly. The lack of qualified and dependable hired labor, however, is a formidable block to expansion of hog enterprises. The work demands are unceasing, and only the exceptionally large operations with numerous employees can provide working schedules competitive with those available in nonfarm industries—5-day work week, vacation time, and sick leave. Further, persons with an education and potential managerial ability plus willingness to dedicate their efforts to a business are essential for efficient operation of a large hog-producing unit, but it is just this type of employee who has aspirations that exceed employment on a hog farm. The best employees commonly work long enough to gain experience, then leave for ventures of their own. Until such time as most activities in hog production can be reduced to nonskilled work on a regular weekly schedule, labor will remain a serious limitation to growth of units much larger than persons with vested interests can handle.

Production Facilities

Hogs can adapt to a variety of environmental conditions. Some still are produced on woodland pastures with little or no shelter. Some are raised in portable housing. Many are handled in drylot situations, consisting of some type of shelter building plus a paved feeding floor. The trend, however, is toward specialized buildings for each phase of production, with emphasis on more confinement of the animals and greater control of all aspects of production. This results in a sharp increase in the investment requirements for long-term assets and pressure for intensive year-round production.

Several factors have combined to foster an increase in specialized housing, including more profitable alternatives for the use of land, mechanization of materials handling, desire for continuous year-round production, better control of diseases and parasites, and need for better control of hog wastes.

Breeding facilities.—Most hog producers still maintain their breeding animals on pasture or in an open-lot environment, largely because of difficulties in obtaining full development of the reproductive capacity of the animals in total confinement. Some operators of large enterprises, however, now successfully manage their breeding programs under partially confined conditions. This practice will increase in the future as problems are eliminated and the disadvantages of maintaining breeding herds under extensive conditions increase.

Farrowing houses.—Use of central farrowing houses to reduce chore labor and permit year-round production became popular some 40 years ago. Inability to control diseases and parasites with intensive housing generally forced farmers to shift to portable facilities rotated among clean pastures. Eventually, the means for satisfactory sanitation and disease control permitted a return to central farrowing houses. Then, in the 1960's, slotted floors and pit storage for manure were added to central farrowing houses. Additional new systems for managing wastes, reducing labor and costs, controlling diseases, and improving hog performance are being developed continually by researchers and innovative producers.

Few producers now farrow pigs without shelter. The use of portable individual or colony-type farrowing houses, which formerly were the mainstay of pasture production systems, has been almost discontinued. Their use will continue to decline as hog enterprises increase in size and are shifted off pasture.

Central farrowing houses are now used by over 80 percent of all producers and account for most pigs produced (*12*), as shown below:

Type of enterprise	Farrowing facilities: No facilities	Type of facility: Portable housing	Central housing: Solid floors	Central housing: Slotted floors	Central housing: Mixed floors	Total
			Percent of farms			
Feeder pig production	.8	11.7	67.1	11.5	8.9	100.0
Farrow-to-finish	6.2	11.0	50.0	12.5	20.3	100.0
			Percent of hogs			
Feeder pig production	.3	9.4	59.2	19.5	11.6	100.0
Farrow-to-finish	5.3	12.1	41.3	19.1	22.2	100.0

A high proportion of central farrowing houses constructed since 1965 are of the slotted-floor type with pit storage beneath the building for storage of wastes. Supplemental heat and mechanical ventilation are provided. Virtually all future construction of farrowing facilities will be of this general type.

Nursery facilities.—Pigs are placed under considerable stress at weaning. They undergo change in both rations and environment. Special nursery buildings, used in conjunction with central farrowing houses, have been brought into use in recent years to ease the transition from the nursing to the growing-finishing stage. Nurseries facilitate earlier weaning, thus permitting more intensive use of the farrowing house, which is the highest cost building in a hog production system.

About a third of all producers now use nurseries; three-fourths of those with annual marketings of 1,000 head or more do so (*12*). Newer nurseries have slotted floors and are environmentally controlled. Nurseries will be component parts of the larger confinement systems constructed in the future. Data on current use of nurseries are shown on top of page 217.

Growing-finishing facilities.—Pigs enter the growing-finishing phase weighing about 75 pounds. They are able to withstand more stress and wider ranges in environment than younger animals. At this stage, Pig nurseries

Type of enterprise	No nursery	Type of nursery: Solid-floor nursery	Slotted-floor nursery	Mixed-type nursery	Total
		Percent of farms			
Feeder pig production	60	34	6	0	100
Farrow-to-finish	70	21	7	2	100
		Percent of hogs			
Feeder pig production	44	42	14	0	100
Farrow-to-finish	59	25	14	2	100

they are managed in a variety of ways, ranging from pasture without shelter to confinement in enclosed, slotted-floor buildings. Permanent-type buildings with either solid or slotted floors now dominate housing for the finishing stage. In 1975, solid-floor housing units (typically open front barns or sheds with paved lots attached) were used by 62 percent of all producers and accounted for 58 percent of total production (*12*), as shown below:

Pig-finishing facilities

Item	No shelter	Type of finishing facility: Portable	Solid floors	Slotted floors	Mixed floors	Total
			Percent			
Farms:	22	2	62	8	6	100
Hogs:	16	2	58	15	9	100

As size of enterprise and extent of specialization in hog production increase, more use is made of confinement facilities—with emphasis on slotted floors or other floor designs aimed at improving the handling of animal wastes. In 1975, about a fourth of total production was handled in such buildings. More than half of the farmers marketing 1,000 hogs or more annually used slotted-floor buildings or were in the process of converting to them. Future construction will emphasize slotted-floor buildings or their variants, with waste management a major consideration.

Marketing Methods

In the narrowest sense, marketing may be considered outside of the production sphere. Nevertheless, the availability and competitiveness of markets for hogs can affect resource organization in the animal production sector.

Some farm enterprises must depend upon contracts with processors as an outlet for production. Entry into production or a change in volume or type of product are constrained by the availability of a contract outlet. Other production enterprises are parts of vertically integrated businesses usually controlled by an off-farm part of the business. Essentially no market exists for potential producers outside of the integrated scheme. Hog producers are not yet constrained by limitations in market outlets. Although change has been occurring both in type of market and basis of pricing hogs, competitive market alternatives still exist for any hog producer, especially in the areas of intensive production.

Most slaughter hogs are sold direct to packers either by direct negotiation or through country buying stations or other buyers. On a nationwide basis, 72 percent of sales were made this way in 1975. Terminal markets handled 16 percent of the slaughter hogs; auction markets handled 12 percent (*12*). Large-volume producers sell a slightly higher proportion of their hogs directly to packers than do producers with a few hogs to market.

Slaughter hogs are sold on a liveweight basis or by the more recently introduced carcass-grade-and-weight method. Use of the latter system rose from 2.6 percent of total sales in 1965 to 8.9 percent in 1975 (*12*). Large-volume producers sell half or more of their slaughter hogs on a carcass-grade-and-weight basis, but few producers limit their hog sales to one pricing system. Typically, producers use a major outlet and one method of pricing for most of their marketings, but occasionally check the market by selling some hogs through alternative outlets and under different systems of pricing, as indicated in the following tabulation:

Hog marketing outlets				
Slaughter hog market outlet			Pricing method	
Direct, country dealers	Terminal markets	Auction markets	Liveweight or head basis	Carcass grade and weight basis
	Percent		*Percent*	
71.6	16.3	12.1	91.1	8.9

Direct transactions between pig producers and finishers are most common in States where production is intensive. The large-volume feeder pig producers are the most likely to have direct contact with finishers. More use is made of auction markets and order buyers in areas of less-intensive hog production.

Prices for feeder pigs are determined on a head basis, weight basis, and various combinations of head and weight. The various outlets for feeder pigs and the bases of pricing all have weaknesses that are providing much of the incentive for recent innovations in marketing methods, such as teleauctions.

Factor Specialization

The production of some agricultural products in the United States has become so concentrated and specialized that each of the major categories of factors of production—land, labor, capital, and management—come from a different source. Poultry production and cattle feeding, for example, often utilize primary production resources obtained from diverse sources.

Characteristics of the sources and control of resources used in hog production are changing rapidly. Some observers believe that the industry may be on the threshold of radical change. However, it is still dominated by the traditional family farm unit, where the operator and family supply most of the resources used in production and are recipients of the resulting gains or losses.

Typical Hog Farm

Detailed input-output information is provided by ESCS for a series of hypothetical farms that typify the production of major crop and livestock commodities in the United States. A crop-livestock farm in Iowa is included in this series to represent the norm in hog production.

General characteristics of this farm in 1976, which remain essentially unchanged in 1979, are shown on page 220 (*32*).

The farm operator owns 120 acres of land debt-free. He cash-rents 200 acres for production of corn and soybeans. Year-to-year differences in product prices cause some shifts in the relative contribution of corn, soybeans, and hogs to gross farm income, which averages around $100,000 annually. Income from corn sales is low because nearly 75 percent of the total production is fed to hogs.

The representative hog enterprise is in the midrange of production in terms of size of enterprise—half of total production originates from larger enterprises and half from smaller enterprises. It is a farrow-to-finish operation producing four groups of hogs each year scheduled around the crop work. Annual sales amount to 650 head

Characteristics of typical hog farm

Resource or enterprise	Amount	Annual production	Contribution to gross farm income
			Percent
Total land	320 acres	–	–
Cropland	275 acres	–	–
Corn	150 acres	15,000 bu.	9
Soybeans	125 acres	4,000 bu.	30
Pasture	30 acres	–	–
Hogs	50 sows	1,545 cwt.	61

of slaughter hogs. Substantial use is made of the newer technologies for hog production, but size economies have not permitted adoption of some of the most capital-intensive technologies, especially in mechanization and housing.

The total labor input for this farm business is just over 3,400 hours, divided among three enterprises. Hogs account for 66 percent of the labor; corn, 19 percent; and soybeans, 15 percent.

The operator and his family provide most of the labor. Some seasonal labor is hired during harvesting of corn and soybeans. The operator accounts for 59 percent of the labor; the family, 14 percent; and hired help, 27 percent.

Capital assets involved in this typical crop-hog farm in 1976 amounted to about $280,000 owned by the operator plus an equal value of land, the use of which was controlled by rental. Annual cash operating expenses, representing the purchase of many different kinds of inputs and services, were about $60,000, part of which was supplied through short-term operating loans. The 1976 balance sheet placed operator equity just over $250,000. Values in 1979 will reflect the effects of inflation, but the general relationship between assets and liabilities will not be greatly affected. The farm balance sheet as of January 1, 1976, is shown on top of page 221.

The farm operator acquires information on financing, production, and marketing from many sources. His actions are limited by many institutional constraints. Final decisionmaking and risk-bearing, however, rest solely with the farm operator, especially from the standpoint of hog production. Uncertainty regarding long-term control of the rented land is perhaps the most tenuous aspect of the farm business and is a matter beyond the control of the farm operator.

Provision of the resources used in hog production are similarly concentrated with the farm operators on typical farms that produce

Assets, liabilities, equity	
	Dollars
Production assets—	
Land and buildings	168,500
Nonreal estate assets	112,200
Production liabilities—	
Reat estate debt	0
Nonreal estate debt	24,400
Equity	256,300

feeder pigs for sale or purchase feeder pigs for finishing to slaughter weight. The main difference is that the former utilizes relatively higher proportions of labor to capital, has a limited capability for producing feed grain, and rents less land than does the typical operator with a farrow-to-finish hog enterprise. Farmers with finishing enterprises exhibit characteristics opposite to those of pig producers.

Leading Hog Farm

Characteristics of the present leading hog farms have many similarities to those of the present typical hog farm. Basically, they reflect an extension of ongoing trends in terms of increasing size of hog enterprises, adoption of technology, and enterprise specialization. Greater dependence is placed on off-farm resources necessary for production, but responsibility for provision and control of these resources still rests largely with the farm operator.

The concept of what comprises a leading hog farm is subject to different possible interpretations. For present purposes, it is taken to be those 3,000 or so producers with annual sales of slaughter hogs generally within the range of 2,500 to 15,000 head. They presently account for about a sixth of national production.

A farm with annual sales of 5,000 head of slaughter hogs is considered representative of this group of leading hog farms. Precise measures are not available, but the operation can be characterized in a general way sufficient for comparison with the operation of present typical hog farms.

The hog enterprise is on a grain-producing farm, with half the feed grain requirements supplied from corn produced on the farm. Sales of hogs account for all of gross farm income. Future expansion of the farm business is most likely to occur in capacity to produce hogs.

Most such hog enterprises are farrow-to-finish, but a small percentage of farms either produce feeder pigs for sale or purchase feeder pigs for finishing to slaughter weight.

Family members operate and control the farm business, typically through a partnership or family corporation. About five man-year equivalents of labor are needed in the operation. Half the labor is supplied by the farm operators and their family members; highly qualified employees provide the other half. Contractual arrangements provide employees with a vested interest in the success of the farm business.

Full use is made of environmentally controlled confinement housing; complete mechanization of materials handling; an on-farm feed manufacturing plant to combine corn, soybean meal, and essential additives into desired hog rations; and liquid systems for managing wastes. The operators stay abreast of and adopt developments in breeding, nutrition, and veterinary medicine, although regular use also may be made of the services of a consulting veterinarian.

All capital comes from the farm business, either from earnings or borrowed funds. Capital investments can only be estimated, and no estimates are available as to the debt-equity position—though improvements typically are relatively new, hence likely to involve substantial debt. Capital investments and annual flows of funds are presently of the following general magnitude:

Capital investments	
	Dollars
Land	1,000,000
Hog building and equipment	500,000
Other buildings and machinery	150,000
Breeding stock	100,000
Annual cash expenses	350,000
Annual sales	500,000

Exceptional Hog Production Units

Some exceptionally large hog enterprises are now in operation. Factor specialization in these operations, though not yet measured, is beyond attainable levels in the present leading hog farms. Information about most such operations now is sufficient only to give examples of a few units known to exist, as shown below:

Hog production units

Type of production	Annual production	Comment
	Head	
1) Farrow-to-finish	100,000	Affiliated with a food processing firm
2) Finishing	130,000	Affiliated with a feed milling firm
3) Farrow-to-finish	30,000	Affiliated with a feed milling firm
Finishing	45,000	
4) Farrow-to-finish	80,000	Affiliated with an agribusiness firm
5) Finishing	50,000	Affiliated with a feed milling firm
6) Finishing	50,000	Affiliated with a farm supply business. Sows are contracted out, pigs returned for finishing. Additional pigs are purchased.
7) Finishing	75,000	Affiliated with a specialized vegetable farm
8) Finishing	75,000	Affiliated with a meat packing firm
9) Farrow-to-finish	250,000	Affiliated with feed firm and poultry production
10) Finishing	60,000	Affiliated with feeder pig order buyer and feed milling firm

As indicated above, most of these large hog operations have strong ties with other businesses. The largest operation, for example, is owned by a publicly held corporation that is involved in poultry production and/or processing in seven Southern States and tenant-operated farming operations in one or more States, in addition to hog production. Receipts from the 250,000 hogs marketed in 1978 represented only about 10 percent of the total sales of this company.

Recent expansion in hog production by this company has been rapid. One recent acquisition included facilities for 5,500 sows plus a grain elevator with a capacity of 1.8 million bushels, a modern feed mill, and about 10,000 acres of farmland.

Hog production facilities included in this acquisition involve the most advanced technology in environmentally controlled confinement housing. Complete feed manufacturing facilities are located near the hog houses, and feed and materials handling is completely mechanized. Liquid systems involving farmland irrigation are used to control and dispose of hog wastes. Strict sanitation practices and preventive health-care measures are used to reduce losses via diseases or parasites.

Labor and first-line management personnel specialize in either breeding herd care and feeder pig production or in finishing feeder pig to slaughter weights. Bonuses and other incentives are used to encourage efficient production. Highly trained professionals (nutritionists, veterinarians, etc.) provide advice on production processes and problems. Ultimate control of the operation, however, is exercised by a wholly owned subsidiary of the parent corporation.

Changes in Efficiency of Production

No single measure fully reflects all of the changes that have occurred in the performance of hog production. The best overall measure of performance through time is cost of production per unit of product. This can be only a general indicator, however, as change has occurred in both kind of product and timing of production. Both changes impact on costs of processing and distribution that occur beyond the farm gate and on product value to consumers. Also, substantial changes have occurred in the input mix, resulting in increasing output-to-input ratios for some and decreasing ratios for others. Changes in production performance should therefore be examined from more than one point of view.

Cost of Production

Estimates of the national average cost of producing hogs are available only for 1976-79 (*10, 27*). It is not possible, therefore, to gauge change in total cost of production directly for a long enough period to determine any trend in overall efficiencies of resource use in hog production.

Prices received for hogs provide an indirect means for estimating changes in cost of production. Price is unrelated to cost of production at any given time. Price may be above or below cost, depending upon the supply of hogs and demand for them. Over time, however, because producers vary output in response to recent and anticipated price-cost relationships, price cannot long remain either above or below cost of production. Thus, price can be used as a general indicator of cost of production, at least to determine trends.

Inflation has caused prices to increase, especially in recent years. It also has affected the prices of the inputs that producers use in hog production. To use the price of hogs as a proxy for cost of production over an extended period, the effect of inflation must be removed to determine whether there has been a real change in cost of production.

Actual hog prices have cycled with changes in supply since 1950, moving to sharply higher levels in recent years (*9*). When these prices are deflated by the index of cost of all production inputs, they leave a pattern of relatively high prices during 1950-54, relatively low prices in 1955-64, and relatively high prices again during 1965-78 (*9*). This suggests that there were gains in overall efficiency in the use of resources in hog production in the first 15 years which were lost in later years. Farmers evidently were willing to produce hogs for a lower real price in 1955-64 than the latter period; hence, real cost must have changed accordingly. Prices, actual and deflated, during 1950-78 were:

	Price received per cwt. for hogs (1967 = 100)	
Period	Actual dollars	Deflated dollars
1950-54	19.75	21.80
1955-59	16.20	18.00
1960-64	15.60	16.80
1965-69	20.60	20.60
1970-74	27.60	20.80
1975-78	42.95	22.50

Antibiotics were among the first and most effective introductions of technology in this period, being first used intensively in the mid-1950's. Their use increased performance ratios and cut unit costs of production. They also made it possible to shift to capital-intensive confinement systems of production, which began in the mid-1960's and have been used increasingly to the present. To be cost effective, these facilities must be used intensively year-round. Many farmers did not have an overall farming program which allowed such intensive production of hogs. Other enterprises still required some seasonal interruption in the hog production schedule. Therefore, farmers responded with output only at higher real costs of hog production.

The higher real cost of hog production for the period since 1965 thus appears to be a mark of less efficient use of resources recently than in the past. It is, however, a result of the way technology has been used rather than any fault in the technology. In 1975, farmers had capacity in farrowing facilities for more than double their actual production and finishing facilities for up to 75 percent more hogs than were actually produced (*12*). Enterprises still were of insufficient size to fully utilize the capacities of many of the specialized machines and items of equipment included in the system.

The present situation, however, may result in a net overall gain in pork industry efficiency. Hog production is now more nearly year-round, with considerable production in seasons of the year when costs are higher. This results in a leveling of the seasonal flow of hogs to market, with efficiencies occurring in processing and distribution beyond the farm gate. Producers also have shifted to production of meat-type instead of lard-type hogs, again with efficiencies of resource use that may be greater off than on the farm.

As conditions continue to change so hog enterprises can become larger and farmers can adopt more intensive, uninterrupted, year-round hog production schedules, it will be possible to utilize the capacities of facilities more completely. Cost efficiencies will be greater, and farmers will bring them into their plans for production response.

Litter Size

Maintenance of breeding stock is essentially a fixed cost at any given time. Cost per pig produced per sow varies directly with the number of pigs produced per sow. Year-to-year variations occur in litter size due to such factors as weather and disease. Position in the farm production cycle also affects average litter size. As expansion occurs, a higher proportion of gilts enter the breeding herd, and first-litter gilts farrow fewer pigs per litter than do older sows. Herd liquidation results in a higher proportion of sows versus gilts in the breeding herd—hence the potential for a larger average litter size.

The following tabulation shows how average litter size increased nearly one pig (16 percent) during 1940-78 (*9*):

Period	Pigs farrowed per litter
1940-49	6.3
1950-59	6.8
1960-69	7.2
1970-78	7.2

Most of the gain took place in the 1940's and 1950's, and there was a leveling in litter size (in the 7.0 and 7.3 range) during 1955-78. Better control of disease through introduction of antibiotics and improved housing were major factors affecting the increase. The latter was essential as farrowing moved from spring-fall periods into winter (*9*). Past gains in litter size have therefore come at a cost.

Hogs have the potential for producing many more pigs per litter. Production scientists generally believe that present litter size is around 30 percent of that which is possible. Advances in science will determine the rate of increase in this aspect of productivity.

Death Losses

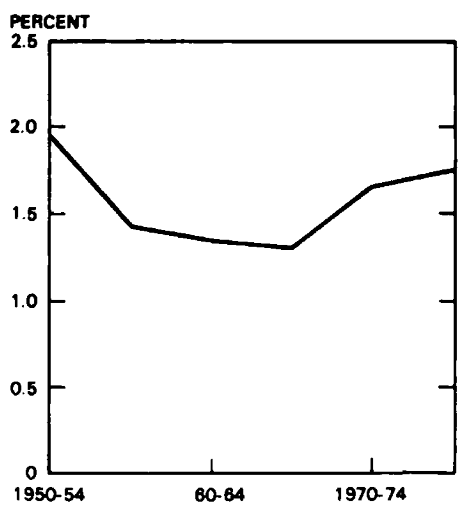
The pattern of death losses was the same during 1950-78 as that of overall efficiency of resource use (*8*). Losses were high in the early years, averaging about 2 percent of production (figure 9). With the introduction of antibiotics, losses declined to 1.2 to 1.3 percent of production. Subsequently, losses rose toward the 2-percent level with more intensive confinement, increased production in the hazardous seasons of the year, and much larger numbers handled per worker.

Hogs get less individual attention in mechanized confinement systems. Infectious diseases can spread more rapidly and other health problems can occur more easily when many hogs are in proximity to each other, and death losses are higher despite the availability of more technological aids for health care. Producers believe that the greater productivity per worker achieved through mass handling of hogs more than offsets the small increase in death losses.

Seasonality of Production

Historically, hog production has been associated with crop-livestock farms, with pig production (the heavy labor-using activity)

FIGURE 9
AVERAGE DEATH LOSS AS PERCENTAGE OF LIVEWEIGHT PRODUCED IN FARROW-TO-FINISH HOG ENTERPRISES ALL SIZES, ILLINOIS



concentrated in the spring and fall before and after crop work. Winter pig production was minimized because of climate. In the 1940's and through most of the 1950's, 60 to 65 percent of all farrowings occurred during December-May, with the heaviest concentration in the spring (*9*), as shown below:

Period	Percent of sows farrowing December-May
1940-49	61.7
1950-59	59.6
1960-69	53.3
1970-78	51.2

Production still remains largely on crop-livestock farms, but hog production has become more specialized and though average size of enterprise remains relatively small, size is increasing steadily. Seasonal variations in production have virtually disappeared, and year-round production now is common (*12*). Within major regions of the United States, more production occurs in some months than others because of competing farming activities, but aggregate production for the Nation now differs little from month to month (*12*). The evolving nature of production systems should result in even further leveling of seasonal production in the future.

Carcass Composition

The hog industry has achieved substantial and rather rapid change in the composition of hogs sent to slaughter. Through selective breeding, it has been possible to raise hogs that provide an increasing amount of lean cuts with far less fat than was produced by the lard-type hogs considered desirable prior to the advent of vegetable oils for cooking and synthetic detergents.

Slaughter hog weights, though cycling somewhat as the feed-hog price ratio has changed, have tended to increase through the years. Hogs now have the capacity to grow to weights well beyond the typical 220-pound goal of years past without encountering severely depressed feed efficiencies. Some packers contend that heavier hogs provide more desirable sizes of some of the major cuts—such as bacon, hams, and chops. Also, slaughtering and processing costs are determined more on a head than weight basis.

Some of the more important changes in characteristics of hog carcasses since 1955 are revealed in a recent report (*21*). The highlights are:

Hog carcasses	1955	1960	1970	1974	1985 targets
Average liveweight, barrows and gilts, lbs.	226.0	229.0	237.0	238.0	246.0
Lard yield, lbs. per hog	32.8	30.4	22.0	16.2	12.3
Chilled carcass weight, lbs.	147.2	152.6	165.0	174.8	184.7
Loin eye size, inches	3.8	–	4.6	–	5.1-7.0
Yield of four lean cuts, percent	48.5	50.0	52.0	53.0	64.0

An increase of almost one-fifth in average chilled carcass weight and of 4.5 percentage points in the yield of the four major lean cuts has been achieved simultaneously with a halving of the average lard yield per hog slaughtered. These developments represent improved performance from the viewpoint of pork consumers.

Economies of Size

Within limits, lower unit costs of production can be achieved in larger enterprises, compared with smaller ones, in the production of any commodity. Major factors making lower unit costs possible in larger enterprises include: (1) the ability to spread fixed costs over a larger output; (2) volume sufficient to justify substitution of mechanization for labor; (3) more proficient management from greater concentration on one activity; (4) more skillful workers who have specialized rather than diversified tasks; (5) lower input prices resulting from larger volume purchases; and (6) possibly higher product prices because of a larger volume of sales or ability to bypass some intermediate stages in the marketing process.

Hog producers have experienced many of these economies of size of business. Expansion in size of enterprise has occurred rather rapidly in recent years, because it has been possible to produce hogs at a lower unit cost in the larger operations. Operator returns, assuming that they are above costs, encourage expansion to larger enterprises—even in the absence of a significant reduction in unit costs of production.

The following sections illustrate the effect of size of enterprise on the costs of some of the major inputs, on the prices of hogs sent to market, and on total costs of production for operations up to annual sales of 5,000 head. Performance data are not available for extremely large operations.

Feed costs.—Quantities of feed used per unit of hogs produced vary considerably among farms, but the size of enterprise has not been an important factor in the variation. In 1975, a random-sample survey of farrow-to-finish producers over the Nation indicated an average of 439 pounds of feed fed per hundredweight of hogs produced. There was no consistent relationship between feed conversion ratios and size of enterprise (*12*).

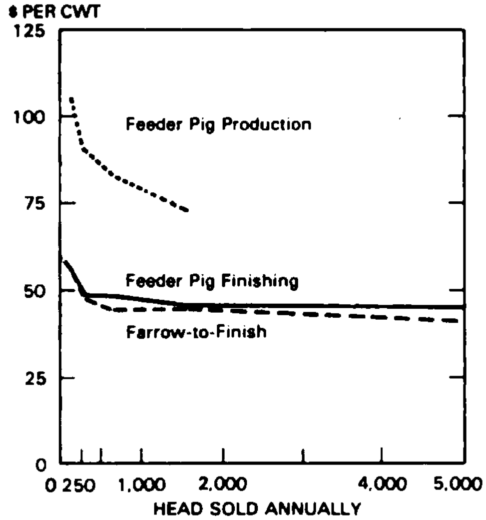
Records of Illinois hog producers during 1968-78 show that producers with annual sales averaging 200 head used 430 pounds of feed per hundredweight of hogs produced (*8*). Those with annual sales of 2,000 head used 424 pounds of feed, which was not significantly different than the physical feed conversion achieved by the group of farmers with enterprises only one-tenth as large (*8*).

Illinois producers with annual sales of 2,000 head paid about 8 percent less per hundredweight of commercial feeds purchased than did producers with annual sales of 200 hogs (*8*). This difference reflects both volume discounts in price and the purchase of some soybean meal by the larger volume producers. The latter entails some additional on-farm processing costs, which partly offsets the lower ingredient price. The total ration cost, including both commercial feeds and grains, was only 1.6 percent lower on farms selling 2,000 hogs than on farms selling only 200 head (*8*). Operators producing 5,000 hogs or more can expect greater discounts in the price of manufactured feeds, but they cannot obtain significant advantages in prices paid for feed grains.

Total costs.—Cost estimates for enterprises with annual sales in 1977 ranging from 40 to 5,000 head show average total costs per unit of production declining throughout the range of sizes of enterprises considered. The total cost per hundredweight of hogs produced averaged $47.55 for all sizes of farrow-to-finish enterprises combined (*27*). Total costs ranged from $60.04 per hundredweight for the 40-head farrow-to-finish enterprises down to $41.00 for enterprises with annual sales of 5,000 head (figure 10). Most of the difference in unit costs occurred in noncash inputs, especially ownership costs of facilities, and unpaid labor and management. Cash costs declined only from $35.72 per hundredweight in the 40-head enterprises to $31.78 in the 5,000-head operations (*27*). The shifting of some costs from the noncash to the cash category, especially labor, occurred as size of enterprise increased. Returns per hundredweight of sales were lowest in the smaller enterprises, because seasonal sales occurred during months of lowest prices.

Total costs per hundredweight of production also dropped in both feeder pig finishing and feeder pig production as size of enterprise increased (figure 10). Most of the change occurred in the unit cost of noncash inputs, as in farrow-to-finish operations. Producers with

FIGURE 10
AVERAGE COSTS OF HOGS BY TYPE AND SIZE OF ENTERPRISE, 1976



small feeder pig finishing enterprises commonly finish only one lot of pigs each year, usually during late fall and winter when demands for labor from other enterprises are least. These producers benefited from the seasonally low prices for feeder pigs purchased during the last quarter of 1976, the reverse of the situation they encountered a year earlier. Prices for feeder pigs were much higher during the first three quarters of 1977, so producers with large enterprises and year-round operations paid more for feeder pigs. Seasonality of sales also affected returns per unit of production to some extent in both feeder pig production and finishing.

Two factors cause most of the difference in noncash costs per unit of production among enterprises of different size. First, the labor input per unit of production is high in small enterprises of all types, partly because of lack of mechanization and partly because of inefficient use of labor. Second, facilities are used much more intensively in large enterprises than in small ones. Both year-round use and better management contribute to the lowering of ownership costs of depreciable assets in the large enterprises, even though they are equipped with more costly facilities.

Ownership costs could be reduced substantially in the small enterprises through more intensive use of facilities, but down time is one of the prices paid when labor is divided among enterprises on multienterprise farms. Once hog businesses are operating, they are reasonably competitive on the basis of cash costs—regardless of size—but eventual replacement of facilities after only part-time use is too costly, as the decline in small-volume hog producers indicates.

Some discontinuities occur in unit costs, especially ownership costs of facilities, as enterprises increase in size. Enterprises of intermediate size sometimes have higher unit costs than smaller ones (*27*). This occurs as producers shift from low mechanization and use of general-purpose facilities to a new threshold of high technology and intensive investment, but do not intensify production accordingly or cannot produce enough to make full use of some components of the new system.

Market prices.—Small-volume producers often have only a few lots of hogs to sell each year. They may be adversely affected by seasonal variations in hog prices, compared with producers who have sufficient volume to market throughout the year. This can be a recurring problem year after year for the small producer—if the production schedule coincides with peak seasonal supplies of hogs—though the risk of lower prices from this cause has lessened as seasonal variations in production have declined.

Some large-volume producers find a higher paying specialty market for part of their production. They tend toward more rigorous testing of alternative markets and can afford to ship to more distant markets, if price differences justify it. Also, a higher proportion of larger producers use grade and yield rather than liveweight as a basis for pricing. Overall, however, large- and small-volume producers receive the same prices for their hogs.

Illinois producers marketing 2,000 hogs a year during 1968-78 recorded a price 2.4 percent higher than those selling only 200 head a year, but the cost of custom hauling, a typical practice in small operations, was deducted from the price received (*8*). Large-volume producers commonly used their own trucks. When that cost is deducted, net prices less hauling are essentially the same for both large- and small-volume producers over the 11 years covered by the records.

Supply Response

All hogs, young animals finished for the slaughter market, and culled breeding animals combined, have been marketed at composite average weights close to 240 pounds per head for the last 30 years. Deviations of a few pounds have occurred as hog price-feed cost ratios have changed, thus shifting the proportion of heavy culled sows in the slaughter mix.

The only relevant change in product over the entire period has been the continuing shift from lard-type to meat-type hogs and the consequent reduction in production of lard. Producers continue to move toward the meat-type hog, but there is doubt whether price differentials among the grades of hogs fully reflect the differences in carcass values. Some argue that price premiums for hogs with the highest yield of lean meat relative to lard should be greater to reflect value differences.

Adjustments in supplies of pork have occurred mostly through changes in numbers of hogs produced. In the 1950's and 1960's, the profitability of hog production one year was a good indicator of the production that could be expected the next year. The hog-corn price ratio, a measure of the bushels of corn that the price of a hundredweight of hogs would buy, was the standard by which profitability was measured. A ratio of 13 to 1 was considered breakeven in 1950. A higher ratio resulted in expanded production; a lower ratio reduced production (figure 11).

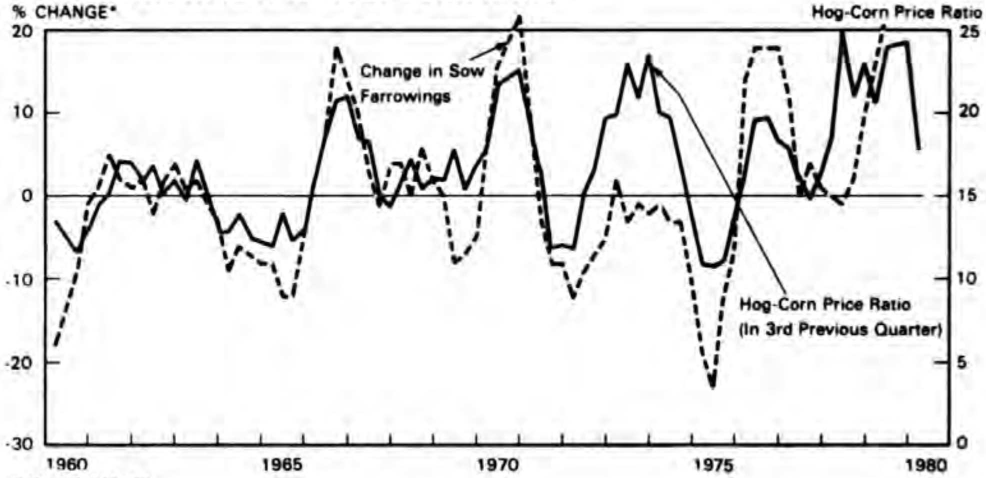
When 40 percent of all farmers in the United States sold hogs, as they did in 1950, supply adjustment was a simple matter. The 2.1 million farmers selling hogs at that time produced only a few litters each year, and production occurred largely during seasons that did not interfere with field work. Aggregate adjustments in supply resulted when farmers bred fewer females or more, as indicated by the returns situation. They could delay this decision to within a month or so of market time, holding gilts for breeding or finishing them for the slaughter market as they chose. Either way, the small increment of change had virtually no impact on the organization of the farm business. Existing resources were adequate for the expansion. Extra corn was sold when production was reduced. Supplies of hogs moved in regular 4-year cycles due to the biological lag in production response. Price changes were much greater than changes in supply due to the inelasticity of demand (figure 12).

The supply adjustment pattern and economic measures that indicate supply adjustment have changed since 1950, especially during the 1970's. Two groups of farmers have been largely responsible for the expansion and contraction of hog production. One group, including both existing producers and new entrants, has specialized in hog production, enlarging enterprises by increments of substantial size each time favorable conditions occurred. The other group—comprised largely of farmers with marginal hog enterprises, older farmers choosing to reduce their farming activities, and farmers who preferred expansion in other enterprises—have maintained hog production so long as returns were favorable and ceased production permanently when returns became unfavorable.

The expansion of the growth group, counterbalanced by farmers who ceased hog production, reduced the number of hog producers by nearly 80 percent between 1950 and 1974. Probably no more than 15 percent as many producers remain in 1979 as in 1950.

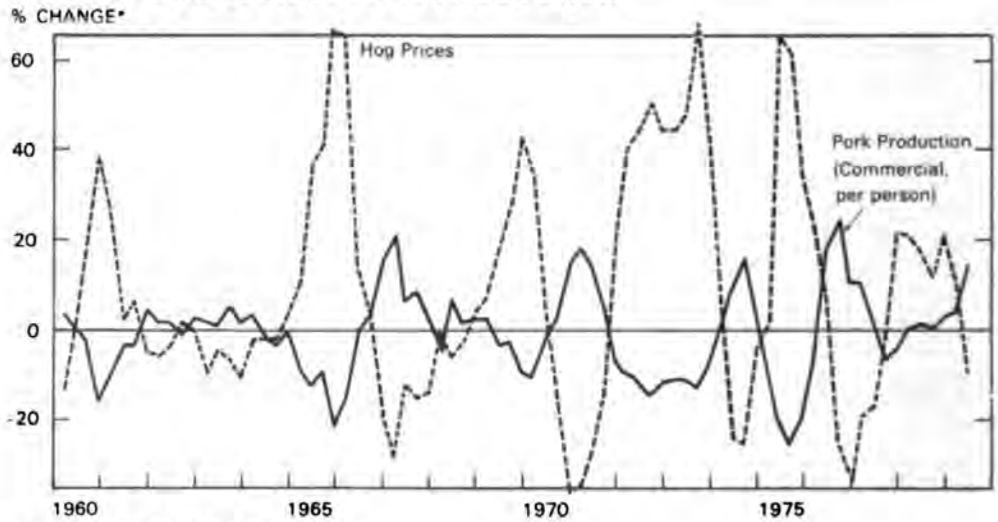
Supply adjustments can no longer occur as simply as they did in 1950. Some flexibility for change in production exists in any system, but most changes of significance now represent major decisions by

FIGURE 11
SOWS FARROWING AND HOG/CORN RATIO



*FROM A YEAR EARLIER

FIGURE 12
CHANGES IN HOG PRICES AND PRODUCTION



*PERCENTAGE CHANGE FROM A YEAR EARLIER

individual producers, not just breeding fewer or more females. Expansion tends to come in much greater increments, often involving the facilities and associated capital to employ at least an additional full-time worker—the added production capacity for another 1,500 or more hogs a year. And this can change the time required for a supply response. Added to the inescapable biological time lag is time needed to: (1) resolve a major decision, (2) acquire substantial additional investment funds, (3) construct new production facilities, and (4) find and train new employees. This partially explains why profitable hog production in recent years has not resulted in expanded output as quickly as in years past.

In addition, the profitability of hog production has been misjudged by some analysis in recent years, resulting in projected increases in supply failing to materialize. As producers have shifted to specialized, capital-intensive confinement systems of production, corn has become a smaller and smaller part of the total cost of production. In the early 1950's, corn comprised 50 percent or more of the total cost of producing hogs. Now, corn usually amounts to no more than 30 percent of total cost, with manufactured high-protein feeds costing about three-fourths as much as corn. All feed costs combined now comprise only about half the total cost of production in farrow-to-finish enterprises, compared with two-thirds or more of total production costs in the early 1950's.

The hog-corn ratio needed to encourage expansion in production is about 24 to 1 and has been recognized—but the problem is that the hog-corn ratio is no longer the best indicator of potential shifts in hog production, because it does not measure the most significant production cost (*22*). The ratio of hog prices to total feed costs would be a better indicator, but there are increasing indications that investment costs are now a major determinant.

Most expansion in hog production has occurred recently and will continue on farms using confinement facilities. The cost of these facilities has increased dramatically in the last few years, and annual costs for facilities, computed on the basis of conventional accounting, approach the cost of corn (*20*). Uncertainties are viewed by some as greater now than in the past because of public policies that have or may make hog production more costly, such as regulations for control of pollution and the banning of certain antibiotics. Substantial amounts of capital usually must be borrowed for major expansion. To meet cash flows and in recognition of greater uncertainties, farm managers may therefore use shorter amortization schedules for depreciable assets. One analyst placed facilities on a 5-year amortization schedule and found that the resulting annual costs for facilities in 1979 are nearly 60 percent greater than the cost of corn (figure 12). The implication is that the estimated probability of rate of return on investment costs is a more accurate indicator of supply response than is the hog-corn ratio. At least the latter is no longer suitable as the sole indicator of change in supply.

Supply adjustment on the downward side will be increasingly more difficult in the future. Over the last 30 years, the large numbers of farmers who quit producing hogs, often for reasons other than lack of profitability from hog production, made room for new entrants and farmers choosing to expand production of hogs. Supplies of hogs seldom had to increase to levels that drove prices so low that losses forced cessation of production.

An increasingly higher proportion of hog production will come from producers who have specialized in it, invested heavily in facilities, and depend largely if not completely on the hog enterprise for an income. Their cost structure differs from that of the diversified operator with a small hog enterprise. Direct costs per hundredweight of production in farrow-to-finish operations in 1977 were nearly $13 less for enterprises with annual sales of 5,000 head, compared with those selling only 40 head (*27*). Cash costs per hundredweight were $4 less for the large enterprise, compared with the small one.

It is economically advantageous to continue production so long as variable costs can be covered. Any residual margin that can be applied to fixed costs is a net benefit, compared with cessation of production, which would leave fixed costs with nothing to offset them. Since unit variable costs are lower in the large enterprises, specialized producers can be expected to continue production until supplies get larger and hog prices lower than was the case when there were many small enterprises. In fact, operating decisions may place employee salaries, ordinarily considered a variable cost, in the fixed cost category, at least for a time, because every effort will be made to retain a skilled labor force in a large operation. Every year, fewer producers remain who can leave hog production with a limited loss; these serve as a cushion for retrenchment of supply.

FACTORS CAUSING CHANGE

A complex and interrelated set of factors has moved hog production into its present organization and continues to cause further change. Hog production has undergone less radical change than some other enterprises, but the kind of change is the same throughout agriculture. It differs only as to degree among enterprises.

Enterprises tend to remain small and associated with diversified farm businesses when variability in costs and income is great; that is, when risk is high, labor requirements are large relative to the need for other resources, and spatial needs are so large it is difficult to bring large productive capacity under the control of one management unit. All of these constraints to size of business in hog production have been greatly reduced, especially in the last 20 years.

Technology

Technology in the broad sense has been the single most important factor causing change. Related actions in the economy and society generally have encouraged the development of technology and assisted in its adoption. Technology improves production performance and increases the predictability of outcome. It increases the productivity per unit of labor by providing the means for combining increasing amounts of capital with labor, and except in crop production, lessens or eliminates the need for a large land base, thus permitting concentration of production activities. As these developments materialize, the economic advantages shift from small, manually operated enterprises on diversified farms to larger enterprises in a more industrialized setting.

Hog producers who have stayed in business have aggressively adopted most new technologies as they became available. Unlike poultry producers of the 1940's and 1950's, they have left no great margin of opportunities for other interests to exploit. Otherwise, the size, structure, and factor specialization in hog production almost certainly would have undergone a radical change instead of the more gradual consolidation that has occurred. Explanation of some of the factors causing change, past and present, helps to clarify the situation.

Nutrition and Health Technology

Technological developments in nutrition and control of diseases and parasites of hogs have virtually freed hog production from the necessity of being associated with a sizeable land base. For example, rations composed of natural and synthesized ingredients can now be prepared to meet the needs of hogs at all stages of their life cycle. There is no longer a need for or advantage from grazing of legumes for protein to supplement grains or the consumption of soils for essential minerals. Antibiotics, medicines, and sanitizing agents now permit effective control of diseases and parasites in a fixed and continuously used production site. Hogs do not have to be rotated from one clean site to another.

Inability to achieve a high level of reproduction by females kept in close confinement still limits using total confinement in all phases of hog production. Most breeding herds are managed outdoors, but the requirement for land for this purpose is small, amounting to little more than exercise lots. Recent research findings and limited commercial experience indicate that even this problem may soon be solved.

It is technically possible to separate hog production from farms completely, except for space for a building site. Yet, most hog production is still associated with farmland and production of feed grain. Why is this so? Little use is made of pasture, but nationally nearly 80 percent of the feed grains fed to hogs, other than in commercially mixed feeds, are produced on the same farm as the hogs. Even producers with the largest hog enterprises in the country commonly have farmland and grow at least part of their feed requirements.

This tying together of land and hog production still occurs largely because of investment opportunities, rather than any requirement for the two to be associated. Existing farms often have had the earning capacity and equity to invest heavily in hog production facilities. Similarly, successful hog operations that began as single-enterprise operations with little land commonly have found additional land to be a most attractive investment opportunity for earnings from hog production. Assurance of control over a suitable land base for utilization of hog manure and to provide a buffer zone between neighbors and the hog production site also tie the two together. However, new uses being developed for manure, such as recycling it into the feed supply or using it for the generation of energy, along with more successful means for controlling odors, eventually may remove waste management as a meaningful force tying hogs to farmland.

Hog production independent of crop farming causes considerable increases in cash expenses of production, as all feeds must be purchased. Potential risk also is greater with no other enterprises to offset diversities in hog production. Capital requirements are greatly lessened, however, when funds can be concentrated in the construction of facilities instead of having to cover the purchase of farmland as well. Also, both facilities and knowledge can be specialized for hog production, as is being done in some of the extremely large operations.

Production Facilities Technology

One set of technologies has freed hog production from land; another set has given the enterprise a place to go. Elimination of the need for clean pastures would have had limited impact on hog production without the parallel development of environmentally controlled housing embodying the components for complete mechanization of materials handling—feed, water, waste, heat, air, and conditions for ease in monitoring the condition of animals and moving them from place to place. These centralized production systems embody the basis for industrializing hog production on a continuous year-round basis in large-scale units. Present investment cost for facilities is around $250,000 per man-equivalent input in the operation, but productivity per man can reach half a million pounds of slaughter hogs on a liveweight basis (*27*).

Requirements for labor are seasonal in crop production. Scheduling hog production to take advantage of off-season farm labor, long a standard practice in the major hog-producing regions, is not economically feasible with modern confinement facilities. The cost of unused capacity that would occur is prohibitive. Enterprises so equipped therefore do little to complement crop farming from the standpoint of labor use. It is only because the crop production base already exists that land is chosen as an investment for earnings, or held as a site for waste utilization and insurance against pollution. Diversified farms have been able to make use of the full level of technologies available in facilities. The economic advantage of such facilities otherwise favors the large-scale, single-enterprise setting.

Crop Production Technology

Changes in crop farming, particularly grain production, have been of special significance to hog production. The availability of chemicals and large field machines has permitted substantial growth in the size of grain farms. Since 1950, some 60 to 80 percent of all purchases of farms have been for expansion rather than simply transfer of ownership. As the crop production base has grown through farm acquisition, small hog or other livestock enterprises which often existed on both farms prior to the consolidation have become less attractive as marginal income producers. They also have become less adaptable to the resources needed to operate larger grain farms. Four-wheel-drive tractors, for example, are unsuited to multiple use in both crop and livestock enterprises. Even specialized workers require knowledge and skills not readily transferable between crop and hog production. The result is that many farmers have dropped hog production and specialized in cash grain production. Fewer than 20 percent as many farmers have hog enterprises now as in 1950. This has cleared the way for the remaining progressive hog producers to expand sufficiently to justify adoption of production technologies as they are available.

Crop technology also has permitted more intensive production of row crops on land with erosion hazards. The zero tillage system uses herbicides to allow intensive production of corn and similar crops on land that otherwise would have to be managed in a long rotation, including forage production. The resulting crop values usually have exceeded the value that could be realized from pastures used for hogs. The result has been larger farm businesses without change in the land area. Hog enterprises became relatively less important and were often dropped, again adding to the opportunity for those hog producers who chose to expand.

Developments in crop production technology have not resulted in any significant interregional shifts in hog production, but they have tended to concentrate production within regions. Areas with the more productive land have shifted strongly to production of cash grains and no production of livestock. Hog production is tending to concentrate in adjacent areas, especially where grain has a transportation cost disadvantage relative to outlets for export.

Credit

Farmers traditionally have held a more conservative attitude toward debt than other businessmen, preferring to pay for improvements from savings insofar as possible. As a group, they often have been accused of not understanding the value of capital leverage in expanding their farm businesses.

Technological developments in hog production facilities require relatively large amounts of capital for intermediate and long-term investments. Requirements for operating funds also are high for a hog operation that fully employs two or three man-year equivalents of labor or more. Other interests would have found an unexploited opportunity in the use of these technologies, had not some important changes occurred. First, farmers have become more willing to borrow to invest in the technologies available. Second, those who have expanded into highly capitalized hog enterprises of substantial size have become proficient at financial as well as production management. Third, financial institutions have made the adjustments necessary to provide individual producers with amounts of money greater than normally available through the country banking system. Thus, as technology became available for change in hog production systems, producers adjusted their attitude and found sources of funds to use it.

Government Policies and Programs

Over the years, government policies and programs have strongly favored the development and use of capital-intensive technologies in hog production as well as other farm enterprises, both directly and by indirect means. Probably the major factors have been publicly funded research which has been heavily weighted toward further development of technology, a system to disseminate information about new technology to producers, and incentives to aid and encourage producers to adopt and use it. Farmers have been in the mainstream of this effort and have been greatly affected by it.

The Federal income tax system has encouraged both the adoption and rate of adoption of new technology in hog production. Investments in durable production assets can be "written off" as expenses of production over a period that commonly is shorter than the useful life of the assets, using—at the discretion of the producer—an accelerated rate of depreciation which permits a large portion of the asset cost to be charged against income in the early years of use. More importantly, an investment credit is allowed which reduces the income tax due by a percentage of the initial investment (*4*). The more specialized the facility, which commonly means that it comprises more advanced technology, the more likely that it qualifies for an investment credit. Small farms, however, realize limited benefit from these tax regulations, especially if they incur little or no income tax liability.

Interest on borrowed capital is a deductible expense in computing income taxes. As hog enterprises are enlarged and taxable income increases, an increasing share is owed for taxes. For example, if a producer has taxable income that places him in the 50-percent tax bracket, borrowing at a 10-percent rate of interest results in a real interest cost of only 5 percent. With a smaller operation, the real cost of borrowing is higher. Further, the rates of inflation that have persisted for several years, and threaten to increase in the future, have encouraged early adoption of capital-intensive technologies, especially when inflation in the cost of facilities and the tax-deductible aspect of interest are considered together. Delaying planned capital investments usually has necessitated larger and more costly commitments.

Legal forms of business organization have made it easier for farmers to expand their hog enterprises and employ capital-intensive systems. Hog farms using even a moderate level of technology in their production systems would create a difficult problem if refinancing were necessary at each change of family operator. The family corporation, however, provides for divisibility of ownership and continuity of production units from one family generation to the next, in addition to providing some potential tax benefits. Regular corporate forms of business have not, therefore, had the overwhelming advantage they might otherwise have had in the use of capital-intensive technologies in sizeable hog production enterprises.

Government-supported programs in crop production, such as price supports on feed grains, indirectly affect specialization and consequent adoption of technology in hog production. Farmers with greater assurance of some minimum price for grains have less need for the risk protection of hogs through which to market their grain if the price falls too low. Their release of hog production capacity has left one of the many gaps in potential supply into which the more specialized hog producers have moved.

Even government-imposed pollution regulations have favored hog enterprises equipped with capital-intensive technologies and, as such technologies are economical only for the larger enterprises, the regulations have given advantage to size of enterprise (*16, 25*). Producers must prevent runoff contaminated with hog wastes from entering streams or reservoirs. Open-lot production systems, long common on hog farms, often present a pollution problem requiring remedial action. Total confinement housing, which reflects most recent advances in technology and is the most capital-intensive of all systems, also embodies the best available means for control of runoff. Some confinement systems were built before water pollution was a recognized problem and now conform to regulations by chance. Construction of new systems is geared toward confinement because of the necessity for pollution control.

Only recently have governmental actions done other than foster new technology in hog production. One example of the reverse use of technology is the possible need to ban some antibiotics from use with hogs (*33*). If this occurs and suitable substitutes are not found for control of diseases, the high density of hogs raised in present confinement facilities could prove impossible. The ripple effect would therefore affect the use of many other technologies currently used and size of enterprise as well. The chance of failure to discover suitable alternatives, however, is considered remote.

Economies of Size

Some technologies, such as antibiotics, can be used competitively by small- and large-volume hog producers alike. Others require a substantial volume of production before use can be justified economically. The capital-intensive durable assets represented by confinement production facilities are in this latter category.

The relatively inexpensive portable A-frame field farrowing houses used in previous pasture systems of hog production had little impact on unit costs. As farmers began to invest in confinement housing, however, pressure built for intensified production. Fixed costs per unit of production were unacceptably high, unless the production schedule was shifted from a seasonal to a continuous year-round basis. Further expansion often was dictated by unused capacity of certain components of the system, such as feed mills and waste-handling equipment.

Environmentally controlled housing permitted year-round production. Greatly reduced labor requirements permitted a two- or three-man work force to handle the most technologically advanced production facilities and realize most of the size economies available from them. Enterprises of larger size began to involve multiples of system components. For them, there was much less to be gained from size economies involving use of the technology embodied in the production system alone. From this standpoint, the leading family hog farms have left little unexploited unit cost advantages for exceptionally large operations.

Pecuniary economies of size associated with purchases of inputs have followed a similar pattern. Certainly, input suppliers alter prices according to the volume of sales to purchasers. For example, a hog producer buying a few bags of protein supplement each week cannot be supplied at the same unit price that can be offered profitably to the user of truckload or freight carload lots (*1*). Similarly, soybean meal, which must be fortified with additional essential ingredients, can be used to advantage if the volume of use is sufficient for direct purchase from a processor; it is seldom competitive with commercially manufactured high-protein feeds if the volume of use is too low to justify direct purchase. The same situation applies to purchases of other supplies and the services of veterinarians. Again, however, the leading hog producers have been able to get at least a large share of available input price economies either because of their volume of hog production or volume of input purchases for the total farm business, which commonly includes substantial crop production as well as hog production.

In addition to pecuniary economies of size in the purchase of inputs, there are potential product price advantages to large-scale and continuous production of many agricultural products. Because of savings in scheduling and assembly costs, processors of some farm products can afford and often are willing to pay higher unit prices to producers who can provide significant quantities on a regular basis than to producers with only small or sporadic output. This is particularly true where market outlets for farm products are limited in number.

The market for hogs, however, is still composed of many outlets, especially in the areas of intensive production. Producers with large numbers of hogs to sell may get some price advantages because of their capacity to fill special needs of buyers, but overall, given the quality of the slaughter hogs to be sold, the small-volume producer has fared about as well in the market as the large-volume producer at any given date and location. Differentials in market price have not been an important factor in the changing size and structure of hog-producing enterprises, except in feeder pig production where sufficient volume for direct dealings between pig producer and finisher yield results superior to those in the open market.

Attempts to utilize excess productive capacities in industries associated with livestock production, including hog production, are responsible for some of the extremely large hog operations that now exist. Feed manufacturing firms lose business as the number of small-volume hog producers declines and many of the large-volume operations formulate their own rations on the farm. The resulting excess capacity for feed manufacturing can be utilized at low marginal cost for hog production managed by a feed company, and several of the extremely large hog operations noted earlier are affiliated with feed manufacturing companies. Similar pressures exist for other supply industries and for meat packers confronted with guaranteed work weeks for their employees. Intrusion into hog production by nonfarm firms is as yet limited, but the productive capacities of their fixed investments provide some cost advantages, compared with new investors.

Tenure

The farm leasing systems common to the major hog production regions of the country are a constraint to the development of larger and more capital-intensive hog enterprises on a shared basis. A high proportion of the owners of farmland for rent are older persons with relatively fixed incomes. Many have neither the capital nor the planning horizon to justify large additional investments in durable assets. Typical short-term leases do not allow the renter sufficient security of tenure to justify establishment of long-term investments on rented land. Further, the high level of management and relatively large labor input required in hog production make it difficult for a landlord to offer a renter an acceptable offsetting contribution to the business.

Hog farms involve substantial rented land, often from several different landowners. For reasons given above, however, the hog enterprises usually are maintained on a tract owned by the operator, with the rented land used only for crop production. Landlord participation in hog production occurs on 10 percent or less of all farms now producing hogs. It is likely to decline in the future.

Management and Labor

Technology usually develops in small increments. A high level of management is necessary to combine the parts into an integrated system and to adjust to change. Qualified workers are needed to make the system function effectively.

Present leading hog farmers—those with annual sales in the general range of 5,000 head or more—have, for the most part, grown with the development of technology. They frequently started with small hog enterprises handled with general-purpose facilities and expanded stepwise to their present operations, moving from one stage to the next only after each stage was first fully under control. Only a small number of the more than 2 million farmers selling hogs in 1950 were able to make this transition.

The maturity of management of present leading producers has been extraordinary. They have mastered management in the broad context—management of the increasing technological aspects of hog production and marketing; management of relatively large and complex financing of expanding operations; and perhaps most importantly, the successful management of capable employees. The scarcity of employable personnel proficient in all of these areas of management is a major reason why nonfarm interests have been able to develop only a few extremely large hog operations outside of the typical farm setting.

Lack of qualified, capable, and dependable employees also has been a major constraint on size of hog enterprise (*7, 20*). Leading hog farmers still rely on family members for much of their labor requirements, but they also view employees differently than does the average farmer, who often needs no more than an experienced tractor driver during the peak seasons of planting and harvesting. It is not uncommon now for the operator of a successful hog farm to visit colleges and universities to interview graduates right along with the personnel officers of industrial firms. Contractual offers are made that include competitive salaries, fringe benefits, and incentive programs. These managers have recognized that technology cannot entirely substitute for the people who run a modern hog operation.

Despite advances that have been made by managers of the leading hog farms, problems and questions remain. Most present managers developed with their business. As the business moves under control of the next generation, the new managers will not have had the unique experiences of the builder of the business—and perhaps may lack organizational abilities. The job may be more than some can handle. Some farm families have no children or none interested in pursuing a career in hog production. Adequate management is still difficult to hire. So the outcome in some cases may be that progressive hog operations will have to be sold either to other farmers outside of the immediate family or possibly to nonfarm interests concerned with securing control of a large volume of production even in dispersed units. There is a good possibility that the basic decisionmaking unit may move off some of these hog farms in the future.

Although educated, dependable, and highly motivated persons are being employed on leading hog farms, the labor problem has not been fully solved. A few people can achieve production of many thousands of hogs annually, but a small crew is left with a serious burden when one worker is absent for any reason. It is difficult to get an adequate replacement for work in a complex operation on a short-term basis. Further, the uninterrupted work requirements of continuous hog production do not permit work schedules competitive with large nonfarm industries—5-day, 40-hour weeks plus vacation and sick leave—unless the operation is many times larger than present leading hog operations and has a much larger number of employees.

What appears to be the strongest part of the present employment program also has proven to be one of the more troublesome for hog farmers. The most desirable employees have aspirations well beyond employee status. They usually want a business of their own. And if they do not, there is limited room for advancement between beginning worker and manager, even in the largest operations. Consequently, managers typically find that their businesses are used for apprentice training rather than places of permanent employment.

Expansion of Farm Business

Many of the present large hog operations were developed to accommodate additional family members in the farm business. Expansion through purchase or rental of additional land frequently has been impossible, but acquisitions often could be handled by getting larger field machines without changing the labor force.

Among the several alternatives for business expansion through livestock, hog production has been considered to offer a good chance for success. Family farm hog enterprises accounted for most of production. No new land base was required. The new entrant could start and gain experience with limited capital and shift to a more capital-intensive operation as resources became available. If a hog enterprise existed, it could be expanded to make use of the services of an additional person. Some of the largest and more progressive hog farms now involve father-son(s) combinations established on this basis. The capital base built over two or more generations has enabled them to invest in the most capital-intensive technologies available for hog production.

Farmer Viewpoint

Various production systems have been and still are being used profitably in hog production. The prevailing idea among hog growers, however, is that long-term success requires use of the most advanced technology, especially in production facilities.

This belief, which places advanced technology in the category of a necessity, has kept many farmers from entering hog production, even when returns were highly attractive. It also has kept many hog producers from improving or expanding their enterprises under such conditions, because they could not foresee expansion to a size of enterprise that would justify a fully advanced system of production. Such producers have determined, right or wrong, that smaller enterprises will not be competitive with the larger, advanced operations over the long run. Many have ceased hog production when income levels deteriorated. Such an attitude regarding technology, along with consequent farmer actions, has accelerated the rate of adoption of technology by removing much potential supply and allowing the growth segment of producers to expand with more favorable prices than would have been possible otherwise.

Attitude also has been somewhat of a constraint on the development of extremely large hog operations controlled by outside interests. A neighborhood farmer who has developed a large and successful hog operation over many years typically is viewed with community pride. An equivalent operation built by outsiders commonly encounters resistance, both open and covert. It bears a negative image for area residents, especially if it is managed under the corporate form of business.

Demand for Pork

Past changes in resource organization, and probably future ones as well, have had to occur within the framework of the domestic supply of pork and demand for it. Demand for pork has been more inelastic than the demand for other meats. Consumers have shown a strong preference over many years for a certain amount of pork in their diets. When the supply became greater, prices had to decline sharply to clear the supply. When supply dropped, consumers bid vigorously to hold their share.

Price elasticities of demand have been estimated by several researchers. Results differ, depending on the time period covered. Changes in consumer income consistently have a greater influence on purchases of beef, the major competing red meat, than on the amount of pork that consumers will buy. Also, changes in the price of beef consistently affect the amount of pork purchased more than changes in the price of pork affect the amount of beef purchased. The price elasticities provided below show the relative positions usually observed for the major meats (*23*):

	Demand elasticity	
Product	Retail level	Farm level
Beef	−.64	−.42
Pork	−.41	−.24
Lamb and mutton	−2.63	−1.67
Chicken	−.78	−.60

Per capita consumption of pork, excluding lard, has remained within a rather narrow range throughout this century. During 1909-75, per capita consumption held between 58 to 72 pounds for

56 of the years (*9*). It was lower during only 4 years and higher during 7 years. There is no indication of any change in this pattern in recent years.

Consumption of pork per person has declined when lard is counted in the total product. Changes in living habits, age structure of the population, development of vegetable oils, and other factors have resulted in a drop in per capita consumption of lard by over 80 percent since 1950, when use was 12 to 13 pounds per person. Use now is near 2 pounds per person.

Hog producers have adjusted in large part to the disappearing demand for lard by shifting from lard-type to meat-type hogs. The change must be viewed as rather rapid, considering that it had to be achieved through breeding programs rather than changes in rations or other practices unconstrained by the biological time clock.

Consumers have shown a strong preference for beef and poultry over the years, compared with pork. Consumption of beef per person has increased to almost double the amount used in 1950; use of poultry per person is now more than twice the 1950 rate. Hog producers have had only population growth to increase the market for their product, and even that has not resulted in a proportionate increase in the market because of the rapidly declining demand for lard. If 1.7 million of the 2.1 million producers selling hogs and pigs in 1950 had not been absorbed into other farms or dropped hog production for other more economically attractive enterprises, it would have been difficult—if not impossible—for the rapid increase in adoption of capital-intensive technologies and size of hog enterprises to have occurred.

Demand seems certain to favor beef and poultry, compared with pork, in the future, so production of expanders and new entrants into hog growing must continue to be largely offset by producers leaving, if excess output of hogs is to be avoided (*24*).

FUTURE CHARACTERISTICS

Most of the factors that promoted changes in U.S. hog production during the last 10 to 20 years appear likely to prevail for the remainder of this century. Thus, barring the development of effective new, countervailing forces, the general direction of changes in the structure of hog production over the next 20 years appears to be rather clearly defined by the changes discussed above. The rates at which recent changes may continue, however, are functions of developments in the overall domestic and world economy, hence much more difficult to project.

The current consensus is that long-term success in hog production will require use of the most advanced production technology, especially in the area of facilities. Under present conditions, this would imply steady and rapid continuation of the trend to relatively large, fully enclosed, high-density, intensively utilized hog housing furnished with mechanical feed preparation and distribution equipment, mechanically automated ventilating, heating, and air conditioning equipment, and pit storage for wastes handled mechanically in liquid form. There are, however, at least two recent developments which could retard or even reverse this trend.

First, consideration is now being given to the increased human health protection that might be gained from prohibiting the use of certain antibiotics and related antibacterial drugs at subtherapeutic levels in hog (and other animal) feeds (*33*). One advantage attributed to the routine use of these chemicals is that they help to supress and prevent the spread of diseases among hogs. Many producers believe that the risks of catastrophic losses to disease among hogs maintained in large, high-density facilities would be unacceptably great without the protection afforded by antibiotic feed additives. Some antibiotics that are now being used as hog feed additives are not included in the current prohibition proposal, and other effective substitute products may be forthcoming. Nevertheless, the loss of several drugs that have been perceived as important contributors to the development of concentrated hog production could, at least temporarily, slow the trend to total confinement, centralized facilities.

Second, a continuation of the recent rapid increases in energy costs could offset much of the economic advantage currently offered by modern confinement systems. Efficiency in the use of labor is one of the biggest attractions of centralized, high-density facilities, achieved through virtually complete mechanization in handling materials. Continuing rapid increases in the costs of electricity and petroleum fuels would add significantly to machinery operating costs in such production systems, eventually negating their labor cost advantages. Even it this should happen, however, the costs of additional land required for more dispersed pasture systems of hog production probably would make confinement facilities competitive—unless energy costs increase enough to drastically reduce the value of farmland for crop production.

Thus, new and unidentified forces probably will affect developments in the organization of hog production over the next 20 years, but ongoing trends appear to offer the best clues on structural characteristics in the year 2000.

Enterprise Size Distribution

Rapid declines in the proportions of market hogs produced in enterprises with annual sales of fewer than 200 head and those selling

200-999 hogs annually are likely to continue in response to economies of size in hog production (figure 13). By the turn of the century, enterprises in these two size classes, each of which produced about 46 percent of the hogs sold in 1964, may account for a combined total of only about one-fourth of hog sales.

In contrast, units selling 1,000 or more hogs annually may provide three-fourths of the hogs sold by the year 2000. The most rapid growth is likely to occur in confinement units that utilize at least one full man-equivalent of specialized labor and management and produce 2,000 or more hogs annually. In fact, with current cost relationships, economies of size favor expansion at least to the point where fully mechanized materials-handling systems are used to capacity, requiring a two- to three-man specialized work force. Thus, the typical hog production enterprise at the start of the 21st century may have many of the characteristics of today's leading hog farms, described previously in the section entitled "Factor Specialization."

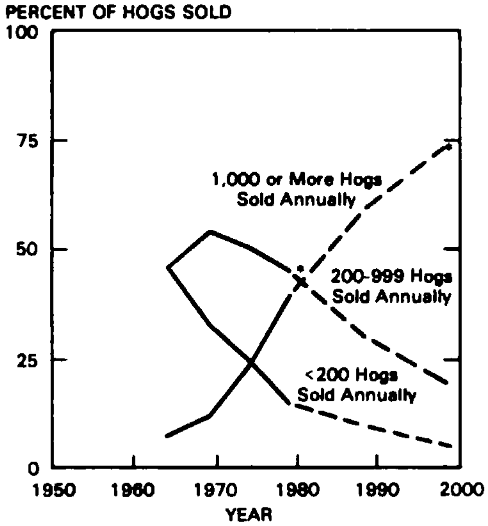
The extent to which farmers are able to adopt new technologies and to provide the associated physical, financial, and managerial resources will determine the proportion of future hog production that is provided by family farm operators. A few extremely large enterprises, most of which are parts of farm-related industrial organizations, now produce about 15 percent of all market hogs. Current hog production technology does not provide significant cost economies to such very large producers, compared with leading hog farm operators, and the problems of obtaining and retaining the required highly skilled and dedicated management and labor apparently have constrained their proliferation. Their number and importance appears to be increasing slowly, however, and they are likely to take advantage of any future technological opportunities that are not exploited rather rapidly by aggressive farm operators.

Number of Producers

The rapid decline in the number of hog producers, from 1.4 million in 1954 (2.1 million in 1950) to an estimated 400,000 in 1979, will continue, though at a somewhat slower rate, through the 1990's (figure 14). Unless there is a significant change in international trade in pork, U.S. producers still will be providing little more than domestically consumed pork in the year 2000.

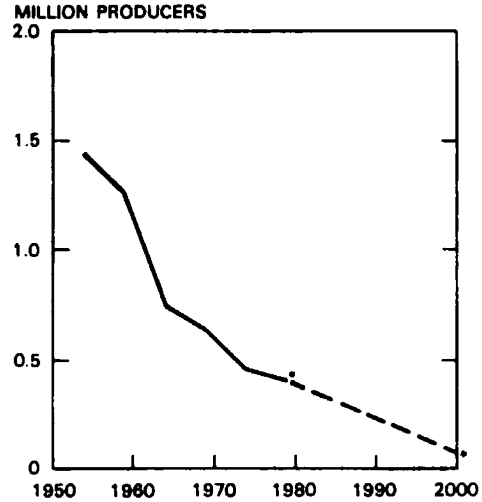
U.S. consumers have demonstrated a willingness to consume no more than about 60 pounds annually (carcass weight) of pork per capita at prices that will cover total costs of production. This amounts to about 85 pounds of liveweight per capita. Thus, a U.S. population of 264.4 million in 2000 would provide effective demand for the pork derived from about 22.5 billion pounds of hogs

FIGURE 13
DISTRIBUTION OF U.S. HOG PRODUCTION



*FIGURES FOR 1979 AND 1999 ESTIMATED

FIGURE 14
NUMBER OF U.S. FARMS WITH SALES OF HOGS AND PIGS



*FIGURES FOR 1979 AND 2000 ESTIMATED

(liveweight), or about 90 million slaughter hogs averaging 250 pounds per head. Given the enterprise size distribution projected above, this suggests there will be about 80,000 hog producers at the beginning of the 21st century.

Enterprise Specialization

Hog production is heavily concentrated on farms that also produce other livestock in addition to part or all of the feed grains used in the livestock enterprises. In 1975, nearly 60 percent of the farms with hog sales had other livestock enterprises as well, and almost 80 percent of the grain fed to hogs was produced on the same farm.

Except for the production provided by industrial organizations, such as commercial feed milling concerns, most hog production in 2000 probably will still be associated with farmland operation and grain production. Savings in the costs of transporting grains, the value of farmland as an acceptable site for the disposal and fertility value utilization of hog wastes, and the attraction of farmland as a valuable and familiar source of investment by hog producers seem likely to ensure this association. However, the increasingly specialized nature of facilities, machinery, and even management and labor used in the production of different species of livestock will severely restrict the number and proportion of farms that produce more than one type of livestock.

A higher proportion of hog producers also will specialize in only one phase of hog production—feeder pig production or feeder pig finishing. Split-phase production accounts for roughly one-fifth of all hogs produced now; it may account for close to one-third by the year 2000. A higher proportion seems unlikely, however, because most producers willing to accept the increased labor demand and risks involved in feeder pig production will elect to capture the additional returns provided by hog feeding. Exceptions usually will involve producers who have access to limited quantities of relatively inexpensive feed grains.

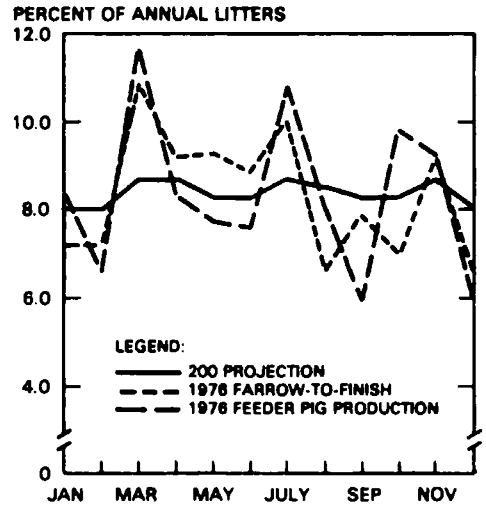
Location of Production

The anticipated association between production of hogs and feed grains will prevent any drastic regional changes in hog production during the remainder of this century. The Corn Belt and Lake States, which traditionally have accounted for about two-thirds of the national output, may produce a slightly larger share in 2000 because of petroleum price increases which will cause a faster rise in the costs of producing irrigated feed grains in the Plains States and Southwest. However, these regions account for less than one-sixth of total production now.

Seasonality of Production

The trend to year-round production—facilitated by the development of environmentally controlled, total confinement production facilities and strongly encouraged by high fixed costs per unit of production when such specialized facilities are not used near capacity—already has reduced much of the seasonal variation in production associated with one- or two-litter-per-year pasture systems of production. In 1975, the proportion of litters farrowed

FIGURE 15
PROPORTION OF HOG LITTERS FARROWED BY TYPE OF ENTERPRISE, 1976 AND PROJECTION



during the heaviest month exceeded the proportion during the lightest month by only 4.3 percentage points in feeder pig production enterprises and by 5.8 percentage points in farrow-to-finish enterprises (figure 15). As hog production enterprises become larger and more specialized in response to the forces discussed above, seasonal variations in farrowings will virtually disappear before the end of this century. Environmentally related seasonal differences in litter size and in rate of pig weight gain also will be largely eliminated, leading to approximately equal monthly production of slaughter hogs.

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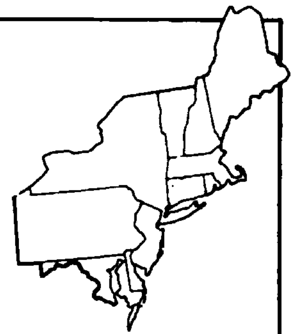
Part III.

Regional Contrasts in Farming



The Northeast

Lyle P. Schertz

SUMMARY

Farming in the Northeast has undergone substantial transformation since World War II. Land used for crops has decreased more than 40 percent since that time. The number of people on farms has declined and now accounts for only a little over 1 percent of the total population of the region. Even in rural areas, people on farms constitute only 8 to 9 percent of the population; a drop in use of farm labor of over 75 percent during 1950-77 compares with a similar decrease of about 70 percent for the United States as a whole. Farm size has increased but average acreage now is less than one-half of the U.S. average. In farm receipts, however, the average Northeast farm is just under the U.S. average.

Intensive specialized production is common, especially among medium to large farms. Many of these farms emphasize one or two crops or a livestock enterprise such as dairy or poultry.

There is great diversity in the way farms are organized and managed. Some farms, such as a number of large poultry units, are large when measured either by total resources utilized or production. They use relatively large amounts of purchased inputs such as machinery and chemicals and many finance a large part of their operations with loans. Other farms are much smaller and some are very small. Many, but not all, of the households related to these farms have nonfarm incomes.

Several forces have contributed in major ways to the transformation of Northeast farming. Inflation, credit, new technologies, tax

rules, and nonfarm employment have been especially important—as they have been for all regions of the United States. Opportunities which allow families to combine farm and nonfarm employment are unusually good in most areas of the region. In addition, the limited amounts of highly productive land along with a general division of most land into small parcels has hampered the aggregation of large tracts of land for farm purposes; this has had considerable influence on the way farms are organized and managed. Further, government programs and policies have had a pervasive influence on the stability and profitability of dairying and the manner in which dairy products are marketed. In turn, farmers have organized their resources to be compatible with the opportunities provided by these programs and policies.

Lower transportation costs have enabled producers in other regions to compete more effectively with Northeast producers, especially in fruit and vegetable production. Conversely, lower transportation costs have made it possible to transport grain to the southern part of the region to produce poultry at costs competitive with those of growers closer to the source of grain.

Changes in energy prices create great uncertainties for Northeast farming. The terms of trade among factors of production are changing. These changes will encourage individual farmers to conserve land and capital goods relative to labor. Higher transportation costs should enhance the competitive position of Northeast fruit and vegetable farms. However, the supply response of the Northeast to market forces is uncertain.

PAST AND PRESENT

Northeast Highly Urbanized

One of every four Americans lives and works in the Northeast . . . about 54 million people in 1970. Most of these people live in cities and even a majority of the people in rural areas are not engaged in farming. For example, people on farms in the Northeast account only for slightly over 1 percent of the total population of the region and are equivalent to only 8 to 9 percent of the total nonmetropolitan population. Thus, not more than 1 in 12 people in the rural Northeast live on a farm. This extent of urbanization reflects the shifts of population in the Northeast in the 1970's toward open country and small towns (*1*).[1]

Added perspective about farming in the Northeast is given by data

[1] Italicized numbers in parentheses indicate references listed at the end of this chapter.

which relate population, land, and farm numbers for the Northeast to those for the United States as a whole, as follows:

	Northeast percent of U.S. total
Population	26
Land area	6
Farmland	3
Farm production	4
Farm numbers	7

It follows from these and other data that:

- A large proportion of people in the region are not engaged in farming, but nonetheless are in proximity to farmland.
- Those engaged in farming generally are close to nonfarm employment opportunities.
- People in the Northeast consume more food than is produced in the region.
- Farming is intensive on the most productive farmland in the region.

Changes in Northeast and U.S. Compared

One of the most striking developments in farming in the Northeast has been the decrease in land used for crops for 100 years. The total of this land reached an historic peak in about 1880 (*6*). It then declined and later rose to a World War II peak of 21 million acres in 1944. Then there was a continuous decline to 12 million acres in 1969–a decrease of over 40 percent from the World War II peak. A portion of the decrease was due to the construction of roads and new housing, but the major portion involved land that was no longer profitable to farm. Such land reverted to trees. Since 1969, there has been about a 10-percent increase in acreage of land used for crops.

The directions of these changes in land devoted to crops are similar to changes for the United States as a whole. However, in percentage terms, the Northeast decline in acreage was much larger. The recent increase in Northeast crop acreage began in 1969, compared with 1962 for the United States as a whole, and has been relatively smaller: 8 percent compared with 13 percent. Data on comparative acreages are shown on top of page 260.

Thus, one of the conditions underlying the transformation of farming in the Northeast was a dramatic decrease in the amount of

Acreage	Land used for crops Northeast	United States
	Million acres	
Largest acreage in 1940's	21 (1944)	379 (1944)
Lowest acreage since 1940	12 (1969)	331 (1962)
Largest acreage in 1970-77	13 (1977)	377 (1977)

land in crops during 1944-69. This phenomena is related closely to changes in the number of farms and their size. Farmland in the United States that became available as people left farming has, for the most part, been recombined with other land into larger farm units. However, this has not been the case in the Northeast; a substantial portion of such land has gone out of farm production. Land suited for subsistence-type farming in the 1800's has continuously shifted back to trees. Major shifts occurred in the thirties, fifties, and sixties.

These contrasts are implicit in the changes in farm numbers and farm size, as measured by acres. The number of Northeast farms declined 63 percent during 1950-78; the comparable U.S. percentage was 53 percent (figure 1).

As in the United States as a whole, the Northeast rate of decline in number of farms has slowed substantially in recent years. The decrease in the fifties averaged 3.3 percent per year, 2.4 percent in the sixties, and (as of 1978) 0.5 percent in the seventies. Related average farm sizes are:

Year	Average farm size Northeast	United States
	Acres	
1950	105	213
1977	167	396

While U.S. average farm size has almost doubled, size in the Northeast has increased by two-thirds (figure 2).

When size is measured by total receipts, the average Northeast farm is about equal in size to the average for the United States. It was somewhat greater for several years, but in recent years the average size of farm in the Northeast, as measured by cash receipts,

FIGURE 1
NUMBER OF FARMS

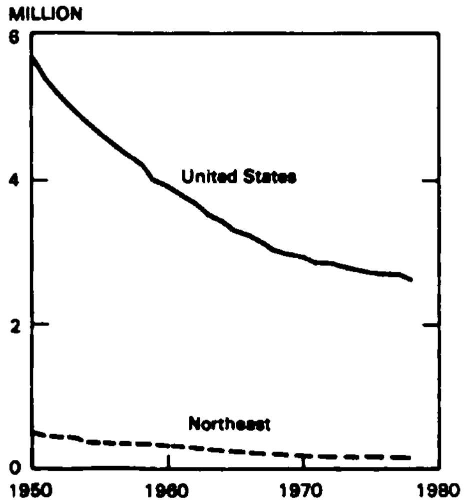
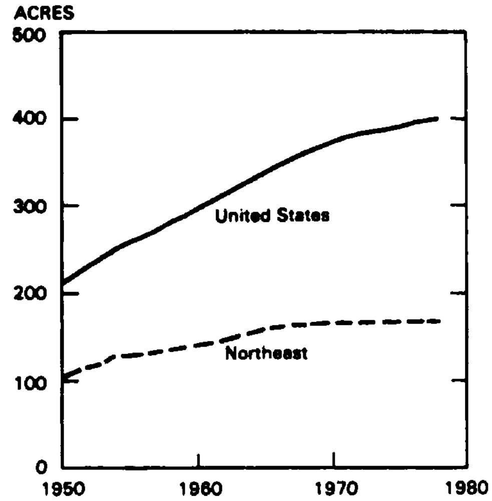


FIGURE 2
AVERAGE FARM SIZE



has been about 10 percent less than the U.S. average. Data on Northeast and U.S. receipts follow:

	Cash receipts per farm			
	Current dollars		1978 dollars	
Period	Northeast	United States	Northeast	United States
	Thousands			
Average				
1960-62	101	10	23	21
1970-72	20	20	36	37
1976-77	22	24	37	41

The growth in farm size in the Northeast during the seventies has been extremely small, when measured in constant 1978 dollars. The increase for the Northeast was between 3 and 4 percent; for the United States, it was almost 11 percent.

The contrasts between acreage and cash receipts as measures of farm size reflect emphasis in the Northeast on high-value farm products. It is an intensive type of farming, compared with the rest of the country. For example, during 1975-77, the Northeast share of total U.S. cash receipts for each of the following farm products was greater than 7 percent (the percent that the number of farms in the Northeast is of the number of U.S. farms):

Farm cash receipts, Northeast, 1975-77	
Commodity	Percent of U.S. total
Dairy	21
Broilers	17
Eggs	15
Greenhouse and nursery	19
Potatoes	19
Apples	28

The decrease in farm numbers is associated largely with farms of less than 500 acres (figure 3). The number of Northeast farms of more than 500 acres has varied from about 8,000 to 9,000 since 1954. The number was nearly 9,100 in 1964, but dropped 11 percent in 1969 before increasing to about 9,000 in 1974. The best farmland in the smaller units has been combined into larger units which compete effectively both in the region and nationally. Data on Northeast farms numbers during 1954-74 follow:

Farm numbers, Northeast				
Farm size	1954	1959	1969	1974
Acres		*Thousand*		
Less than 500	370.0	276.6	164.6	137.1
500-1,000	6.8	7.2	6.8	7.4
1,000 and over	1.3	1.2	1.3	1.6
	378.0	285.1	172.8	146.1

Farms of less than 500 acres account for all of the decrease in land in farms in the Northeast. Land in farms in each category—the 500- to 1,000-acre size and the 1,000-acre and over size—has increased. These increases reflect the consolidation of land from smaller farms into larger farms during 1954-74, as shown on top of page 263.

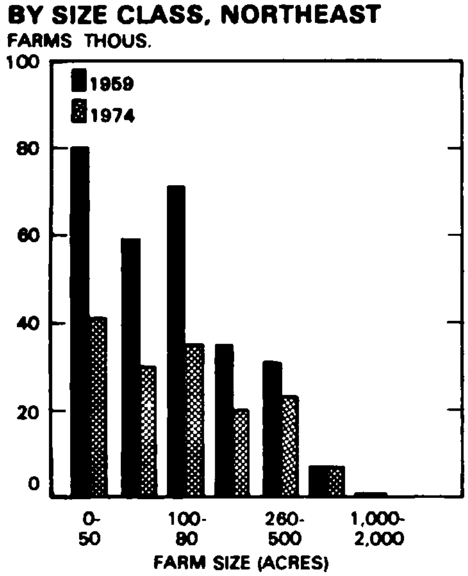
There also have been changes in the size distribution of farms, when measured by sales. The most pronounced change has been a large decrease in number of farms that are relatively small. For example, during 1959-69, the number of farms with sales of $2,500 to $20,000 dropped by 50 percent (figure 4). Conversely, the number of farms with sales greater than $20,000 increased. These comparisons are influenced somewhat by inflation; for example, the

Land in farms, Northeast				
Farm size	1954	1959	1969	1974
Acres	*Million acres*			
Less than 500	39.3	33.4	22.6	19.3
500-1,000	4.3	4.6	4.4	4.7
1,000 and over	2.1	2.3	2.2	2.6
	45.7	40.3	29.2	26.6

index of prices received by farmers increased 13 percent during 1959-69.

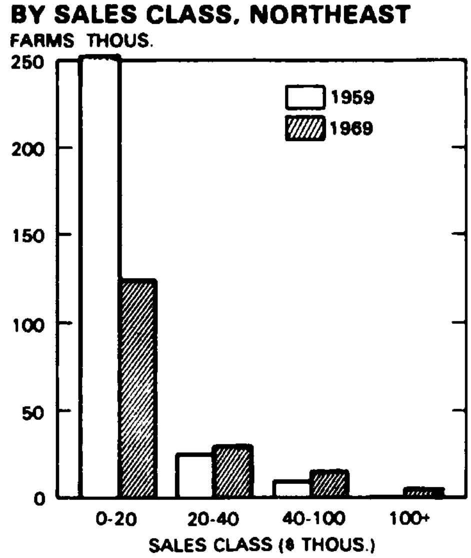
A direct comparison of size distribution between 1969 and 1974 provides limited insight, however, because of an increase of about 80 percent in farm product prices in those 5 years. Figures 5 and 6 are adjusted for inflation, in that the 1969 distribution (figure 6) is plotted on the basis of 1974 dollars. Detailed comparisons of farm numbers for these sales classes illustrate the substantial changes in the sixties and smaller adjustments in the early seventies. The number of farms in the $0 to $36,000/$40,000 sales class (1974 dollars) was practically unchanged during 1969-74. In contrast, farms in the $36,000/$40,000 to $72,000/$80,000 sales class (1974 dollars) declined from $30,000 to $26,000. These numbers, in combination with those presented in the U.S. chapter, suggest that the rate of concentration into larger farms in the Northeast has been less rapid than in the United States as a whole. Data on

FIGURE 3
FARM DISTRIBUTION BY SIZE CLASS, NORTHEAST



NOTE FARMS WITH MORE THAN $2,500 SALES

FIGURE 4
FARM DISTRIBUTION BY SALES CLASS, NORTHEAST



farm numbers, by sales class, follow:

Number of farms in the Northeast				
Sales class				Sales class
Current dollars	1959	1969	1974	1974 dollars
Thousand	*Thousands of farms*			*Thousand*
0- 10	202			0- 20
0- 10		99		0- 19
0- 20			98	0- 20
10- 20	50			20- 40
10- 20		25		20- 36
20- 40			23	20- 40
20- 40	24			40- 80
20- 40		30		36- 72
40- 100			26	40- 100
40 & over	9			80 & over
40 & over		19		72 & over
100 & over			11	100 & over
Total	285	173	158	

Unfortunately, similar data are not available for the 5-year period since 1974. The very slow increase in average farm size (in

FIGURE 5
FARM DISTRIBUTION BY SALES CLASS, NORTHEAST, 1969

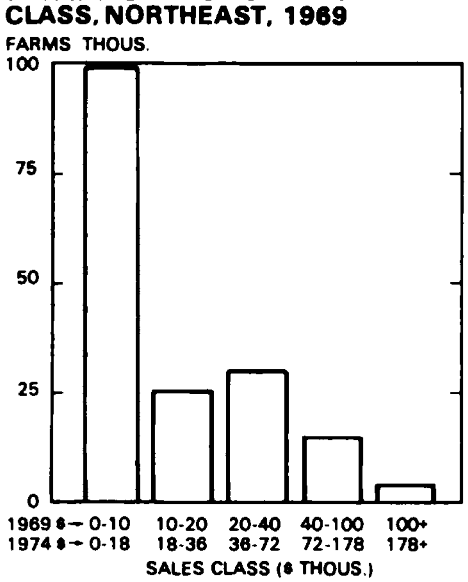
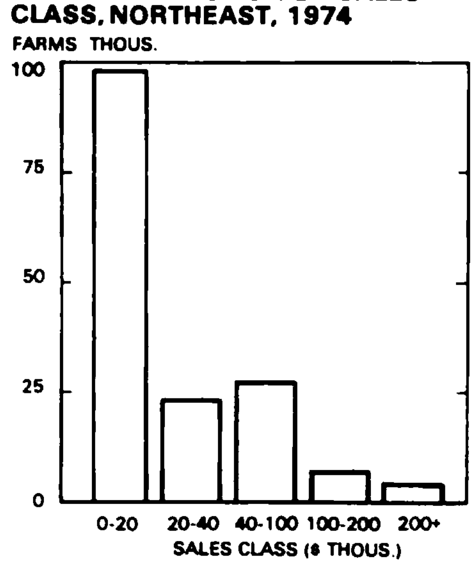


FIGURE 6
FARM DISTRIBUTION BY SALES CLASS, NORTHEAST, 1974



acres) suggests relative stability in the distribution of acreage among Northeast farms. However, this implication is not necessarily true; the increase in average sales per farm since about 1973 (in 1978 dollars) (figure 7) could be reflecting growth among larger farms. This increase also could be associated largely with the decrease in the number of small farms.

Operators Own Three-Fourths of Farmed Land

The proportion of land in farms in the Northeast that is rented is considerably less than for the United States as a whole. In 1974, only 26 percent of the land in farms in the Northeast was rented; for the United States, it was 40 percent. As in other parts of the country, part-owner farms are larger than full-owner or tenant farms. About 38 percent of the land in these part-owner farms was rented in 1974.

Dramatic Changes in Resource Mix

The transformation of Northeast farming has involved many changes in the mix and productivity of resources. The following have been especially notable:

- A continued decline in use of labor in the aggregate but not per farm.
- A long-term decline in amount of land farmed for the region as a whole.
- Expanded use of fertilizer inputs, with levels of application greater than rates of application for the United States as a whole.
- Postwar productivity gains about equal to the United States in the entire post-World War II period, but markedly less in the last 10 years.
- Stable production, with increases in productivity just offsetting declines in the quantity of inputs.

Inputs

The mix of inputs used for farm production changed during 1950-77, as shown on top of page 266.

In the Northeast, the increase in capital items such as agricultural chemicals has not completely offset the declines in labor and land inputs, so that the quantity of all measured inputs in 1977 was about one-third less than in 1950 (*2*).

Productivity

The decreases in inputs, however, were offset by increased productivity during 1950-70 (figure 8). These productivity gains in the

Production inputs	Northeast	United States
	Percent	*Percent*
All farm labor	Down 76	Down 68
Cropland harvested	Down 23	Unchanged
Mechanical power and machinery	Up 5	Up 40
Agricultural chemicals	Up 82	Up 80
All measured inputs	Down 32	Down 1

region were roughly comparable to those in the United States. However, in recent years, such changes in the Northeast have been erratic and lagged behind the rest of the country, particularly in crop production. Figure 9 shows the index of farm production per hour of labor for (1) livestock and livestock products and (2) crops.

Crop yield increases in the Northeast have lagged behind increases in other regions of the country (figure 10). This lag is partially explained by comparing levels of fertilizer use in the early post-World War II period and changes since then. In 1950, the rate of application (plant nutrients per acre of crop) of fertilizer in the Northeast was higher than for any other region of the country—and, in fact, more than three times the rate in the Corn Belt. Only in recent years has the rate of application in the Corn Belt surpassed the Northeast rate, as indicated below:

Primary plant nutrients per acre harvested		
Region	1950	1977
	Pounds	
Northeast	64	152
Corn Belt	20	173
United States	24	130

Thus, the significant gains in farm productivity in the Northeast through the seventies offset the decrease in inputs to farming. The productivity gains have ceased, but the decrease of inputs for farming also has slowed. Thus, output has been in most of the past 15 years, between 95 and 100 percent of 1967 production (figure 11).

Production Trends

It is useful to compare production trends with respect to changes in (1) the mix of farm products produced within the Northeast, and

FIGURE 7
CASH RECEIPTS PER FARM, NORTHEAST

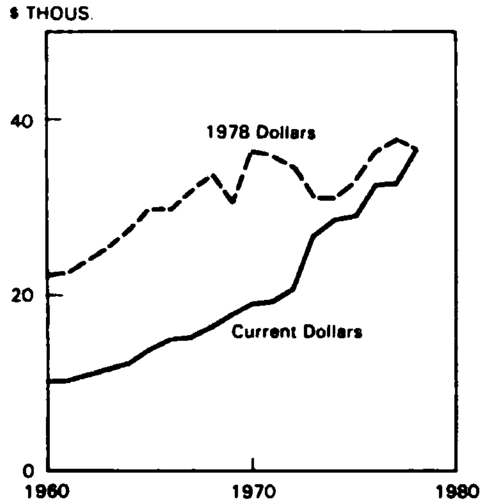


FIGURE 8
FARM PRODUCTIVITY

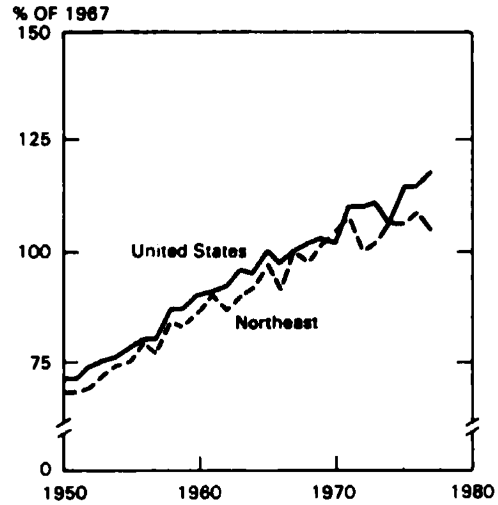


FIGURE 9
FARM PRODUCTION PER HOUR, NORTHEAST

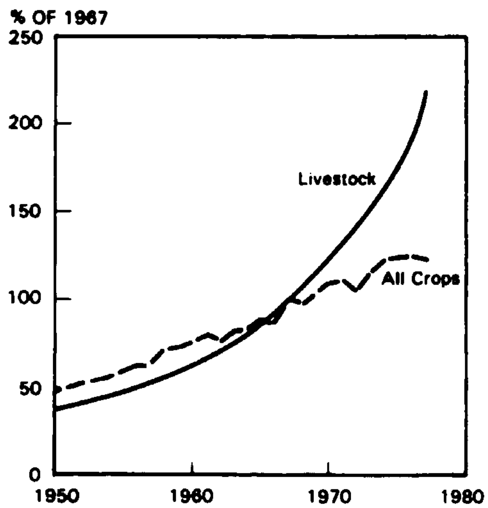
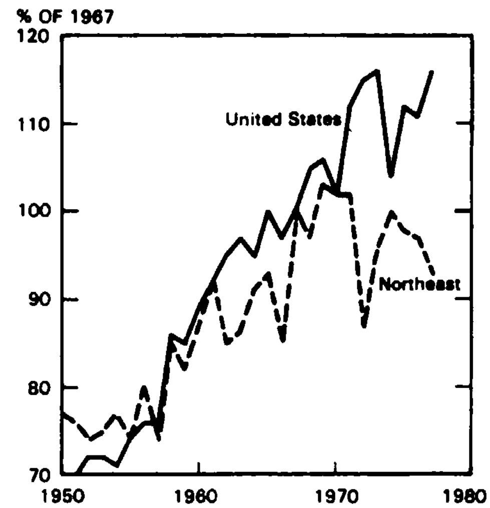


FIGURE 10
CROP PRODUCTION PER ACRE



(2) changes in the region relative to changes in the rest of the Nation.

Total farm production in the Northeast during the past 20 years has been relatively constant. Dairy production has accounted for 40 percent of all farm cash receipts in the region (figure 12). Egg production has declined somewhat; broiler production has increased slightly. None of the individual crops rank especially high. Greenhouse and nursery crop receipts are 6 percent, however, of all farm cash receipts in the region.

The relative stability of Northeast farm production, in the context of increased production in the Nation, has meant a decreased Northeast share of cash receipts for many commodities, even for

FIGURE 11
FARM OUTPUT INDEX

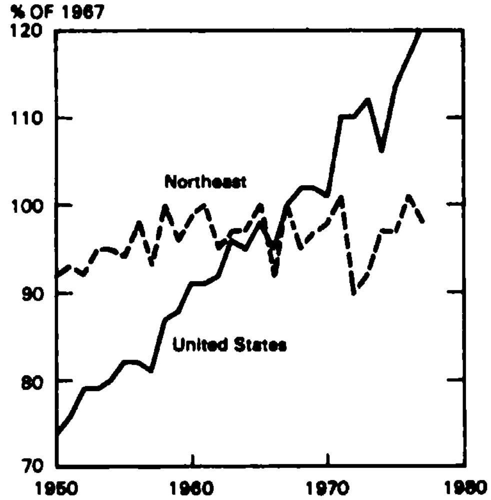
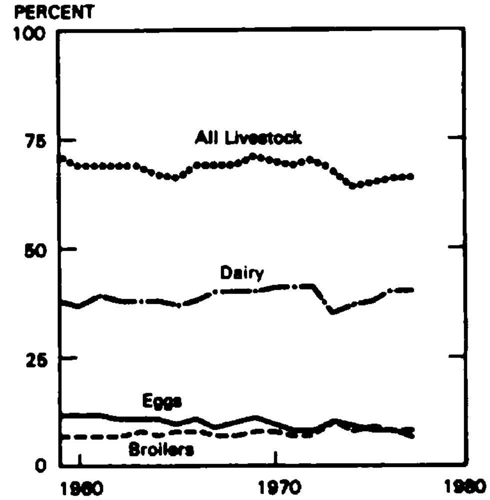


FIGURE 12
COMMODITY RECEIPTS



those products which are dominant in the Northeast—such as dairy products, as shown below:

Northeast share of U.S. cash receipts

Commodities	1960	1975-77 average	Decline
	Percent		*Percentage points*
All commodities	9	6	3
Dairy	24	21	3
Broilers	23	17	6
Eggs	22	15	7
Greenhouse & nursery	29	19	10
Potatoes	28	19	9
Apples	31	23	8

Farm Income and Wealth

Increases in farm earnings in the Northeast have been less than for the country as a whole. For example, in the Northeast, farm earnings of farm proprietors during 1974-76 were only 9 percent above the 1969-70 average; the comparable change for the United States was an increase of 60 percent.

Relative increases in farm real estate values in the Northeast have been roughly comparable to changes in the country as a whole (*3*).

However, the changes have lagged substantially behind changes in the Corn Belt. Data on real estate increases follow:

Change in farm real estate values, 1970-77	
Region	Percent increase
Northeast	118
North Central	174
United States	124

Capital gains on farm assets have overshadowed farm earnings (figure 13). During 1970-77, capital gains on farm physical assets were nearly $19 billion. Over three-fourths of this amount was related to real estate. Farm earnings for the same years totaled $5.7 billion.

Returns to Resources in Farming

Each year during 1970-77, capital gains exceeded annual earnings from farming (figure 14). As a percent of physical assets, capital gains exceeded 20 percent in 1973. The calculated return reflects a sharp increase in farm income from 1972 to 1973 (it more than doubled). Land values also were influenced by other urban and rural demands.

FIGURE 13
FARM EARNINGS AND CAPITAL GAINS, NORTHEAST

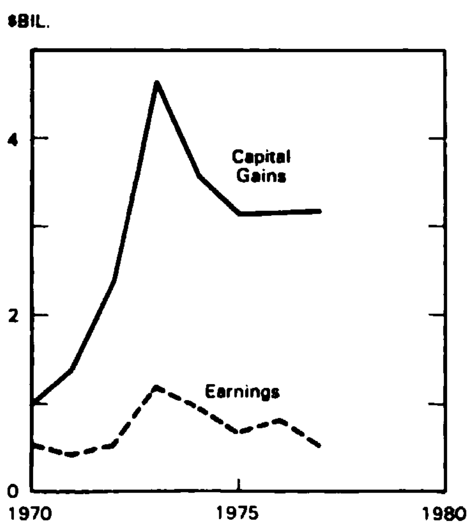
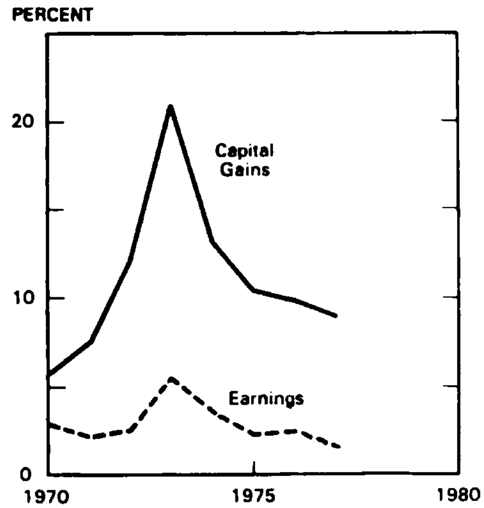


FIGURE 14
FARM RETURNS, NORTHEAST



FORCES BEHIND CHANGES

In the discussion of the United States as a whole in Part I, seven forces were identified as having had an overriding influence in recent decades on the way individual farms are organized and managed in the United States. Six of these appear to be equally applicable to the Northeast:

- Inflation.
- Availability of credit for purchase of land and capital goods.
- Commodity programs, specifically dairy.
- Availability of capital goods incorporating new technologies.
- Tax rules applicable to incomes and estates.
- Nonfarm employment opportunities.

At the same time, there are other forces that have significantly influenced the size of farms in the Northeast and the way they are organized and managed:

- Natural resources of the region.
- Long-term decreases in costs of transporting farm inputs and products.

Interaction among the first six forces listed above and the size, number, and organization of Northeast farms closely parallel the relationships discussed in the U.S. chapter. At the same time, there are some special conditions in the Northeast that affect these forces. For example, in the Northeast, as in the United States as a whole, the price of land has increased in response to demand for farmland. Part of this demand is associated with increased farm earnings and the attractiveness of land as a hedge against inflation. Nonfarm demands for land associated with urbanization also appear to be especially acute in the Northeast, when compared with the rest of the United States and other regions (e.g., the North Central), as shown below:

	Urbanized land[1]			
	1977		Change from 1967 to 1977[2]	
Region	Acres	Percent of total land	Acres	Percent of total land
	Mil.		*Mil.*	
Northeast	14.1	12.9	4.3	3.9
North Central	23.4	8.5	5.5	2.0
United States	94.8	5.7	29.2	1.9

[1] Nonfederal land in urban and other built-up areas, and transportation uses (*5*).
[2] Assumes that quantity of land in built-up areas of one-fourth to 10 acres was unchanged during 1967-77.

These data reveal that one of every eight acres in the Northeast was urbanized by 1977. About one-third of this urbanization has occurred in the previous 10 years.

The data related to urbanization indicate the proximity of Northeast people to rural lands. This proximity and urban and suburban growth trends have given rise to demand for land—in anticipation of the potential effects of further urban growth on the price of the land. The potential values often overwhelm the possible price increases attributable to farming. In turn, interest in farming wanes and land goes from farm production to rural residences and to brush and trees. Inflation also affects input prices and, in many cases, land taxes.

The availability of credit in combination with inflation has limited opportunities for land purchases to those who have other assets which provide capital that can be used to bridge the gap between possible farm production earnings and debt service requirements. Readily available credit facilitates the holding of land for prospective urban development.

Capital goods, such as milking equipment used in dairying, have enabled size increases in individual farms. Mechanization also has led to decreased dependence on migrant labor for large-scale vegetable and some fruit farms. Technological innovations also have been very important in the establishment of large-scale poultry units in parts of Pennsylvania, Delaware, and Maryland.

Nonfarm employment opportunities are especially important in the Northeast, and are major factors enabling a large number of people to combine farm and nonfarm employment. In many cases, the farming activities are relatively small. One of every three manufacturing jobs in the United States is located in the Northeast.

While the Northeast has not shared in recent U.S. growth in manufacturing, there has been substantial decentralization of jobs that previously were located in central cities. This decentralization has facilitated the combining of farm and nonfarm employment and, in turn, fostered the retention of some resources in farming that would otherwise not be used for farming. The nonfarm employment opportunities also have led to the retention of resources in small production units rather than consolidation into larger farm businesses.

There are significant differences between the government program supporting dairy product prices and the commodity programs discussed in the U.S. chapter. Commodity loans are not used to support prices. Instead, the government purchases dairy products when necessary to realize the mandated support level for dairy products. In addition, Federal and State milk marketing orders establish and enforce a system of prices for milk at the farm in major market areas.

There are two very important price effects of these regulations:

- Prices received by producers reflect higher prices for milk used for fluid consumption than for milk used in manufacturing dairy products such as butter and cheese.
- Differences between prices in the Lake States and in the Northeast have been greater than would have been the case without these regulations.

These price effects, in combination with government support of dairy prices, have encouraged more milk production, led to higher farm incomes, and slowed the decline in farm numbers in the Northeast.

Fallert and Buxton have estimated how these regulations, in combination with price supports, have influenced dairying in the Northeast (*4*). Their estimates of the effects of eliminating government regulations involving pricing and pooling policies of dairy products, along with discontinuing price support purchases, are as shown on top of page 273.

As these estimates indicate, present regulations insulate Northeast dairy producers from competition of producers in other regions, especially the Lake States. Prices for fluid use are based on distances from Eau Claire, Wis. Thus, related prices throughout the Northeast are greater than the Wisconsin price. The differences may not be as great in the absence of regulations. Areas of New York and Pennsylvania, where more fluid milk is produced than is consumed, would be particularly affected. The effects of eliminating these regulations probably would be less now than several years ago. In recent years, the spread between fluid milk prices and manufacturing milk prices has narrowed.

Another government regulation prohibits the sale of reconstituted milk at prices lower than for fresh milk. Reconstituted milk is made from powder but sold in liquid form. In the absence of this regulation, large producing areas, such as Wisconsin, could supply powdered milk and ship it to other consuming areas at much less cost than for shipping fluid milk. The net effects on Northeast farms of permitting this technology to be effectively used would be similar to those estimated by Fallert and Buxton.

Restrictions on imports of cheese and butter have similar effects. Their relaxation would mean lower prices, fewer cows, less milk production, and a smaller number of farms in the Northeast.

Natural Resources

Areas such as southeastern Pennsylvania, the central plains of New York, and parts of Maryland have high-quality soils that are well-drained, relatively flat, and relatively homogeneous over substantial

Effects of eliminating dairy product price and pooling regulations and price supports[1]

Regions	1977	1985
	Percent difference	
Number of farms with milk cows		
Northeast		−3.2
Lake States		+4.4
United States		−.6
Number of milk cows		
Northeast		−3.2
Lake States		+4.4
United States		−.6
Milk production		
Northeast	−.3	−3.2
Lake States	+.1	+4.4
United States	−.2	−.7
Prevailing fluid use price		
Northeast	−12.3	−7.4
Lake States	−7.0	−2.2
United States	−9.7	−6.7
Net cash income of representative farms		
Northeast	−16	−7
Lake States	+13	+14

[1] All effects are in relation to baseline estimates, assuming continuation of present regulations and policies.

areas. Thus, large-scale mechanization can be used efficiently in these areas. Conversely, large portions of the Northeast have poor and variable soils with rough topography which hinder large-scale mechanization.

Differences in the nature of soils are evident from comparing the proportions of land in land-capability classes I, II, and III (the three classes the U.S. Soil Conservation Service defines as "land suitable for regular cultivation") (*6*). Data on such land are shown on page 274.

Relatively small tracts of land combined with limitations on the quality of land affect farm organization and management. It is much more difficult to aggregate large tracts of land into one production unit where parcels are small than it is if parcels are larger.

Farm acreage is less per owner in the Northeast than in other

	Land suitable for regular cultivation[1]	
Region	Acres	Percent of total[2]
	Mil.	
Northeast	35	37
North Central	162	64
United States	614	44

[1] Land-capability classes I, II, and III in 1977.
[2] Percent of total nonfederal rural land.

regions. A landownership survey showed that 15 percent of the land in Northeast farms was owned by people with 50 or fewer acres; only 7 percent of the farmland in the North Central region had ownerships with comparable acreage (*7*). The farm owners with 50 to 100 acres in the Northeast had 18 percent of the land; in the North Central region, such owners had 12 percent of the land.

Transportation Costs and Market Development

National markets have developed for many commodities. For example, fruit and vegetables grown in California are sold throughout the country. Dairy products also are being shipped greater distances than in earlier years, as some restrictions have been relaxed. These changes have enabled farmers to produce commodities increasingly consistent with their comparative advantage, relative to producers in other parts of the country. This trend toward national markets partially accounts for declines in the Northeast's share of total U.S. cash receipts for farm products.

One of the primary factors in the development of national markets was a decrease in the relative cost of transportation. Improved highway systems and refrigerated trucks were involved. Such technological innovations and associated investments enable producers in other regions to more easily compete in the markets of the Northeast. At the same time, nonfarm employment opportunities and pressures of urbanization encourage land and labor to leave farming.

But comparative advantage works both ways. While tomato and lettuce production in California became more competitive, similar efficiencies in transportation costs facilitated the shipment of grains to the East for use in producing poultry and milk. This grain might have been used to produce poultry, eggs, and milk closer to the source of grain. But the owners of available resources in the Corn Belt, for example, obviously chose not to do so and presumably profited from the choice.

THE FUTURE

If trends in the Northeast continue for the next 20 years, there will be further decreases in the number of farms and more decline in acreage of land in farms. The land taken out of production will be abandoned, consolidated into ongoing units, or used for nonagricultural purposes. Farm size, as measured by acreage, will increase, and there will be some small increases in large farms, as measured by the real value of farm sales. Part-owner farms, as a portion of total farms, will increase somewhat, and capital goods will continue to be substituted increasingly for labor and, in some cases, for land.

However, we live in an era of discontinuities, and it is possible that many of these trends will not continue. Relative changes in energy prices are the most important discontinuity that could alter trends in the way farming is organized and managed in the Northeast. Higher energy prices already have had a substantial impact on the cost of capital goods and, as indicated in Part I, labor prices in recent years have increased less than the prices of capital goods and land. This contrasts sharply to the long period during and after World War II, when wage rates increased much more rapidly than prices of land or capital goods. Thus, changes in terms of trade among the factors of production have shifted dramatically in recent years. These changes will encourage individual farmers to conserve land and capital goods relative to labor, and the way farms are organized and managed will be affected accordingly.

Higher energy prices raise substantial questions about prospective changes in the cost of living in the Northeast, relative to some other parts of the country. The eventual contrast in cost of living changes could lead to further relocation of industry from the Northeast to other parts of the country and, in turn, to continued migration out of the region. This could have effects on demands. However, the Northeast is bound to be deficit in food production for a long time to come. This situation could affect job opportunities for people who want to combine farm and nonfarm work.

Transportation costs take on special meaning because the region will continue to import food from other parts of the country. Prospective further increases in prices of gasoline and diesel fuel and wage increases associated with inflation will increase the costs of transporting food from other parts of the country to the Northeast. While these increases will increase the economic opportunity for production in the region, the supply response and its effects upon the size and number of farms in the region are uncertain.

One possible scenario would be a slight increase in farmland over time, as farmers found it advantageous to cultivate land that had been abandoned previously but not yet placed into urban uses. The mix of farming likely would reflect the production of higher valued crops, such as vegetables, fruits, and nursery products to compete with crops that are now imported from other regions.

Continual emphasis would be given to the conversion of roughage into milk and beef, unless twinning of calves becomes a reality—in which case the return associated with small beef cattle operations may be too limited to attract labor, management, and other resources necessary for their production.

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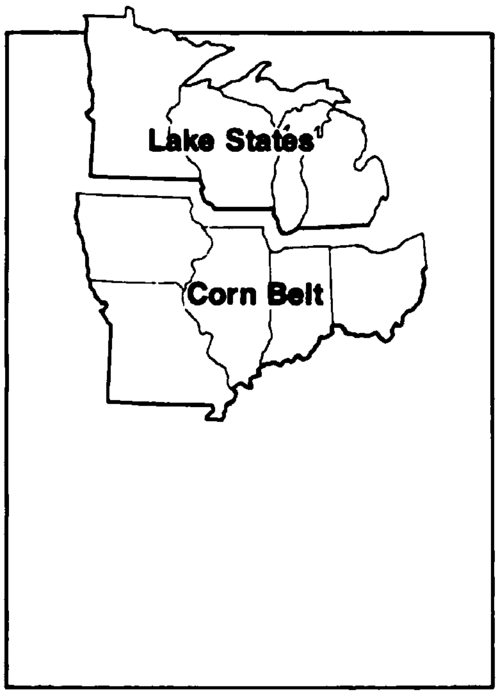


The North Central

Lyle P. Schertz

SUMMARY

Farming in the North Central region is undergoing a transformation involving:

- *Increased farm size measured either by land area or sales.*
- *Increased specialization by farmers, especially between crops and livestock.*
- *Increased separation of ownership and use of land and machinery.*

Farms vary in size; production has shifted increasingly toward larger farms. In the North Central region, as in other regions, there are substantial differences in size among farms. More than a third of the farms in the region in 1974 involved less than 100 acres. Conversely, almost 10 percent of the farms involved more than 500 acres. Over a period of years, the number of farms over 500 acres has increased while the number of those with less than 500 acres has decreased. However, in more recent years, the number of farms with less than 50 acres has increased.

Farm receipts data also indicate an increased proportion of production by larger farms. The transformation of farming involves the substitution of capital goods for labor and land. Specialization of farms has involved choices between crops and livestock as well as among crop and livestock enterprises.

The increases in wealth of farmers in the North Central region are among the largest in the United States. Real estate values in 1977, for example, were nearly three times their 1970 value. When

inflation is taken into account, the increase is slightly over 50 percent. Thus, changes in asset values have exceeded the inflation rate. As in the United States as a whole, annual earnings from farming in the region are dwarfed by capital gains in assets.

The seven forces identified in Part I as having a major influence on the way U.S. farms are organized and managed also are applicable to the North Central region. The original approach in settling the Northwest Territory and the 160-acre tenet of the homestead legislation, as well as the highly productive nature of much of the soil in the region, also have been important forces.

Prospects appear strong that farm numbers in the North Central region will continue to decline and their average size will become larger in terms of both land area operated and value of products sold. The decline in farm numbers, however, is likely to be concentrated among the middle-size farms, but the rate of decline may continue to slow. Major developments in our economy—inflation, energy prices, and changes in tax rules—could alter these trends.

Concerns about the separation of ownership and use of resources may be particularly evident in the North Central region in the future. Ownership of individual land parcels in the next two decades will involve multiple ownership by descendants of those who experienced the capital gains of the 1970's. This in itself may involve separation of ownership and use of land. In addition, some children not farming will want to sell their interest, but family people may not be able to buy and potential buyers may not be farm operators. In fact, those family members farming likely will prefer that sales be made to people willing to rent the land to them.

The magnitude of these developments probably will be much greater than likely sales to non-Americans. However, the characteristics of the operators and the resulting organization and management of farms may not be greatly different.

PAST AND PRESENT

Decline in Farm Numbers Slowed

Farming in the North Central region is undergoing a transformation involving:

- Increased farm size measured either by land area or sales.
- Increased specialization by farmers, especially between crops and livestock.
- Increased separation of ownership and use of land and machinery.

The changes in averages and distributions of characteristics of farming in the North Central region are very similar to those for the

United States. This situation is largely because of two conditions:

- A large proportion of cropland and farm production in the United States is associated with the North Central region. Thus, numbers for the North Central region heavily influence numbers applicable to the United States as a whole.
- Farms in the North and South generally are smaller and farms in the West generally are larger than farms in the North Central region, thus offsetting each other somewhat in the calculations of U.S. averages.

The North Central region often is considered to have two major subregions–the Lake States and Corn Belt. A perspective of the differences and similarities of these subregions, as well as the relationship of the North Central region to farming in the United States as a whole, is given in the following data:

North Central subregions compared

Subregions	Population, 1977 Total	Population, 1977 Farm	Farm numbers, 1978	Cropland, 1974	Farm receipts, 1977
	Mil.		*Thou.*	*Mil. acres*	*Bil. dol.*
North Central	53	2.9	864	137	31.1
Lake States	18	1.1	285	41	
Corn Belt	35	1.8	579	96	
United States	216	7.8	2,668	439	95.7
North Central as percent of United States	25	37	32	31	32

Additional comparisons are included throughout the text of this chapter.

Farm numbers in the North Central region have dropped 45 percent in the 30 years since 1950 (figure 1). This decline has been less pronounced than in other regions, especially when compared with the Northeast's comparable decline of over 60 percent in farm numbers. Nonetheless, the changes in farm numbers in the North Central region have been substantial, with the sharpest declines in the 1950's and 1960's and annual rates close to 2 percent a year. The rate of decline slowed considerably in the 1970's to a rate about two-thirds of earlier years, as shown on top of page 280.

Total land in farms has decreased slightly as farm numbers have declined. However, land used for crops has increased as farmers

Farm numbers, North Central region

Year	Thousand	Decline: Thousand	Decline: Percent per year
1950	1,552		
		335	−1.9
1960	1,217		
		261	−1.9
1970	956		
		92	−1.2
1978	864		

cropped larger proportions of their farms. The decrease of total land in farms in the region has been about 15 percent since 1950. Partially because of commodity programs, changes in (1) the amount of land used for crops and in (2) the total amount of farmland were approximately the same until the mid-to-late 1960's (figure 2). Since then, land in crops has increased about 20 percent, while land in farms has continued to decline about 5 percent. The net result of declining farm numbers and the mixed changes in farmland and cropland involves an increase in average size of farm, measured in acres of land, of over 50 percent since 1950 and close to a 30-percent increase since 1960 (figure 3).

The increase in farm size is even more pronounced when measured by cash receipts than when measured by land. For example, when receipts per farm for each year are expressed in terms of 1978 farm product prices (1978 dollars), 1978 receipts per farm are double the 1960 level (figure 4).

Production Shift to Larger Farms

In the North Central region, as in other regions, there are substantial differences in size among farms. Nearly one-fifth of the farms in the region in 1974 involved fewer than 50 acres. Conversely, almost 10 percent of the farms involved more than 500 acres. During 1959-74, the number of farms in each class of less than 500 acres decreased (figure 5). The number of farms with fewer than 50 acres, however, increased during 1969-74, as people combined part-time farming with nonfarm employment, as shown on top of page 281.

These distributions of farms by size indicate substantial concentration of land in large units. In 1974, the most recent year for which

Farm numbers, North Central region[1]

Farm size	1969	1974	Change
Acres		*Thousand*	
Less than 50	141	153	+12
50- 260	516	432	−84
260- 500	179	159	−20
500-1,000	56	64	+8
Over 1,000	9	14	+5
	901	822	−79

[1] Farms with sales greater than $2,500.

data are available, 10 percent of the farms in the region were 500 acres or larger and accounted for 34 percent of the land in farms, as shown below:

Farms and land by size class, 1974, North Central region

Farm size	Farm numbers	Land in farms
	Percent	
Less than 50	18	2
50- 260	53	33
260- 500	19	31
500-1,000	8	23
Over 1,000	2	11
	100	100

Farm receipts data also indicate an increased proportion of production by large-size farms. As in the Northeast, for example, the most pronounced change has been a drop in the number of farms now considered to be relatively small. The decrease in the 1960's was quite large and continued in the first part of the 1970's, but at a slower pace.

During 1959-69, the number of farms with sales of $2,500 to $20,000 declined by one-third. The number of farms with sales of $20,000 or more, on the other hand, increased in the same period (figure 6). These data reflect the effect of inflation to some extent,

FIGURE 1
NUMBER OF FARMS

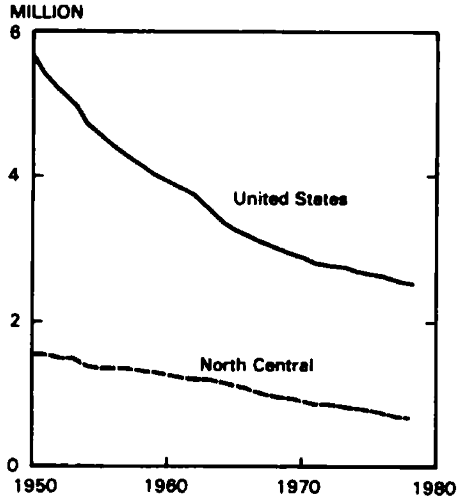


FIGURE 2
LAND IN FARMS, NORTH CENTRAL

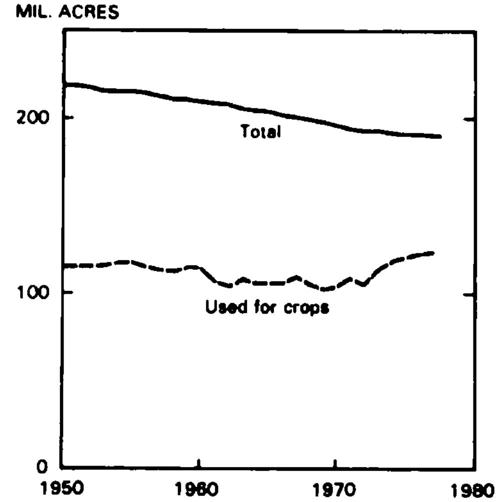


FIGURE 3
AVERAGE FARM SIZE

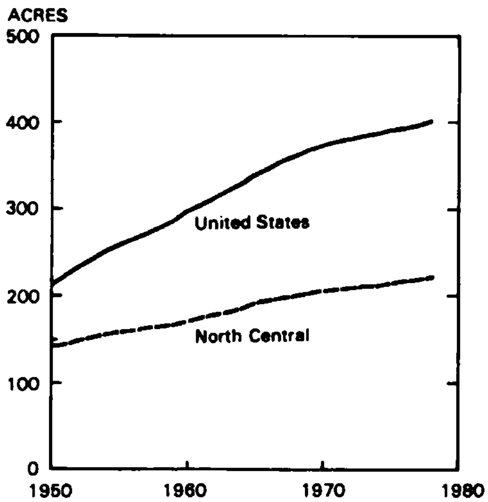
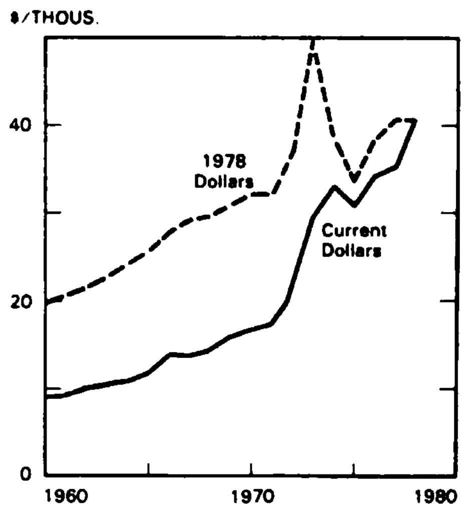


FIGURE 4
CASH RECEIPTS PER FARM, NORTH CENTRAL



but only to the degree that the index of prices received by farmers increased 11 percent during the 10 years.

Changes in size distribution have continued into the 1970's. Direct comparison of size distribution between 1969 and 1974 provides limited insight, however, because of increases in farm product prices of about 80 percent in those 5 years. Figures 7 and 8 account for inflation in that the 1969 distribution is plotted on the basis of 1974 dollars. Note that the vertical scales for these figures are one-half the scale used in figure 5. Detailed comparisons of farm numbers by sales class illustrate the substantial changes in the 1960's with smaller adjustments in the early 1970's, as follows:

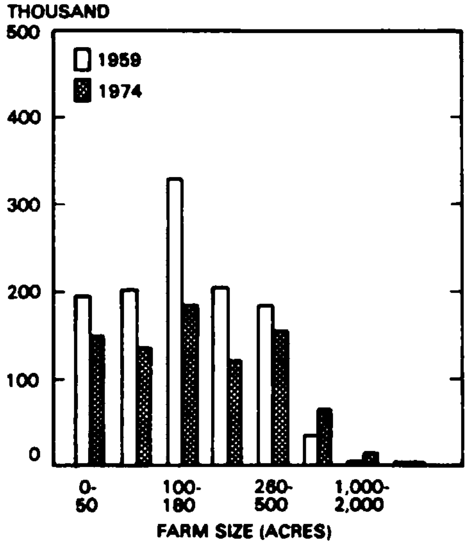
Comparison of farm numbers, by sales class

Sales class	Number of farms			Sales class
Current dollars	1959	1969	1974	1974 dollars
Thousand	*Thousands of farms*			*Thousand*
0- 10	848			0- 20
0- 10		514		0- 18
0- 20			490	0- 20
10- 20	208			20- 40
10- 20		167		18- 36
20- 40			140	20- 40
20- 40	74			40- 80
20- 40		144		36- 72
40-100			141	40-100
40 & over	24			80 & over
40 & over		77		72 & over
100 & over			51	100 & over
Total	1,154	902	822	

The number of farms with sales less than $36,000/$40,000 (1974 dollars) declined about 8 percent during 1969-74. The greatest decline occurred on farms with sales of $18,000/$40,000 (1974 dollars). Farms with sales of $36,000/$40,000 to $72,000/$100,000 (1974 dollars) evidently declined in number, but the data do not permit a percentage calculation. The decline is evident, however, since there were about 144,000 farms in the $36,000/$72,000 (1974 dollars) sales class in 1969, while there were only 141 in the much larger sales class of $40,000/$100,000 in 1974.

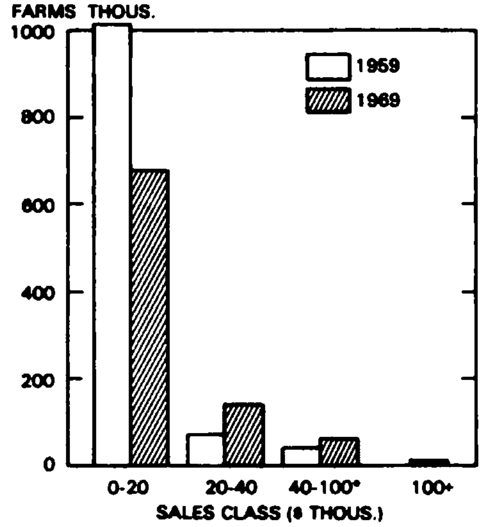
Comparable data are not yet available for the 5-year period since 1974. The slow increase in average farm size, as measured by acres, may imply relative stability in distribution of acreage among farms (figure 4). But acreage size has not been a good indicator of size, as measured by sales or distribution of size. Further, average sales per farm in the region in 1978 were 23 percent above the 1974 level, when measured in current dollars, and 12 percent, when measured in 1978 dollars. These changes could be reflecting growth among larger farms.

FIGURE 5
FARM DISTRIBUTION BY SIZE CLASS, NORTH CENTRAL



NOTE: FARMS WITH MORE THAN $2,500 SALES

FIGURE 6
FARM DISTRIBUTION BY SALES CLASS, NORTH CENTRAL



*40+ FOR 1969

FIGURE 7
FARM SIZE DISTRIBUTION BY SALES CLASS, 1969

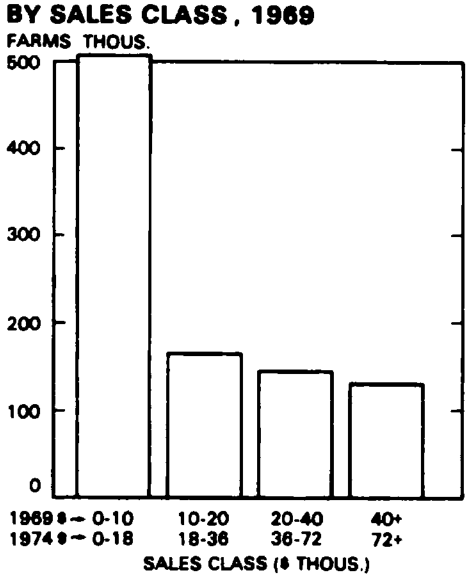
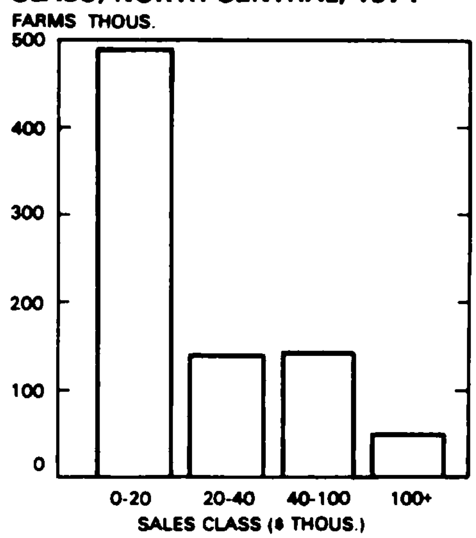


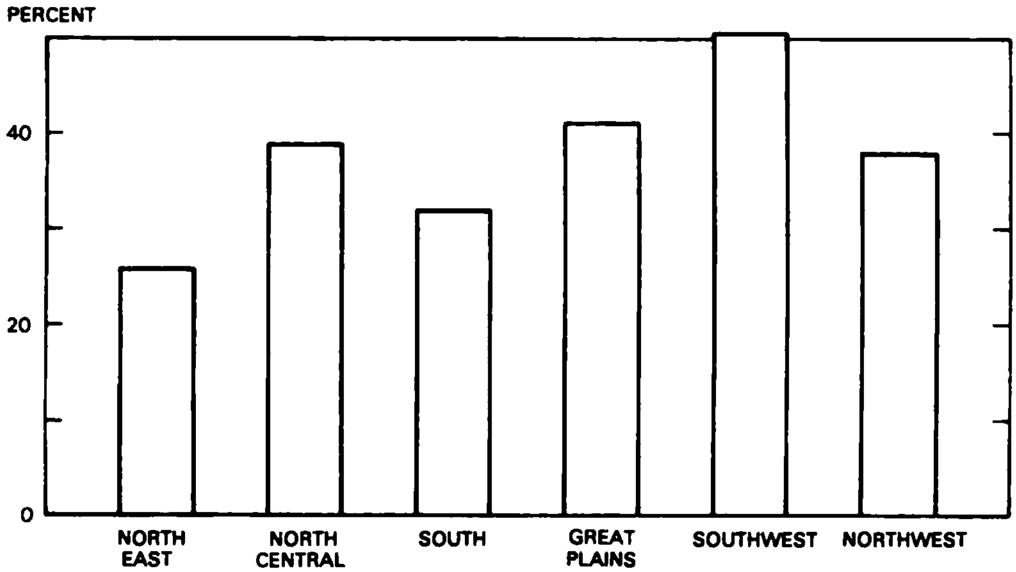
FIGURE 8
FARM DISTRIBUTION BY SALES CLASS, NORTH CENTRAL, 1974



Operators Own Three-Fifths of Farmed Land

The proportion of land rented in the North Central region is greater than in the Northeast and South but less than in other regions (figure 9). In 1974, 39 percent of the land in farms in the North Central region was rented. There is a contrast between the Lake States and Corn Belt, however. In the Lake States, 28 percent of the land is rented; in the Corn Belt, 44 percent. Part-owner farms are larger than either full-owner or tenant farms. Increasingly, nonoperator landowners are selecting tenants who already operate other land and own all or part of it.

FIGURE 9
LAND RENTED, 1974



Less Labor and More Capital Goods

A shift in the mix of resources used in farm production has been associated with decreases in numbers of small farmers and increases in the number of larger farms (*1*).[1]

The amount of farm labor decreased precipitously after World War II in both the Lake States and Corn Belt. By the late 1970's, the decline was more than 70 percent (figures 10 and 11). Land inputs declined somewhat in the Lake States but were quite stable in the Corn Belt, and chemical use tripled after 1950. While increases in the use of mechanical power and machinery were slower, these changes were vital to changes in farm size.

Machinery enabled farmers to accomplish crop production tasks faster. This speed enabled farmers to acquire larger farm operations without undue risks of missing planting and harvesting schedules. Mechanization also enabled livestock producers to enlarge their operations without corresponding increases in labor. Capital items also have enabled precision control of the environment for animals and preparation of feed, thereby facilitating increases in the size of livestock production units. The changes in the mix of inputs used in farming reflect adjustments in functions performed by farmers. At one time, farm resources—labor, land, and capital—produced much of the energy and fertilizer used on farms and did much of the handling and processing of farm products. Many of these activities now are performed by resources in input industries—and industries which market, process, and distribute farm products (*3*).

Differences in the transformation of farming in the Lake States

[1] Italicized numbers in parentheses indicate references listed at the end of this chapter.

FIGURE 10
FARM INPUTS, LAKE STATES

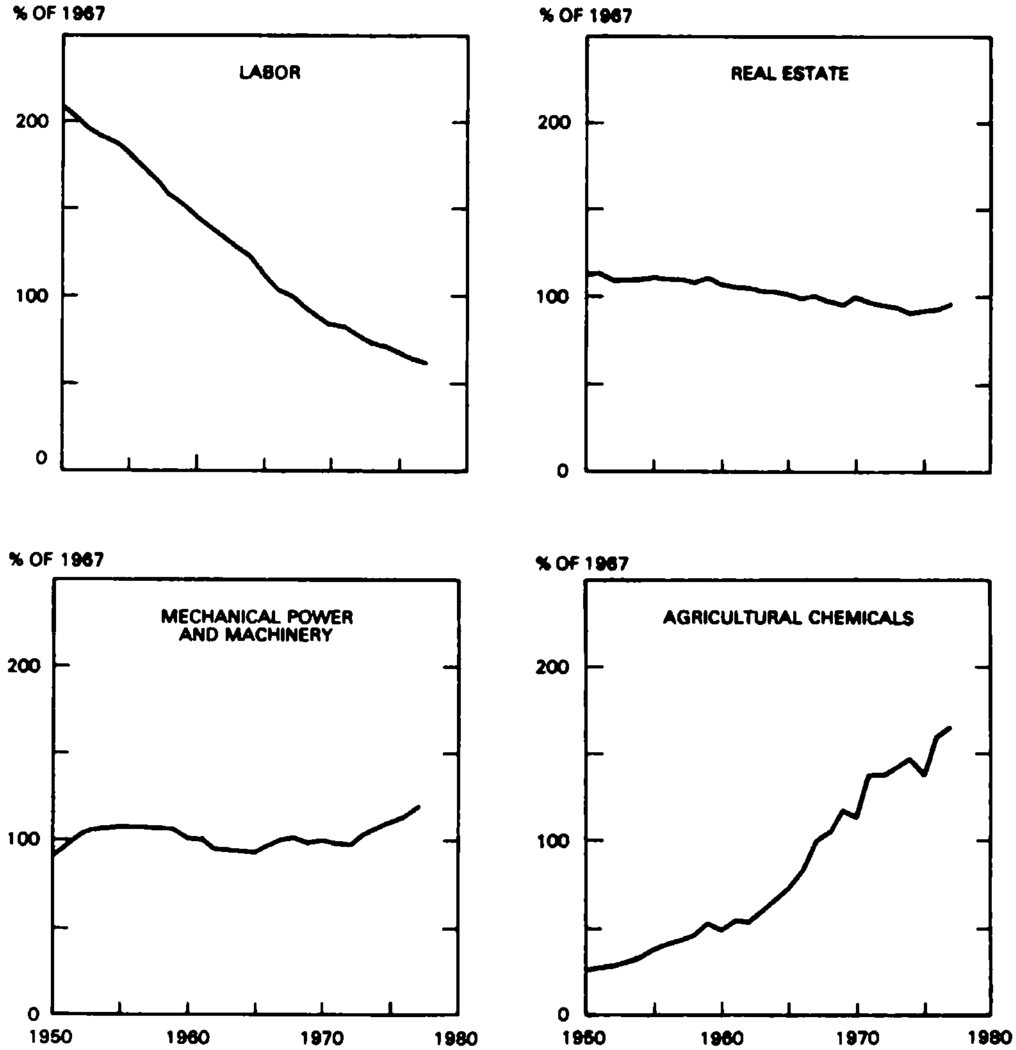
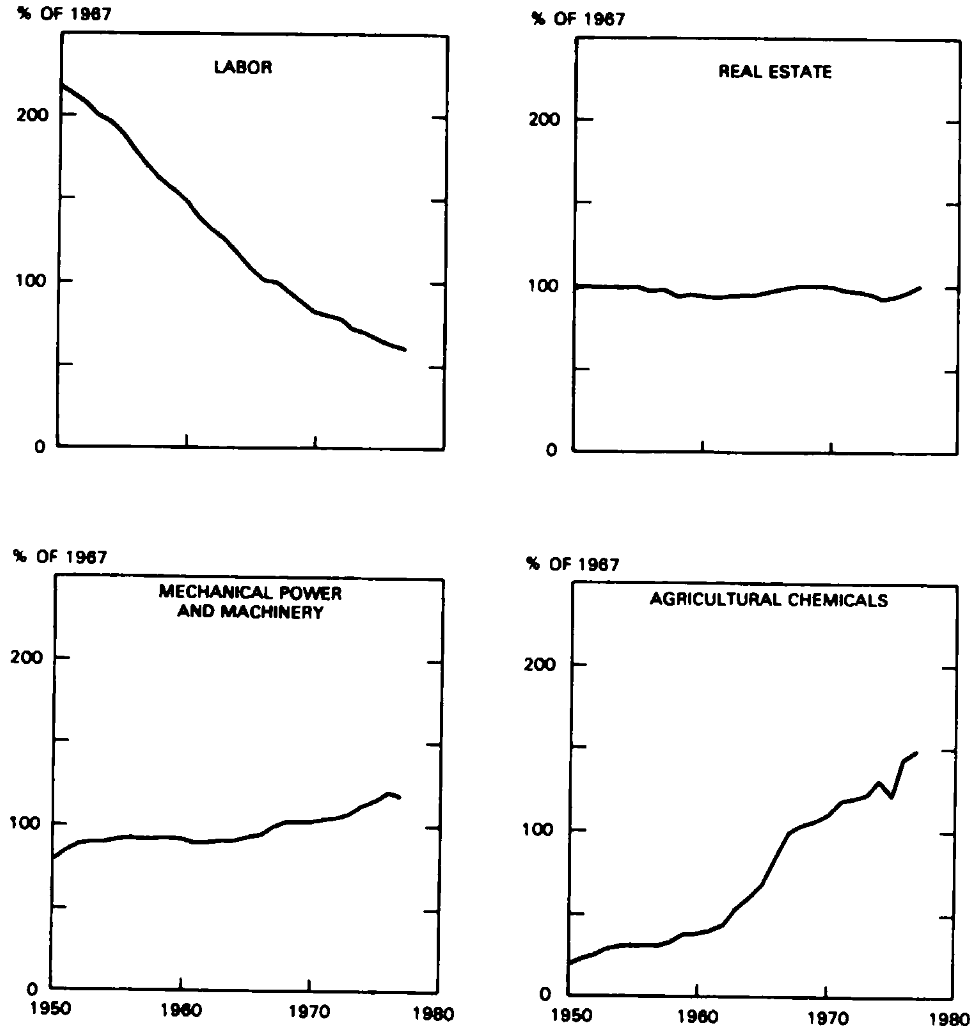


FIGURE 11
FARM INPUTS, CORN BELT



and Corn Belt are reflected in contrasting changes in total inputs to farming and corresponding changes in output. All measured inputs in the Lake States declined about 12 percent from the early 1950's to the latter part of the 1970's. In contrast, inputs in the Corn Belt declined only slightly into the 1960's and then increased about 8 percent, with the level of inputs in 1975-77 up 6 percent from the early 1950's, as indicated below:

Period	Total farm inputs, index (1967 = 100) Lake States	Corn Belt	United States
1950-54	112	96	106
1960-64	104	94	100
1975-77	99	102	102
1975-77 as percentage of 1950-54	88	106	96

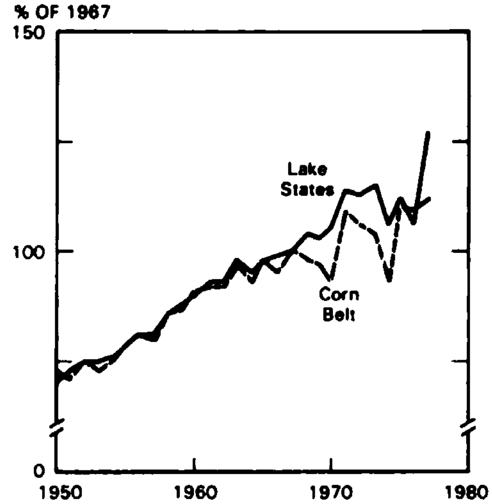
The growth in output during the 1950's and 1960's in the Corn Belt was increasingly faster than in the Lake States, as well as the United States as a whole, as shown below:

Period	Farm output, index (1967 = 100) Lake States	Corn Belt	United States
1950-54	82	67	78
1960-64	98	88	93
1975-77	114	113	117
1975-77 as percentage of 1950-54	139	169	150

However, the contrast in the fifties and first half of the sixties between the Corn Belt and Lake States is associated entirely with the drop in farm inputs shown in the tabulation above. Productivity changes in the Lake States and Corn Belt were almost identical throughout the 1950's and the first half of the 1960's (figure 12).

In recent years, increases in productivity in the Lake States have exceeded those in the Corn Belt. This contrast is attributable to two developments: (1) in 1975-77, livestock production in the Corn Belt was 12 percent less than in 1967, while in the Lake States it was unchanged from 1967; and (2) gains in labor efficiency in livestock production in the Lake States were greater than in the Corn Belt in

FIGURE 12
FARM PRODUCTIVITY,
NORTH CENTRAL



1967-77. Dairy farms in the Lake States were particularly aggressive in substituting machinery and equipment for labor during this period.

During the entire 1950-77 period, the most dramatic contrast between the subregions was an increase in crop productivity in the Corn Belt, measured either by production per acre or labor per hour, as shown below:

Indexes of crop production per acre (1967 = 100)

Period	Northeast	Lake States	Corn Belt	United States
1950-54	76	71	60	71
1960-64	88	92	86	93
1975-77	96	111	112	113
1975-77 as percentage of 1950-54	126	156	187	159

Indexes of crop production per hour (1967 = 100)

Period	Northeast	Lake States	Corn Belt	United States
1950-54	52	45	37	38
1960-64	79	80	74	72
1975-77	127	151	153	148
1975-77 as percentage of 1950-54	244	335	414	389

These changes in input-output ratios reflect increased inputs of capital items—especially machinery, fertilizer, and other chemicals such as herbicides. The measured inputs to farming do not count labor incorporated in the inputs obtained from nonfarm sources or labor involved in the marketing and distribution subsector of U.S. agriculture.

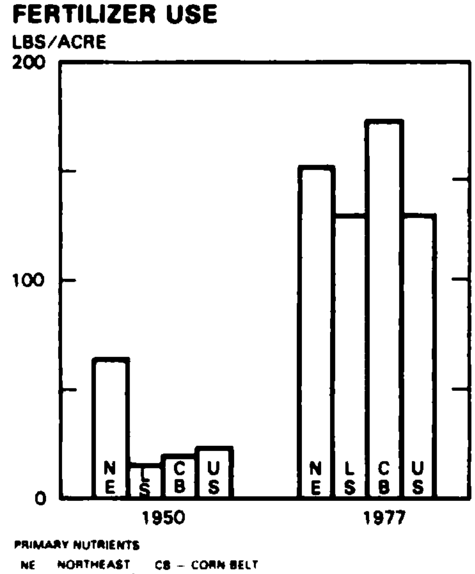
Increases in crop production per acre since 1950 have been somewhat greater in the Corn Belt than in the Lake States or the United States as a whole. Changes in fertilizer use by farmers account for a large part of this difference (figure 13). Note especially that in 1950 both the Lake States and Corn Belt lagged behind the Northeast and United States as a whole in terms of application of plant nutrients per acre of cropland. In contrast, in 1977, applications of fertilizer in the Corn Belt were greater than in the Northeast, Lake States, or United States as a whole.

Changes in the indexes of crop production per hour of labor reflect not only the status of mechanization in the late 1940's and early 1950's but also the extent to which the use of large-scale farm equipment and large tractors has expanded. The greatest expansion has been in the Corn Belt, compared with the Lake States.

Farms More Specialized

Specialization of farms has involved choices between crops and livestock as well as among crop and livestock enterprises. At one time, practically every farm produced several grains, as well as hay and several species of livestock—hogs, beef, dairy—as well as poultry. It is not uncommon today, however, for individual farms in the North Central region to produce corn and soybeans without any

FIGURE 13
FERTILIZER USE



other crops or livestock. This is especially the case on the more fertile lands in the Corn Belt. While there still are some farmers who give equal attention to crops and livestock or poultry, the proportion has declined rapidly as farmers interested in livestock have increased in size. Many of these livestock producers have maintained substantial crop activities, but in terms of "value added" livestock production has become relatively more important.

In crops, corn and soybeans have replaced lower yielding crops such as oats. Even so, the North Central region's share of U.S. corn and soybean production has declined. But this decline is associated with large increases in U.S. production and sales of these products. The region's share of total U.S. crop receipts increased from 22 percent to 31 percent during 1959-61 to 1975-77, as shown below:

Share of U.S. farm receipts, North Central region		
Crop	1959-61 average	1975-77 average
	Percent	
Corn	69	67
Soybeans	72	65
Wheat	19	19
Greenhouse & nursery	24	18
Hay	17	18
Tomatoes	19	9
Sugar beets	14	19
All crops	22	31

North Central region livestock receipts as a share of U.S. receipts reflect the increased specialization of farms. By 1959-61, broiler sales of the eight States making up the North Central region already had dropped to 7 percent of the U.S. total. By 1975-77, the figure was down to 3 percent. In the same time period, egg receipts of the region dropped from 29 to 20 percent of the U.S. total.

In all, the North Central region's receipts from livestock dropped from 40 percent of the U.S. total to 34 percent during 1959-61 to 1975-77. The change in receipts from cattle and calves was especially large, as shown on top of page 292.

This product specialization also shows up in a distribution of the region's sales among products. Livestock products in the early 1960's constituted 70 percent of farm receipts. In recent years, the share has been just over 50 percent (figure 14), and sales of crops

Share of U.S. farm receipts, North Central region		
Commodity	1959-61 average	1975-77 average
	Percent	
Broilers	7	3
Eggs	29	20
Cattle and calves	35	24
Dairy products	39	40
Hogs	72	68
All livestock	40	34

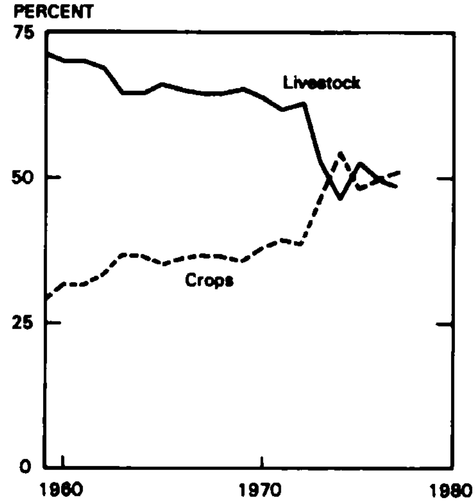
have increased from 30 to just under 50 percent. Changes for individual products are included in the following tabulation:

Farm receipts, share by product, North Central region		
Commodity	1959-61 average	1975-77 average
	Percent	
Livestock	70	51
Crops	30	49
Cattle	24	15
Dairy	17	15
Hog	19	17
Other livestock	10	4
Crops		
Corn	10	20
Soybeans	8	17
Other crops	12	12
Total	100	100

Increases in Wealth Among Largest

Real estate values have increased dramatically in the North Central region, as earnings increased and prospects for farm income remained good. Increases were greater than in any other region in that real estate values of $179 billion in 1977 were 174 percent

FIGURE 14
COMMODITY RECEIPTS,
NORTH CENTRAL



above 1970 values. When inflation is taken into account by deflating real estate values with the index of prices paid by farmers for living and production, the increase is 54 percent. Thus, changes in real estate asset values have exceeded the inflation rate by a significant amount. A comparison of regional real estate values in 1970 and 1977 follows:

	Real estate values			
			Increase	
Region	1970	1977	Dollars	Percent[1]
	Bil. dol.		*Bil.*	
Northeast	12	27	14	118
North Central	65	179	114	174
South	44	87	43	97
Great Plains	60	134	74	124
Northwest	10	20	10	107
Southwest	24	36	12	50
United States	215	482	267	124

[1] Calculated with unrounded numbers.

The increase in real estate asset values for the North Central region also is reflected in changes in all physical assets per farm (*2*). Data per farm, however, reflect the consolidation of land into larger farms, increased amounts of machinery and other physical assets, and higher unit values of these assets. A comparison of regional assets in 1970 and 1977 follows:

Region	Physical assets per farm 1970	1977	Increase
	Thousand dollars		*Percent*
Northeast	91	198	118
North Central	97	265	173
South	59	130	120
Great Plains	130	293	125
Northwest	123	263	113
Southwest	286	390	36
United States	99	229	131

During the period, the increase in physical assets per farm was greater in the North Central region than in any other region. Even so, the 1977 average of $265,000 in assets per farm was still less than the average for the Southwest and Plains, and approximately the same as for the Northwest.

A significant amount of the increase in value of physical assets reflects a revaluation of these assets to account for increases in expected farm earnings. For example, farm earnings in 1973 were more than three times the 1970 level.

A comparison of rates of annual earnings and rates of capital gains for the North Central region parallels such data for the United States as a whole. Annual earnings are dwarfed by the capital gains on physical assets. On a percentage-of-physical-asset basis, annual earnings during 1970-77 ranged from 3 to about 10 percent. Capital gains on the other hand, ranged from 2 to as high as 28 percent (figures 15 and 16).

FIGURE 15
FARM EARNINGS AND CAPITAL GAINS, NORTH CENTRAL

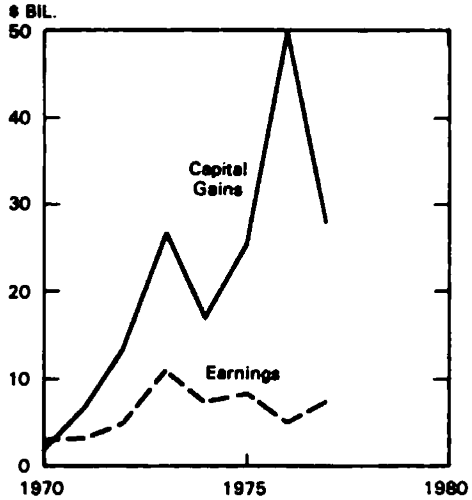
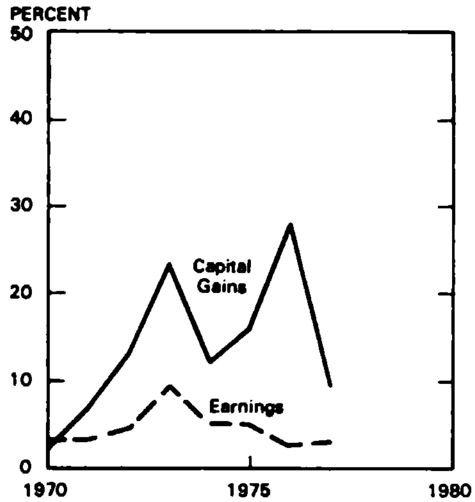


FIGURE 16
FARM RETURNS, NORTH CENTRAL



FORCES BEHIND CHANGES

The U.S. chapter identifies seven forces that have affected the way individual farms are organized and managed:

- Inflation.
- Increases in farm product exports.
- Availability of capital-intensive new technologies.
- Nonfarm employment opportunites.
- Availability of institutional credit for the purchase of land and capital goods.
- Commodity programs supporting farm product prices.
- Tax rules applicable to incomes and estates.

Each force has had a major impact on the transformation of farming in the North Central region. Among the forces listed above, availability of capital-intensive new technologies and increases in farm product exports merit further discussion, in addition to that provided in Part I. Early settlement patterns and natural resources of the region also have had a direct influence on the size of farms in the region and the way they are organized and managed.

Capital Goods

The effect of fertilizer use on farm size probably has been different from the effects of machinery and equipment. Rates of fertilizer use in the Corn Belt in the immediate post-World War II period were low relative to present usage, as well as relative to usage in other regions such as the Northwest. Increased use of fertilizer has facilitated increased yields in the region, especially of corn—which, in turn, very possibly has restricted increases in farm size in acres. Without the increased yields, pressures for farm size expansion, in acreage, would have been greater so individuals could earn higher incomes. The role and possible influence of chemicals on farm size may have been similar.

Machinery and other equipment undoubtedly have facilitated increases in farm size. As pointed out earlier, these capital goods have enabled more timely planting, cultivating, and harvesting. In turn, farmers have been able to effectively manage larger areas of land and its production.

It is not clear to this author why mechanization with large tractors did not occur more rapidly in the North Central region, especially the Corn Belt areas of flat land. Large tractors, combines, and related equipment have been used in the Great Plains for many years. This was not the situation in the Corn Belt or Lake States. More recently, however, the four-wheel-drive tractor has become acceptable to a significant number of farm operators in the North Central States. Their earlier availability and adoption and/or adoption of crawler-type tractors in the region would have added impetus to increasing the size of farms.

Further, certain technologies incorporated in capital goods facilitated large-scale livestock and poultry production. This had (1) a direct effect on farm size by enhancing the feasibility of large-scale livestock production units in the region and (2) an indirect effect on farm size by enhancing the competitive positions of such producers in other regions. The result was a decrease in the share of U.S. livestock production provided by farms in the North Central region, thereby increasing specialization of production.

As pointed out earlier, these capital goods facilitated the shift—from farms to nonfarm enterprises—of functions that had been performed on farms. Energy and fertilizer once were produced primarily on farms. They are not today. Farmers once did much of the handling and processing—and, in some cases, even the distribution. They do not today. This specialization of functions between farms and other enterprises has, in turn, affected the characteristics of farms and how they operate.

Exports

Increased farm exports have provided greater flexibility for aggressive farmers to increase their size by affecting the prices of these commodities and by making it possible for the government to support prices without severe production restraints on individuals.

As pointed out in Part I, the Nation's agricultural exports increased dramatically in the 1970's.

Among the many products experiencing an increase in exports, the increase has been especially large for corn and soybeans, two of the major farm products of the region, as shown below:

U.S. agricultural exports

Crop	Average 1959-61	Average 1969-71	Average 1976-78	1976-78 as percent of 1959-61	1976-78 as percent of 1969-71
	Million metric tons				
Wheat	16.1	16.8	29.4	182	175
Corn	5.3	11.8	38.5	722	327
Soybeans	3.7	10.6	17.4	474	164
Soybean oil	.4	.6	.7	195	121
Soybean oil cake and meal	.3	1.6	2.3	876	139

These increases in corn and soybean exports directly affected prices of commodities and the amount of the government-held stocks of corn and soybeans. Thus, the implementation of commodity programs was affected. The net result in recent years has been an emphasis by producers on these commodities and only limited application of government programs to restrict the acreage harvested by individuals.

Settlement Patterns

The area comprising the North Central region was a significant portion of the Northwest Territory. Thus, settlement policies for this territory influenced the original size of farms. Having owner-operators of farms totaling 160 acres was a key tenet of homestead legislation which affected the settlement of substantial parts of the region. Family members were to be the principal laborers. Substantial economic gains from using slaves were not envisaged and slavery was not embraced. On one hand, the legacy of 160-acre size restrained the transition to larger farms. But, on the other hand, the 160-acre units, as opposed to even smaller parcels such as in the

Northeast, facilitated gradual consolidation into the larger units which are more prevalent today.

Natural Resources

Compared with other parts of the country, a large portion of land in the North Central region is fertile and highly productive. This is especially so in the Corn Belt, where close to 70 percent of the nonfederal rural land is classified in land capability classes I, II, and III (the three classes the U.S. Soil Conservation Service defines as "land suitable for regular cultivation") (*4*).

THE FUTURE

Prospects appear strong that the number of farms in the North Central region will continue to decline and their average size will become larger in terms of both land area operated and value of products sold. The decline in farm numbers, however, is likely to be concentrated among middle-size farms, and the rate of decline may continue to slow.

Some major developments in our economy—inflation, energy prices, and changes in tax rules—could substantially affect these trends. Regardless, underlying conditions point toward further separation of the ownership and use of land. Barring a depression, a significantly larger proportion of land likely will be rented in 2000 than was indicated by the Agricultural Census for 1974. In addition, farm operators likely will own a smaller proportion of their machinery, and hired labor as a proportion of total labor will continue to increase.

An increasing proportion of farmers, and perhaps even a larger number of other people, will seize opportunities to combine farming on a part-time basis with nonfarm work opportunities. Some of these individuals now are middle-size farmers, and their entry into nonfarm work may mean reduced farm activities. Others will be initiating farm activities in combination with their nonfarm pursuits. Still other people solely dependent on farming for a living but with access to only limited resources and without nonfarm employment opportunities also will be among small farmers. As the number of small farms increases, some middle-size farmers will acquire control of additional resources and become larger. Thus, while total farm numbers are likely to continue to decline—albeit at increasingly slower rates—the numbers of small and large farms are likely to increase. These developments would lead to further increases in the concentration of production.

In this context, it is important to consider again how farm numbers have changed in the past 30 years.

The decline in farm numbers in the North Central region during 1950-78 was nearly 700,000—from 1.6 million to 0.9 million farms. The rate of decline appears to have slowed in the past few years. In the 1970's, the rate has been 1.2 percent per year, compared with 1.9 percent a year in the previous 20 years. If the rate of decline averages 1 percent a year in the future, farms in the region would number about 692,000 in 2000 and some 626,000 in 2010, compared with about 864,000 in 1978.

Major Developments

Major changes in the U.S. economy could alter these trends. Clearly, an economic depression with large-scale unemployment and/or sharply lower prices could cause deviations from trend values. Also, credit, tax, and commodity policies could be altered substantially and lead to disincentives for increased farm size growth. This could lead to more and smaller farms rather than fewer and bigger farms.

But, as pointed out in Part I, the character and degree of influence of the seven forces identified have changed in ways of great significance for the future transformation of farming. Changes identified in that section with respect to inflation, energy costs, and tax rules are especially applicable to the future of farming in the North Central region.

High rates of inflation reinforce the trend toward increased farm size, and capital gains on farm assets (reflecting expected increased earnings from farming) make farmland an attractive investment alternative. This attraction, combined with the effect of inflation on interest rates and the consequent superior competitive advantage of those who already own assets, promises to lead to purchases of resources by those who already have resources (farm and/or nonfarm) and thereby to fewer but larger farms.

Increased energy costs inject substantial uncertainties in the farm sector. Because of transportation requirements in agriculture, these changes in costs are likely to stimulate regional shifts in production—but their effects on ownership and management of farms are not clear. Consequent changes in irrigation costs are likely to stimulate regional shifts in production as well.

Recent changes in Federal tax provisions related to capital gains and valuation of assets have made the ownership of farm assets increasingly more attractive. The benefits of these changes are worth more to wealthier than to poorer people. Consequently, the changes likely will lead to wealthier people (farm and nonfarm) obtaining more farm assets and perhaps lead to larger farms.

Changes in marketing arrangements for farm products also may accelerate the rate of increase in farm size. This could result in markets not being available for products of smaller farms, thus leading to substantial declines in the number of small and middle-size farms.

These declines could occur as managers of large farms find it financially advantageous to innovate ways to market their production. Such techniques—as contracts with processors or delivery of production to facilities far from farm communities—tend to decrease the number of local marketing firms by eroding their profitability and viability.

Other Considerations

The way the Northwest Territory was divided into "grids," combined with the contiguous nature of highly productive soils in much of the region and the availability and acceptance of large tractors and equipment, could facilitiate further consolidation of land resources into larger operating units. The Northwest Territory "grid" of 1-mile-square sections of land has resulted in fields of square or rectangular shape, in contrast to the irregular shapes in many other regions. These fields facilitate the use of equipment, especially when the fields are consolidated.

Admittedly, roads every mile are a hindrance . . . but not a big one, since many old farmsteads have been abandoned, thereby reducing the requirements for roads. In addition, road maintenance costs continue to increase. The combination of these conditions suggests possible abandonment of many roads, except when related ditches are important for drainage. Such abandonment would facilitate the establishment of fields that extend across more than one section of land.

Separation of Ownership and Use

In the 1980's, public debate about how farms are organized and managed in the North Central region likely will focus on (1) further declines in farm numbers, (2) increased concentration of production among larger farms, and (3) ever-decreasing marketing opportunities for small farmers. But these issues may be of secondary importance to another related issue—the potential separation of ownership and use of resources. It seems likely that ownership of individual land parcels will in the next two decades involve multiple ownership by the descendants of those who experienced capital gains in the 1970's.

This development will lead to a sequence of transactions resulting in separation of ownership and use of land. Concerns about such separation of ownership and use of resources may be particularly evident in the North Central region. People in this region have a traditional interest in farming and farmers and how related resources are organized and managed.

Available statistics do not indicate big changes over time in the proportion of land operated by owners in the region. For example, Census data indicate that 41 percent of farmland was owner-operated in 1974, only slightly different from the situation in earlier years.

On the other hand, limited information indicates that the land rental market is not in equilibrium. In response to demands for rental land, rents are increasing and leases are being changed from crop share to cash. It is not clear that these higher rents will lead owner-operators to rent more of their land. Measurements of rents relative to owner-operator returns and past behavior of landowners in response to changes in such ratios would be helpful.

Anyway, the implications of intergenerational transfer of family resources may be more important in the longer term than rents and returns to owner-operators in affecting the separation of landownership from land use. As pointed out in Part I, the wealth of some farmers has increased dramatically in the last 7 years as land values have increased in response to increased earnings from farming and owning farm assets. There are two major sets of implications of this development for the possible separation of ownership and use.

First, as explained in the U.S. chapter, those who have become wealthy have a competitive advantage in buying additional land over those with fewer assets. And this competitive advantage is facilitated by the combination of inflation and readily available credit.

Second, the substantial value of even moderate-size farms makes intergenerational transfer of resources to a single child extremely difficult, even if modification of tax rules may permit avoidance of large tax liabilities at the time of such transfers. The assets of even moderate-size farms cannot be aggregated easily into the hands of one or two children when other children are involved. Because of the increasing inability of one child to purchase the interests of the other children and their natural inclinations to not give up their inheritance, it seems likely that ownership of individual land parcels will in the next two decades involve multiple ownership by the descendants of those who experienced capital gains in the 1970's. This, in itself, may involve separation of ownership and use. In addition, some children will want their money and therefore will sell their interests. But other members of the family may not be able to buy and potential buyers may not be farm operators. In fact, those members of the family in farming likely will prefer that any sales be made to people willing to rent the land to them—rather than having the new owners farm the land themselves.

The magnitude of these developments probably will be much greater than sales to non-Americans.

Such a scenario is in sharp contrast to the much-discussed taking over of farmland by non-Americans. The characteristics of the operators and the organization and management of farms may not be greatly different, however. The major difference would be in who the landowners are. In one case, they would be non-Americans. In the other case, they would be: (1) descendants of those who realized the increased wealth in the 1970's, and (2) other Americans attracted to invest in farmland to realize profit from rents and possible further appreciation in asset values.

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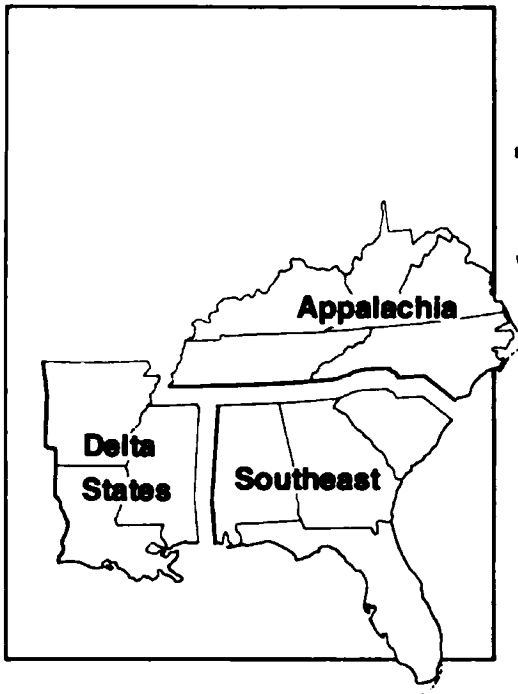


The South

W. C. McArthur

SUMMARY

The trend toward fewer but larger farms continues in the South. The large farms are becoming more specialized in production and more efficient in resource use. Productivity is increasing. The Delta (Arkansas, Louisiana, Mississippi) leads the South in farm-size growth.

The farm labor force continues to decline. The result is a growing shortage of labor, particularly seasonal labor, at prevailing wage rates and increasing pressure on farmers to adopt labor-saving production technology.

Family-operated farms dominate agriculture in the South, accounting for 90 percent of the farms and 77 percent of the land farmed in 1974. The importance of corporate and partnership types of organization is expected to increase in the future. Most farms are owner-operated. Part-owner farms are expected to increase in importance as the pressure mounts on farmers to increase size of business.

Among several factors influencing changes in resource organization and use over the last 30 years have been soils and topography, technology, government programs, and off-farm employment opportunities. More recently, the major factors affecting farm structure have been inflation, energy problems, and price variability.

New patterns of structure and organization appear possible for southern farms of the future. The emerging pattern appears to be: (1) a relatively large number of small farms (essentially part-time and

part-retirement farms); (2) an increasing number of large farms organized around the family; and (3) a growing number of large to very large farms operated under a corporate or partnership form of organization. Small farms benefit from the growth of off-farm employment opportunities in the South. Present economic conditions and those being projected for the future enhance chances for survival of large farms, in contrast to the traditional medium-sized family farm.

INTRODUCTION

The character of the farm production sector varies from region to region across the United States. Its structure and performance characteristics are diverse and constantly undergoing change. The pattern of change in the South differs not only from other sections of the country, but from area to area within the region. Some changes relate to the unique character of farming in the South; others relate to economic conditions affecting the whole of agriculture.

The objectives of this chapter are to provide an overview of changes in the structure and performance of southern agriculture over the last three decades, to assess the effects of key factors underlying specific changes, and to indicate possible new developments in the organization of southern agriculture by the year 2000. Enhancing the understanding of the regional nature of structural change and its impact on farming is essential to sound policy decisions, as well as to decisions regarding adjustments in resource use and farm output.

HISTORICAL PERSPECTIVE

Agriculture in the South was deeply rooted in cotton production from the colonial period to the early part of the 20th century. Cotton farming spread from the tidewater region of Georgia and South Carolina to the Piedmont of North Carolina and Virginia and then to Alabama, Mississippi, and Louisiana. Cotton farming then moved westward into Texas and Oklahoma, and finally to the irrigated farms of Arizona and California.

In the beginning, the soil and climate favored cotton production in the South, but output expanded slowly because the task of removing lint from the seed was slow and expensive. Then the invention of the cotton gin in 1793 marked a turning point in southern agriculture. This development, coupled with strong demand for cotton in Europe, opened the way for large-scale production. Cotton became the largest commercial crop in the South and the basis of its economy. The region supplied cotton to the textile mills of New England and Europe. In the process, cotton became the largest single export commodity of the United States.

As the South concentrated more and more on cotton, the land first used for production became eroded and unproductive. The rapid westward expansion of cotton farming and the inherent weakness of a one-crop system eventually led to a decline in the South's economy relative to other regions. Despite efforts to introduce industry in the region and to diversify its agriculture, little progress was made until after the Civil War, when the region's agriculture lay in ruin. Even then, progress was slow, partly because of the depression following the war.

A tenant system of farming was established shortly after the Civil War, replacing the use of slave labor in cotton production. The tenure system included several forms of share-renting. Production costs increased as farmers became more dependent on purchased inputs, which encouraged a move to diversification of farming and the development of improved production methods. Many large landowners had moved to town by the end of the 1890's, leaving an overseer to manage their land.

Despite all the problems, a new surge in cotton production began with the turn of the century. Cotton prices began moving upward during the Spanish-American War in 1898. As a result, cotton production increased substantially over the next two decades or more. Agriculture prospered, and farmworkers and tenants as well as the owners of cotton farms shared in the prosperity of that period. But trouble lay ahead for cotton farmers in the South.

The boll weevil appeared in Texas in 1894 and began spreading to the cotton fields of the South. The damage from boll weevil infestation became critical in the post-World War I period. Production costs rose sharply, and competition from the West increased. These developments, along with the economic depression of the 1930's and the New Deal agricultural programs curtailing production, made cotton only one of several enterprises in southern agriculture.

An increasing degree of diversification was realized during 1930-50. Large quantities of corn had always been produced, but not to compete as a cash crop. Peanuts, tobacco, hay crops, and orchard crops by that time occupied a significant part of the cropland. Livestock production also increased. Soybean production began during this period, but the phenomenal growth in soybean acreage was to occur in the years after 1950.

Other trends were emerging. They related to increases in farm size, mechanization, landownership, and the migration of people to the cities from rural areas. These factors and others were key elements giving shape to the structure of agriculture in the South as it was about to enter the last half of the 20th century.

STRUCTURE AND PERFORMANCE OF SOUTHERN AGRICULTURE: AN OVERVIEW

Significant changes have occurred in southern agriculture since 1950. Some changes have followed national trends; others reflect the impact of problems and resource situations that are unique to the South. This section contains an overview of changes and trends in the character and structure of southern agriculture, and in its performance the last three decades. For this study, the South is divided into three regions: Appalachia, Southeast, and Delta.

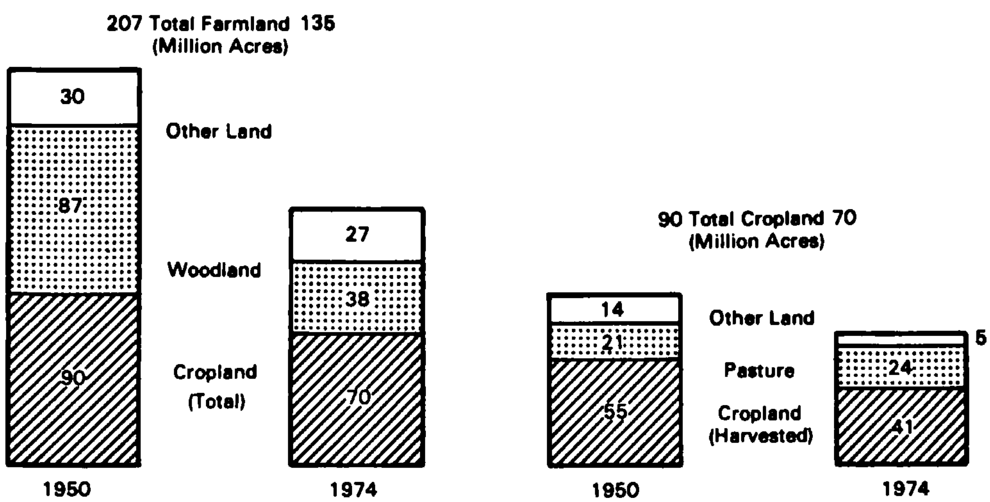
Adjustments in the Resource Base

Important changes have occurred since 1950 in the quantity and mix of resources committed to production in the South, and in the way the resources have been organized for production. These changes have influenced the location of production, farm output, and returns to the farm family.

Farmland Base

Total land in farms declined sharply in the South during 1950-74. The decline occurred in all categories of farmland use (figure 1). The decrease in cropland acreage was less marked than in total farmland. Cropland uses also underwent substantial change (figure 1). While harvested acreage decreased by about 25 percent during 1950-74,

FIGURE 1
FARMLAND USES IN THE SOUTH



SOURCE: 1(15).

acreage in pasture increased slightly. These shifts reflect adjustments in land use, including the shift of a substantial acreage of land into nonfarm uses. One result, according to some observers, has been the movement of some marginal land out of production, thus increasing the overall quality of land left in production.

Farm Work Force

The total farm work force decreased by more than 50 percent in the three southern regions during 1950-78. The rate of decline has exceeded the U.S. average for the last decade or more (figure 2). Before 1950, southern agriculture was dominated by production of labor-intensive crops—cotton, tobacco, fruits, and vegetables. But the development and adoption of new labor-saving machinery and other technologies have substantially reduced labor requirements for these crops and others, particularly labor required in harvest operations. The steady growth in farm size the last three decades has favored the use of larger machinery, thus reducing labor requirements for all operations. Conversely, the increasing cost of labor coupled with a scarcity of labor at prevailing wage rates (particularly seasonal labor) has hastened the adoption of labor-saving machines and other production technology.

The decline in family labor has exceeded the decreases in hired labor for the last 20 years or more (figure 3). This pattern of change probably is an outgrowth of the decline in small farms utilizing only family labor and the increasing importance of large farms utilizing hired labor.

Capital Inputs Increasing

There has been a marked increase in the use of capital inputs in southern agriculture. Much of the change has involved the substitution of capital goods for labor. The estimates shown on top of page 308 show the magnitude of increases in farm machinery and chemical inputs during 1950-77 in regions of the South, compared with the United States.

The most significant increase in capital outlays for agricultural chemicals occurred in the Delta region. Much of this increase may be attributed to the continuing importance of cotton in the Delta, rapidly growing soybean acreage, and increases in farm size coupled with a declining labor supply.

Farm Numbers and Size

The trend toward fewer but larger farms continued through the 1970's in the South (figure 4). The number of farms in the region

	Indexes of farm inputs (1967 = 100)					
	Farm machinery			Agricultural chemicals		
Region	1950	1965	1977	1950	1965	1977
Appalachia	69	93	116	55	86	131
Southeast	76	95	119	45	82	144
Delta	68	92	112	38	80	160
United States	84	94	116	29	75	151

Source: (*11*).[1]

declined by 50 percent during 1950-79; average size increased from 135 acres per farm to 209 acres (about 55 percent) during the same period. The decline in farm numbers was greatest in the Delta region and least in the Appalachian region (figure 5). Increases in farm size are occurring more rapidly in the Delta, where farm enlargement possibilities are more favorable than in other regions of the South.

The changes occurring in total farm numbers obscure developments within farm size groups. For example, during 1950-74, the number of farms in the South increased in all size groups of 200 acres and over of harvested cropland, as indicated by the following:

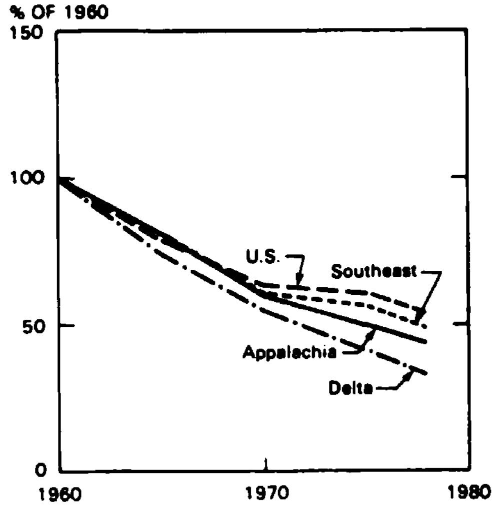
	Farm numbers			
Year	Less than 100 acres	100-199	200-499	500 acres and over
	1,000 farms			
1950	1,827	46	16	4
1954	1,536	50	20	5
1959	1,036	50	22	6
1964	809	44	25	9
1969	581	39	27	13
1974	461	38	29	16

Source: (*15*).

The largest farms tend to dominate agriculture in the region. According to the 1974 Census of Agriculture, the top 13 percent of all farms accounted for 76 percent of gross farm sales. In the "commercial" farm category, 8 percent of the farms accounted for about 77 percent of gross farm sales.

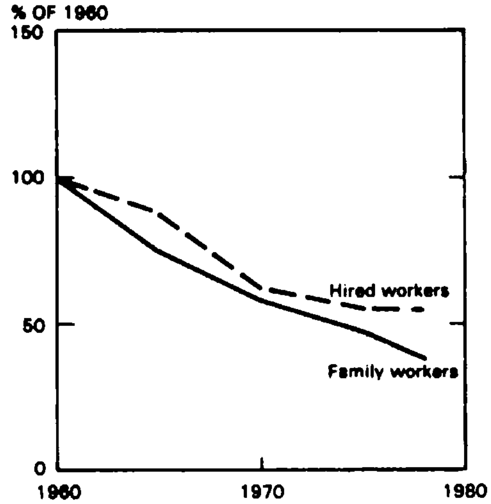
[1] Italicized numbers in parentheses refer to references listed at the end of this chapter.

FIGURE 2
DECLINES IN FARM LABOR FORCE



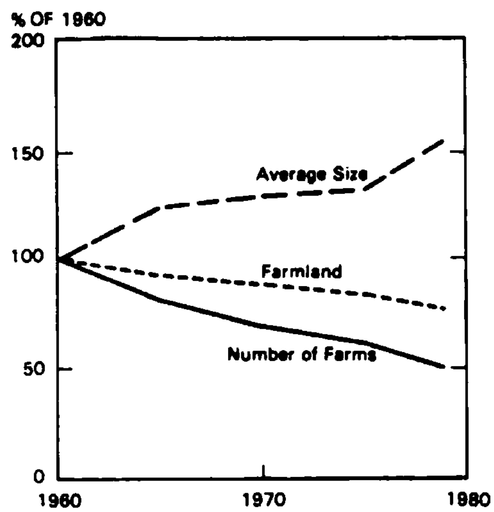
SOURCE (9)

FIGURE 3
DECLINES IN FAMILY AND HIRED WORKERS



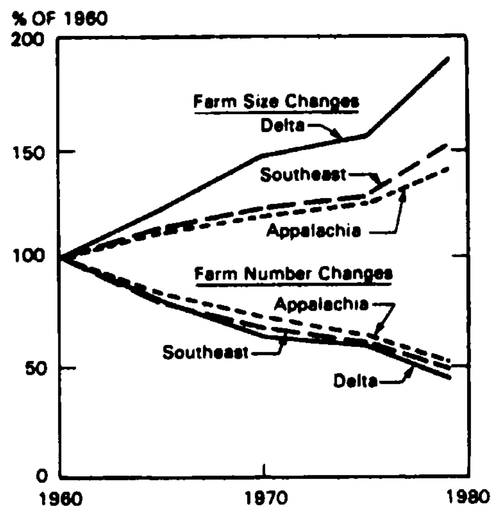
SOURCE (9)

FIGURE 4
FARM NUMBERS AND ACREAGE



SOURCE (14)

FIGURE 5
FARM NUMBER AND SIZE TRENDS



SOURCE (14)

Farms are more heavily concentrated in the lower investment levels in the South than in agriculture nationwide. This concentration is less significant in the Delta and Southeast than in Appalachia and there has been a slower rate of farm size growth in Appalachia, compared with the rest of the South and the United States as a whole, as shown on page 310.

Farmland Values

The value of farmland rose sharply in the South during the 1970's, exceeding the U.S. average in all areas except the Delta region (figure 6). The average value per acre in the entire region increased from

Region	Less than $20,000	$20,000-$69,999	$70,000-$149,000	$150,000 or more
		Percent		
Appalachia	29	45	15	11
Southeast	22	42	19	18
Delta	21	44	18	17
South	25	44	17	14
United States	15	37	22	26

Distribution of farms by level of investment, 1974

Source: *(15)*.

$311 in 1972 to $618 in 1978, compared with $219 and $517, respectively, for the United States. The increase was greatest in the Appalachian region and least in the Delta region. Several factors contributed to increases in the demand for land–including farm enlargement, expanded urban-industrial needs, and population growth which increased the demand for land for recreation facilities and for a second home in the country. In some locations, land is priced far above its use value in agriculture.

Tenure Characteristics

One of the most significant trends in southern agriculture has been the shift away from tenant-operated farms (figure 7). Less than 1 farm in 10 was operated by tenants in 1974. Increases occurred

FIGURE 6
INDEX OF FARMLAND VALUE PER ACRE

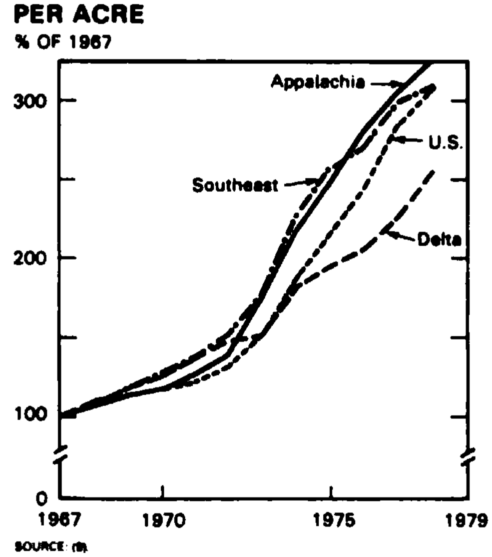
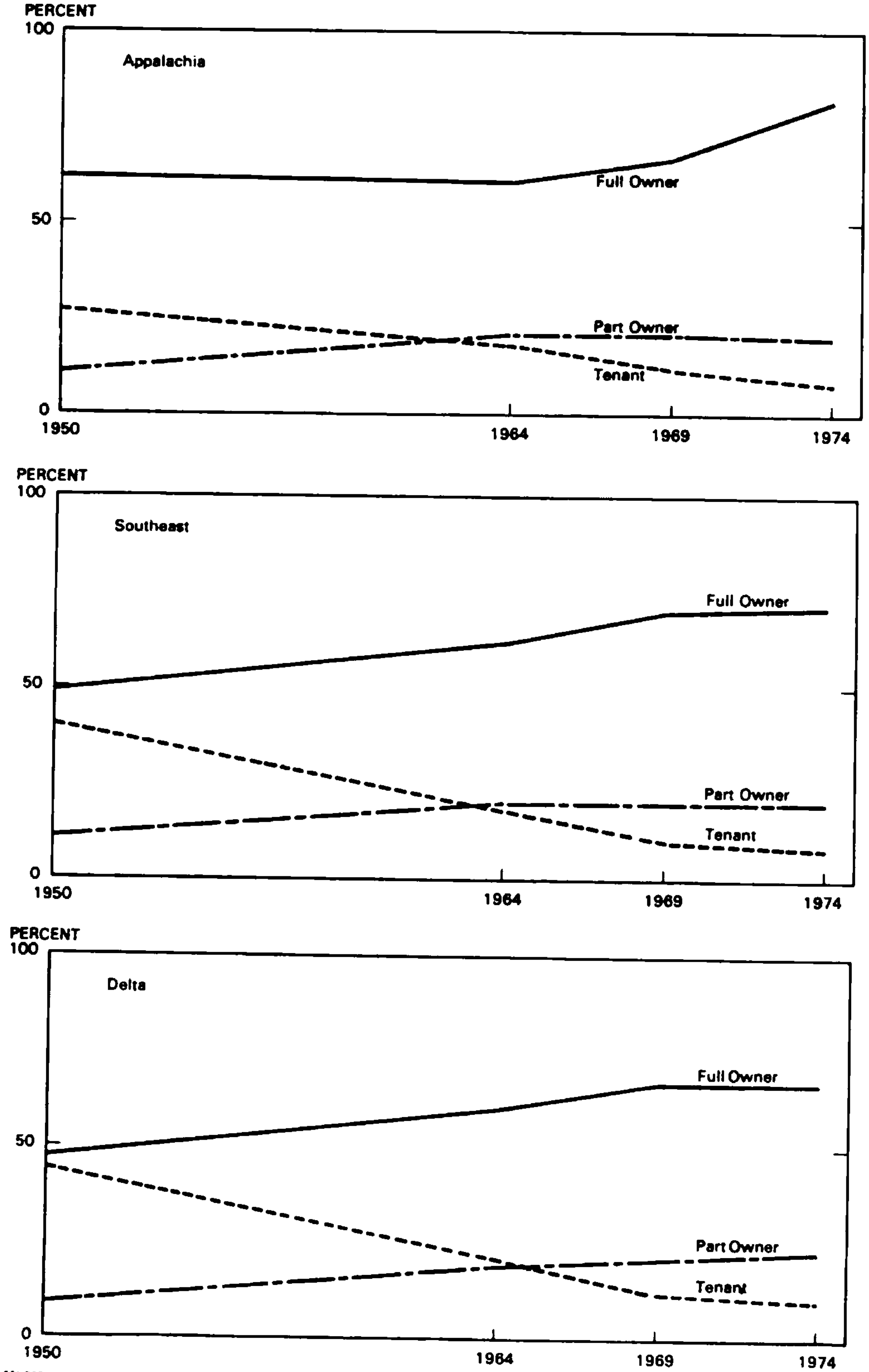


FIGURE 7
TENURE CHARACTERISTICS



SOURCE (15)

largely in the proportion of full-owner-operated farms. While the proportion of part-owner-operated farms has increased only slightly since 1964, this group may grow in the years ahead. The increase in land values clearly is causing the "renting in" of land to be a plausible alternative.

Part-owner farms have been gaining a larger share of the cropland harvested in the South. The share exceeded 50 percent in the Delta and Southeast in 1974. The share on tenant-operated farms has been declining since 1964; the share of full-owner farms has remained virtually constant. The average size of part-owner farms has remained substantially above the full-owner and tenant farms. These factors further emphasize the growing importance of part-owner farms in southern agriculture. The following data summarize farm-size relationships by tenure groups and geographic areas in the South:

	Farm size		
Tenure group	1964	1969	1974
		Acres	
Appalachia			
Full owner	111	114	120
Part owner	170	215	244
Tenant	75	97	126
Southeast			
Full owner	158	186	197
Part owner	354	438	471
Tenant	96	176	254
Delta			
Full owner	132	163	181
Part owner	347	455	523
Tenant	117	259	367

Source: (*15*).

Type of Farm Organization

The continuous decline in number of farms and increases in farm size have raised many questions regarding the fate of the family farm in U.S. agriculture. There is concern that larger, nonfamily-operated farms may become a dominant force in agriculture. Data from the 1974 Census of Agriculture show that individual or family-operated farms accounted for 90 percent of all "commercial" farms in the South; these farms accounted for 77 percent of the farmland.

Partnership and corporation types of organization accounted for 10 percent of the farms and 21 percent of the land farmed in 1974. Farms under a corporate form of organization tend to be much larger than partnership or individual, family-type farms, averaging over 1,500 acres of land in 1974.

Off-Farm Employment

Off-farm employment opportunities continue to expand in the South. The 1974 Census of Agriculture indicates that about 41 percent of all farm operators reported 100 days or more of off-farm work in 1974, compared with about 35 percent in 1964. One-third of the farm operators reported working 200 days or more in off-farm jobs in 1974. The proportion varied only slightly among regions in the South, as indicated by the following data for 1974:

	Percent of operators reporting off-farm jobs	
Region	Less than 200 days	200 days and over
Appalachia	15.6	32.2
Southeast	13.8	36.2
Delta	15.7	32.0
South	15.2	33.2

Source: (*15*).

The nonfarm employment option affects farm size. Over 40 percent of all farm operators working in off-farm jobs in 1974 had less than 100 acres of land. Off-farm employment has enabled farmers to retain small noneconomic farms. Many farmers have chosen nonfarm employment to supplement family income rather than increase farm size, thereby increasing the importance of part-time farming in many areas across the region.

Conversely, the migration of large numbers of farm people to urban centers and into nonfarm employment in the post-World War II era substantially reduced the labor force in agriculture. This development helped accelerate the substitution of capital for labor in the form of machinery and other labor-saving inputs. The result was increased emphasis on farm enlargement to accommodate the larger machinery, a process that contributed significantly to farm size increases in the South.

The Changing Crop Mix

Important changes also have occurred in the mix of crops produced in the South. Cotton and corn have declined in importance, and soybean acreage has increased sharply. Peanuts and tobacco are major crops in localized areas of the Southeast and Appalachian regions. Both crops are still under government programs; hence, year-to-year changes in the acreages of these crops are less marked than acreage changes in the nonprogram crops, as shown below:

Crop	Crop acreages in the South			
	1950	1959	1969	1979
	Million acres			
Cotton	9.1	6.5	4.7	3.4
Corn	20.4	15.6	8.0	8.7
Soybeans	3.2	5.9	13.9	25.1
Peanuts	2.0	1.2	1.1	1.1
Tobacco	1.3	1.0	.8	.8
Rice	.9	.9	1.2	2.0

Source: (*12*).

Regional differences also have occurred in the mix of crops over time. The differences reflect, in part, shifts in the location of production. In other cases, the differences stem from the increasing importance of a specific crop or crops in an area.

In the Southeast, the acreage planted to corn decreased sharply during the 1950's and 1960's (figure 8). The downward trend was reversed in the 1970's, with marked year-to-year fluctuations occurring in corn acreage in most years. The acreage planted to cotton has followed a downward trend since the early 1950's. In contrast, soybean acreage rose sharply during that period. Soybeans accounted for nearly one-third of the harvested acreage in 1974, compared with about 2 percent in 1950. Soybeans and corn are important crops in most areas of the Southeast. Under present market conditions and government programs, neither soybeans nor any other crop is competitive with tobacco and peanuts for the use of land and other resources. Thus, corn and/or soybeans are the main alternatives to cotton in most areas of the Southeast, particularly the Coastal Plain areas and the Limestone Valley. The acreage of other crops, mainly small grains and pasture crops, could be shifted to cotton or other crops, depending upon price relationships between cotton and the substitute crops.

In the Appalachian region, corn acreage fell sharply in the 1950's and 1960's but rose in the 1970's (figure 9). Cotton acreage has trended steadily downward since the early 1950's. Very little cotton production remains in the Appalachian region, except in the brown loam area in western Tennessee. Since this area is near the northern limit of the Cotton Belt, cotton yields are lower than farther south. The combination of lower cotton yields and higher soybean yields makes cotton in that area more vulnerable to competition from other crops than in areas farther south. In contrast to cotton and corn, sharp increases have occurred in the acreage planted to soybeans. Production of peanuts and tobacco also remains high in this region.

Cotton, soybeans, and rice are the main crops in the Delta region. Soybean acreage has increased sharply since the early 1950's; cotton acreage has fluctuated around the 3-million-acre level; and rice acreage has increased substantially since the early 1970's (figure 10). Corn acreage, once relatively large in the Delta, declined to a very low level, where it has remained during the 1970's.

While soybean acreage is large in most of the area, production occurs largely in a supplementary rather than competitive relationship. Soybeans tend to be produced on land that usually is considered less suited for cotton production.

Cotton yields decline in the northern part of the Delta, where the growing season shortens, while soybean yields tend to increase from south to north through the Delta. The sharp distinctions between heavy (noncotton) and light (cotton) soils also tend to decrease from south to north. Consequently, cotton tends to be less competitive with other crops in the northern part of the Delta.

Rice production is receiving more emphasis by producers, particularly in the eastern part of the Delta. Considerable expansion of Delta rice acreage appears possible in the years ahead. The physical environment is well suited to rice production.

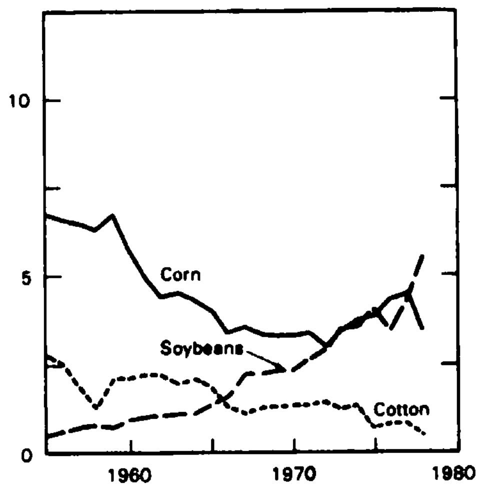
While changes have been occurring in the crop mix, cattle and poultry production is becoming increasingly more important in southern agriculture, as shown by the data below:

Livestock and poultry numbers

Commodity	1950	1960	1970	1977
		Million head		
Cattle and calves	14.1	17.2	20.4	24.6
Hogs and pigs	12.0	10.8	11.2	9.6
Broilers	251.0	1,126.8	2,102.7	2,419.3

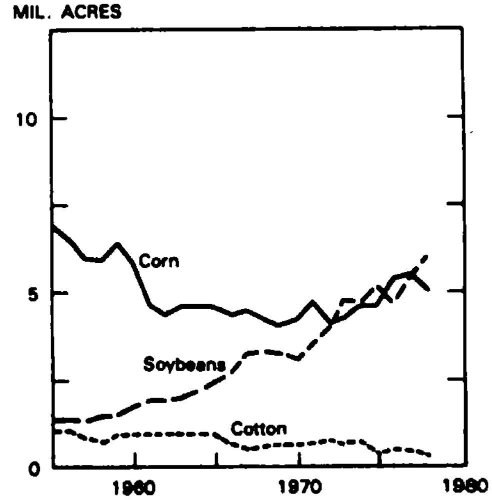
Source: (*9*).

FIGURE 8
ACREAGES PLANTED TO SELECTED CROPS, SOUTHEAST STATES
MIL. ACRES



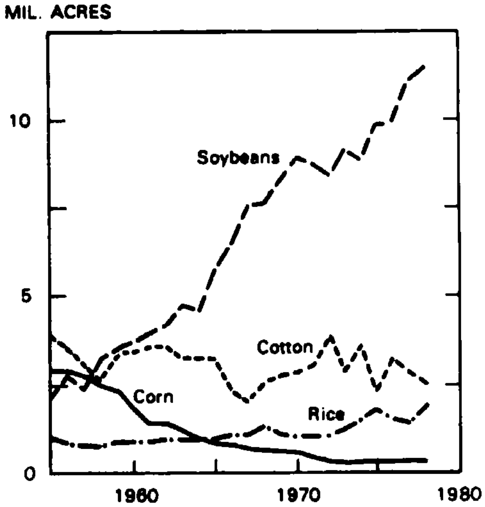
SOURCE (12)

FIGURE 9
ACREAGES PLANTED TO SELECTED CROPS, APPALACHIA
MIL. ACRES



SOURCE (12)

FIGURE 10
ACREAGES PLANTED TO SELECTED CROPS, DELTA STATES
MIL. ACRES



SOURCE (12)

The increases in cattle production have been important in most areas of the South. Increases in broiler production occurred mostly in Arkansas and Mississippi (Delta), Alabama and Georgia (Southeast), and North Carolina (Appalachia). Hog production remained fairly constant in the Appalachian region and the Southeast as a whole during 1950-77, but declined substantially in the Delta region. However, a significant increase occurred in North Carolina, where production more than doubled during the period.

To some extent, the changes in crop mix can be linked to greater enterprise specialization and to increases in farm size. Farmers specializing in one or two enterprises tend to operate larger units than those operating diversified farms.

Specialization in Production

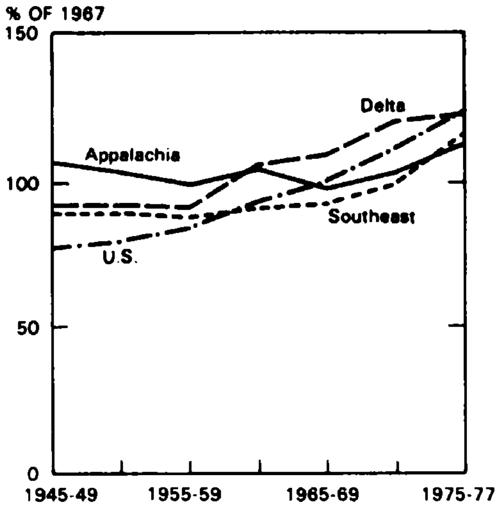
Once highly diversified, farming in the South during the last 10 years has been characterized by increasing specialization. This change is the result of efforts to achieve the scale of operation required for improvements in technical and economic efficiency. An increasing number of farmers now concentrate on one or two enterprises in the farm organization. According to the 1974 Census of Agriculture, the number of cash grain farms increased from 10 percent of the commercial farms in 1969 to 20 percent in 1974. This change reflects the growing importance of farm production specialization, an activity that appears to be more important in Delta agriculture than in the Southeast or Appalachian regions.

Productivity Rising

Average farm output has increased substantially in the South since the 1940's, primarily because of the adoption of new production technology, improved cultural practices, and the consolidation of small farms into larger, more efficient farming units. The increase has been particularly marked in the Delta and Southeast (figure 11). While year-to-year fluctuations have occurred in total farm output, the trend has been steadily upward since the 1940's. The most significant increases occurred in the Delta region, where farm enlargement and improved production practices are key variables affecting productivity.

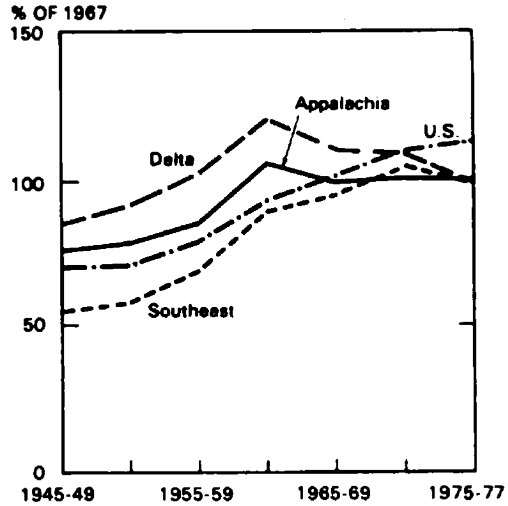
Important increases also occurred in average crop production per acre of land (figure 12). These increases occurred largely in the 1960's and 1970's, periods when the use of yield-increasing technology was receiving increased emphasis by producers. Part of the gain in productivity can be attributed to a shift of some row-crop production to less hilly and generally more productive land areas.

FIGURE 11
INDEXES OF FARM PRODUCTION, ALL CROPS, 5-YEAR AVERAGES, 1945-1977



SOURCE (11)

FIGURE 12
INDEXES OF CROP PRODUCTION, PER ACRE, 5-YEAR AVREAGES, 1945-77



SOURCE (11)

For example, cotton production has virtually ceased in the Piedmont, an area in the Southeast characterized by rolling to hilly terrain.

Production Cost Comparisons

Production costs vary from farm to farm as well as from area to area. The cost estimates below show the extent of area-to-area variations in cotton production costs (similar variations occur in the costs of producing other crops, as indicated in subsequent cost summaries):

Cotton production costs per pound of lint, 1975-78 average

Region	Variable	Total	Percent of U.S. production
	Dollars		
Southeast	.524	.789	5.8
Delta	.376	.624	27.6
Southern Plains	.327	.540	36.7
Southwest	.376	.522	29.4
United States	.364	.569	99.6

Source: (*16*).

Production costs influence the location of production. Shifts in production occur within production areas as well as among regions, and cotton is a prime example. In the Southeast, there has been some concentration of cotton production the last 10 to 15 years in clusters of counties forming relatively small production areas. These small areas still are fairly competitive in the production of cotton.

Conversely, there has been a marked shift in cotton production from the relatively high-cost areas of the Southeast to the Southern Plains and the Southwest (California and Arizona). For example, the Southeastern States accounted for 14.8 percent of U.S. production in 1950, compared with 4.8 percent in 1978. In contrast, production in the Southwest (California and Arizona) increased from 14.5 percent of the U.S. total in 1950 to 27.9 percent in 1978. The cost estimates in the summary above show the lowest cost per pound of lint occurring in the Southwest and Southern Plains.

Costs of cotton production also are favorable in the Delta. Cotton yields in the Delta normally exceed the 1975-78 average of 488 pounds per acre. Unfavorable weather in some years during this period reduced the average yield; thus, average cost per pound of lint was above the normal level in relation to costs for other cotton regions.

The Delta and Southeast had similar production costs for soybeans, based on 1975-78 average yields. They were, however, below the U.S. average. Highest yields and lowest production costs occurred in the Lake States and the Corn Belt.

The Southeast is a high-cost area for corn production. The 1975-78 average cost exceeded the U.S. average by about 60 percent. The relatively high cost of production in the Southeast reflects to some extent production inefficiencies associated with the many small farming units in the region. The data below summarize variable and total costs per bushel for soybeans and corn during 1975-78:

Production costs, 1975-78 average per bushel

Region	Soybeans		Corn	
	Variable	Total[1]	Variable	Total[1]
	Dollars			
Appalachia and Southeast	3.03	4.83	1.77	2.56
Delta States	2.57	4.51	NA	NA
Lake States and Corn Belt	1.38	2.52	.97	1.05
United States	1.80	3.16	1.46	1.60

NA–not applicable.
[1] Excludes land charge.
Source: (*16*).

Distribution of Farms by Gross Sales

Substantial changes have occurred since the 1960's in the distribution of farms by size based on gross sales of farm products. For example, the number of farms in the South with less than $20,000 in gross sales dropped from 93 percent of total farms in 1964 to 80 percent in 1974. The main increase occurred in the group of farms with $40,000 or more in gross sales. As shown in the summary below, the change was most marked in the Delta region and least significant in the Appalachian region. Although inflation accounts for part of this change, the data largely reflect the consolidation of resources into larger farming units. The trend toward larger farms has been more marked in the Delta than in other parts of the South, as shown in the following data:

	Percent of farms with sales of:					
	Less than $20,000		$20,000-$40,000		$40,000 or more	
Region	1964	1974	1964	1974	1964	1974
Appalachia	95	84	3	8	2	8
Southeast	90	75	6	9	4	16
Delta	91	76	5	6	4	18
South	93	80	4	8	3	12

Source: (*15*).

The growing importance of the larger farm units is further emphasized by the concentration of production in this group. For example, farms in the South with gross sales of $40,000 or more accounted for 76 percent of farm sales in 1976. This group was more important in the Delta region than in other parts of the South, accounting for 86 percent of gross sales, compared with 83 percent in the Southeast and 60 percent in the Appalachian region.

FACTORS INFLUENCING RESOURCE ORGANIZATION IN SOUTHERN AGRICULTURE

Many factors influence the way agricultural resources are organized in a given area, and the changes that occur over time in resource organization and use. Physical forces, economic conditions, institutional factors, technology, and government programs affect the location of production and the enterprise mix within geographic areas. This section focuses on some of the key variables affecting the organization of resources and location of production in major areas of the South.

Physical Forces

The physical environment—including soils, topography, climate, and related factors—significantly affects production possibilities for an area. Individually and collectively, these factors influence the mix of enterprises and level of production that can be expected.

Soils and Climate

The South has a wide range of soil and climatic conditions. These differences affect relative costs and returns among farm commodities within the same area, or between commodities in different areas. Any factor having the potential for influencing costs and returns has the potential to influence the location of production. Soils certainly have that potential, as indicated by shifts in cotton and other row crops to more productive soil resources within the same area or in other areas the last three decades.

Topography

There are indications that topography has exerted more influence than soils on shifts in the location of production. The sharpest drop in cotton acreage during 1949-72 occurred in the areas characterized by hilly terrain (Piedmont and Limestone Valley). The change was much smaller in the Mississippi Delta and its terraces west of the river, where the terrain is relatively flat. These areas have increased their share of the U.S. cotton acreage since 1950. The percentages shown on top of page 322 provide an indication of broad topographic differences.

The proportion of cropland in hay crops and livestock sales as a percent of crop sales is much larger in the hilly areas than in the areas with flat terrain. These relationships provide further evidence of increased emphasis on forage crops and livestock farming on rolling lands and the shifting of cotton and other row crops to the less hilly and more productive areas.

Rainfall

Most crops grown east of the 40-inch annual rainfall line extending across the eastern part of Texas and Oklahoma are not irrigated. The

Specific characteristics of cotton farms in selected areas of the South

Characteristics	Piedmont	Limestone Valley	North Delta	East Delta
		Percent		
Cotton acreage, 1949-1972	11	33	68	83
Harvested acreage to total land	5	10	73	56
Cropland in hay crops	27	23	1	2
Livestock sales to crop sales	165	127	38	41
Farms with crop sales to all farms	41	54	91	88
Commercial farms with 200 acres or more	5	7	49	52
Operators work off farm 200 days or more	46	44	16	16

Source: (*15*).

main exceptions are rice in the Delta region and certain vegetable and fruit crops in the Southeast.

Total annual rainfall is more than adequate throughout the South in most years for relatively high crop yields. This distribution of rainfall, however, is less favorable and less predictable than total rainfall. Consequently, irrigation is becoming a more common practice, particularly on high-value crops in the Coastal Plain. For example, about 35 percent of the peanut acreage in Georgia was irrigated in 1977 (*5*). Most observers expect this trend to continue in the years ahead. Nevertheless, caution underlines this expectation because of rising costs and energy-related problems.

Temperature

The length of frost-free periods and average temperatures determine the northern boundary of cotton production. Cotton production usually requires 200 days between killing frosts and a minimum summer average temperature of 77°. Cotton yields tend to decrease toward the northern boundary of the 200-day, frost-free period. In contrast, the yields of competing crops (mostly grains) increase from south to north through the region.

Economic Factors

The cost-price squeeze continues unabated. Farmers have sought ways to increase farm earnings by adopting cost-reducing practices, increasing the volume of output through farm enlargement, volume discount buying of inputs, and the use of hedging, contract selling, or other marketing techniques. Declining profit margins and year-to-year variations in yields and product prices have resulted in extreme economic pressures on many producers, particularly grain and cotton growers in certain areas of the South.

Farm Enlargement

Although average farm size continues to increase overall, farm enlargement opportunities are limited in many areas of the South. Growth in farm size in terms of acres operated varies among areas for a variety of reasons. Shortages of productive farmland in local communities, among other things, often preclude the development of large farming units. In many cases, the alternative for increasing family earnings is to seek nonfarm employment. This is particularly true in areas near metropolitan centers where off-farm jobs are available.

Data on differences in average farm size and off-farm work characteristics of typical counties in the Mississippi Delta and in the Georgia Piedmont indicate a substantial increase in average size of farms in the Delta counties during 1969-74. The relatively flat terrain of the Delta enhances farm enlargement. In contrast, farm enlargement possibilities are limited in such areas as the Piedmont because of the hilly terrain. In the Piedmont counties, farms are much smaller than in the Delta, and a much larger proportion of the farm operators work in off-farm jobs. These data are summarized on page 324.

Instability in the Farm Sector

Many factors affect resource use and farm income. Year-to-year variability in product prices and yields is a major source of instability in the farm sector. Wide swings in product prices have characterized agriculture during the 1970's. Part of the price variability can be attributed to the redirection of major price support programs during the period. Other factors include smaller crop inventories, changes in

Average farm size and off-farm work in selected counties

State and county	Average size	Work off-farm 200 days or more	Principal occupation	
			Farming	Other
	Acres		*Percent*	
Mississippi:				
Bolivar				
1974	712	13	86	14
1969	460	NA	NA	NA
Sunflower				
1974	795	13	85	15
1969	552	NA	NA	NA
Georgia:				
Morgan				
1974	351	34	50	50
1969	345	NA	NA	NA
Walton				
1974	168	45	41	59
1969	176	NA	NA	NA

NA = data not available.
Source: (*15*).

foreign demand, and devaluation of the dollar, which made U.S. commodities more competitive in foreign markets.

Regional differences occur among commodities in the magnitude of year-to-year price changes. The largest differences occurred in cotton prices during 1970-78 (figure 13). Movements in the prices of corn and soybeans followed similar patterns between regions. Peanut and tobacco prices are less subject to fluctuation because of government price support programs.

Forward contracting of cotton became a common practice in the 1970's. This practice was used by the cotton industry to counter some of the fluctuations in price and supply of cotton.

Yield variability as well as price influences enterprise choice. Thus, year-to-year change occurs in acreage planted to various crops in response to price and yield expectations. The yields of cotton and corn fluctuated widely during 1970-79 (figure 14). Soybean yields were quite stable during that period.

FIGURE 13
PRICES RECEIVED BY FARMERS

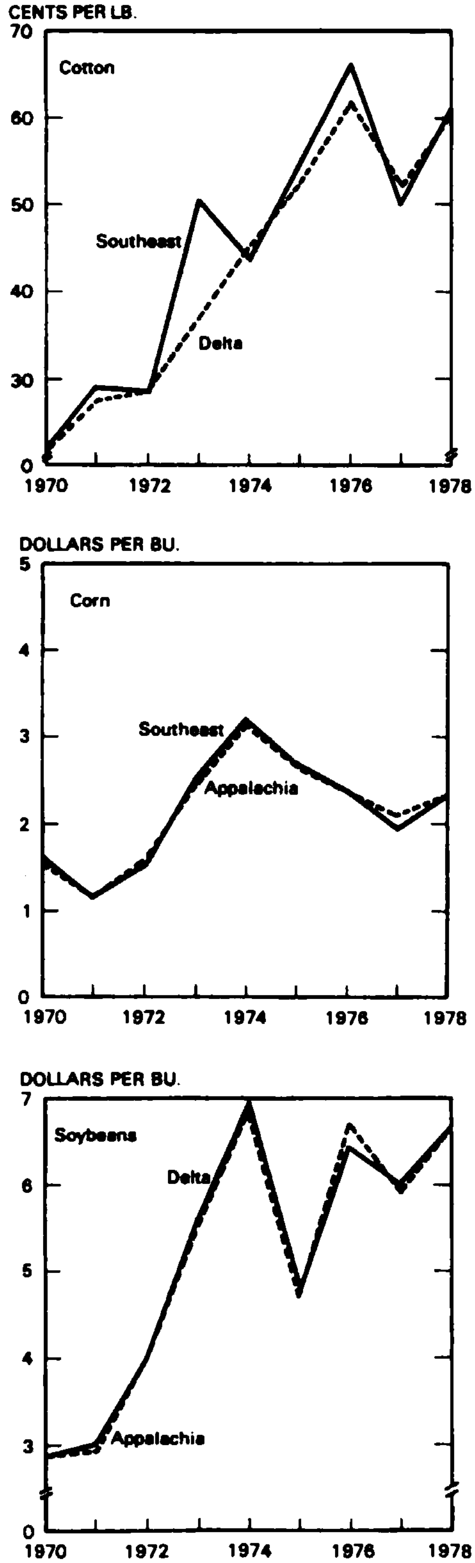
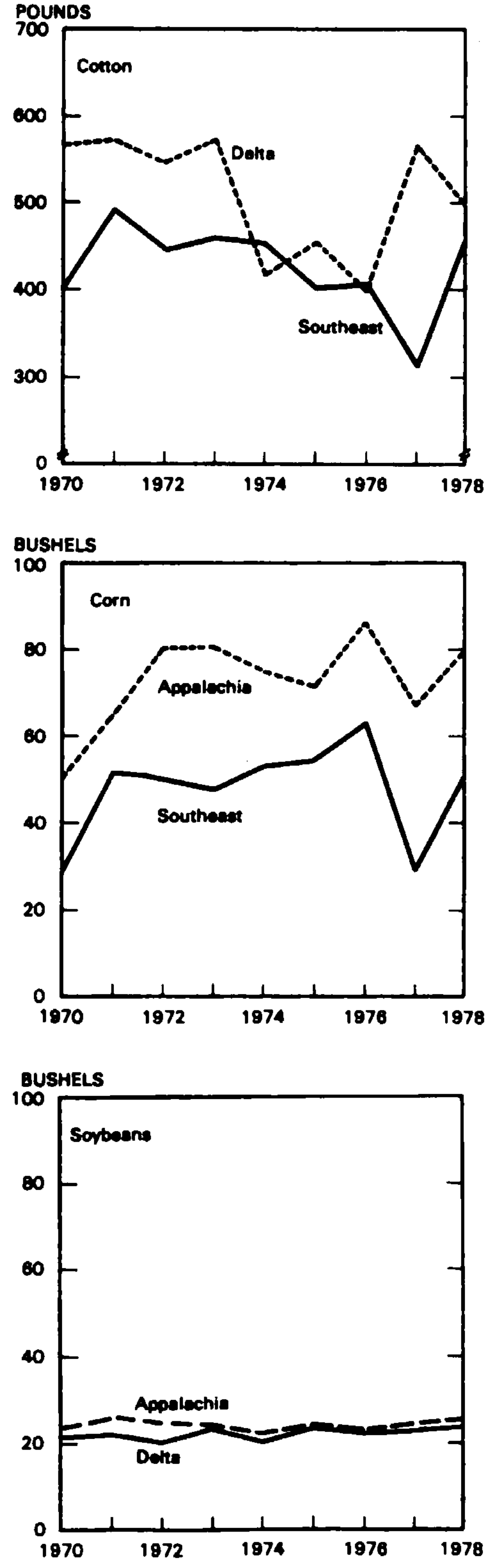


FIGURE 14
YIELDS PER ACRE



Government Programs

How effective are acreage allotments and marketing quotas in adjusting production to market needs? This has been a recurring question since the attempts to control production under agricultural programs of the early 1930's. More recently, the question being asked is: What is the effect of government programs on farm size and ownership?

First, it is difficult to measure the impact of a specific program on production or resource organization because of the influence of several factors. Market conditions, technology, production alternatives, weather conditions, and other factors affect year-to-year production of specific crops as well as production trends over time. However, significant changes in production of cotton and other commodities have occurred following the adoption of new programs extending back to the early 1930's.

Under programs of the 1930's, the acreage planted to cotton declined sharply from the high levels of the middle and late 1920's. The large increase in the cotton acreage in 1937 occurred during a 1-year break in acreage controls. While the acreage planted to cotton continued a rather sharp downward trend to the mid-1940's, the decline in production was less marked because of the generally upward trend in per acre yield levels (figure 15).

The acreage planted to cotton increased in the post-war years under programs emphasizing production expansion—reaching a high of 29.4 million acres in 1951. Following a buildup in cotton supplies under those programs, there was a return to allotments and marketing quotas later in the 1950's, under a program emphasizing land retirement and direct payments to farmers in addition to price support loans. Further decreases occurred in cotton acreages and production in the 1960's, under the Food and Agricultural Act of 1965. While production has increased in some years under programs in the 1970's, the long-term downward trend has continued to prevail—even in the last few years, when farmers have been operating essentially under a free-market situation. The main impacts on production over the next few years are likely to come from changes in production costs and market prices of cotton and competing crops, resulting in substantial year-to-year changes in the acreage planted to cotton.

The emphasis on acreage reduction through the 1960's apparently caused many marginal areas to discontinue cotton production as acreage density in these areas reached a very low level. Conversely, capitalization of allotment program benefits into farmland values, coupled with the proportionally higher payment benefits, to small producers tended to hold many small producers in farming, particularly in some marginal producing areas. However, there are indications of a large exodus of small cotton producers from farming since the early 1970's, when acreage allotment and price support programs have not been a major factor in production. Most of these farms are being consolidated into larger units.

Allotment and price support programs are still in effect for peanuts and tobacco. The Appalachian and Southeast regions contain large acreages of both crops. Given price relationships that now exist and have existed in the past, cotton and other commodities cannot compete with either peanuts or tobacco. Thus, both crops tend to be planted to the full extent permitted under the acreage allotments/marketing quotas established in the program.

Technology

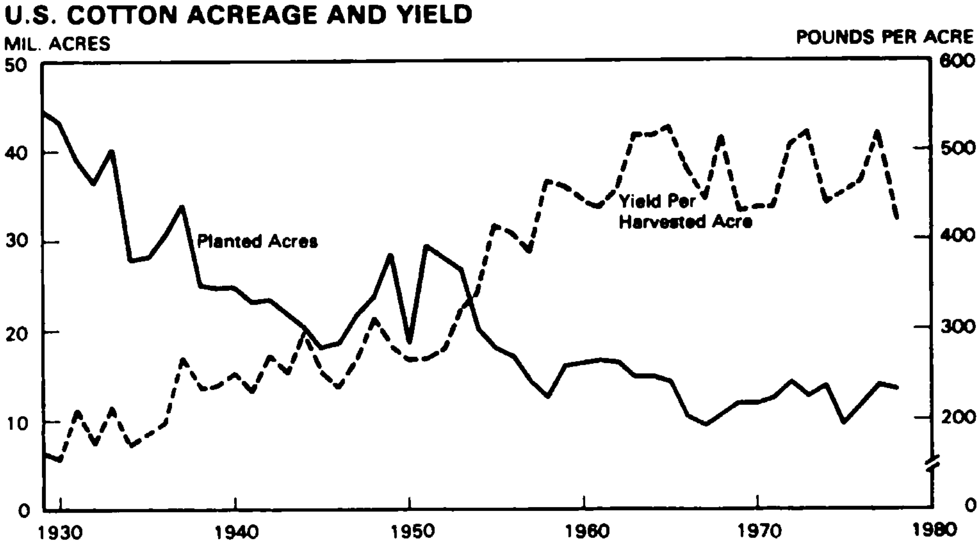
Technology has been important in shaping the structure of agriculture in the South as well as in other regions of the United States. Investments in machinery and other capital inputs have increased the productivity of land, labor, and management. Farms have become fewer and larger with the expansion in mechanization, and production efficiency has increased. The role of management has become more critical to the successful operation of the farm business.

Improvements in management and labor skills have closely followed the adoption of new technology, with changes resulting in the organization and use of resources and the mix of production inputs in southern agriculture. A sharp decline in labor use and a marked increase in the use of agricultural chemicals highlight changes in the mix of production resources (figure 16). Chemical weed control and the development of mechanical harvesters for cotton and other crops have been major factors in the sharp decrease in farm labor requirements. The increasing size structure of farms has complemented the adoption of large machinery and equipment, particularly mechanical harvesters.

Fertilizer use, pesticides, and weed control chemicals constitute the main components of the agricultural chemical input. Total fertilizer use has increased sharply in the southern region since 1960 (figure 17). These inputs have contributed to increased farm size by making production more predictable.

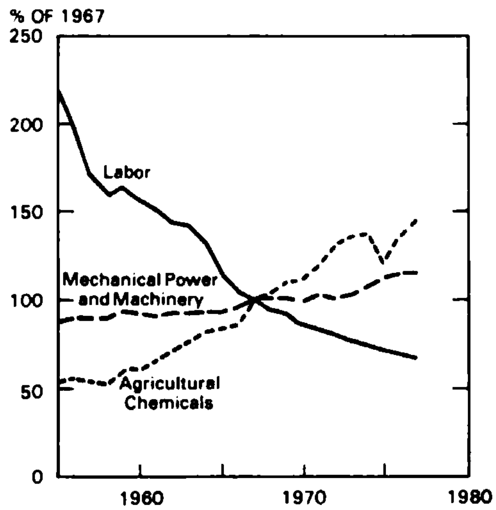
Regional differences have occurred in year-to-year changes in production inputs. For example, the use of agricultural chemicals has increased more rapidly in the Delta region than in the Southeast and Appalachian regions (figure 18). These results reflect the importance of cotton in the Delta; cotton requires substantial inputs of agricultural chemicals for weed and pesticide control. Cotton insect control

FIGURE 15
U.S. COTTON ACREAGE AND YIELD



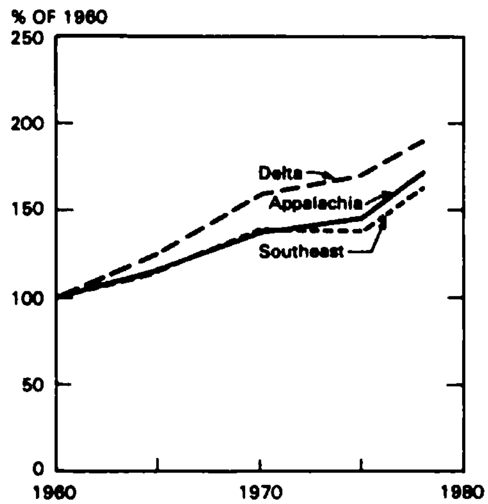
SOURCE (12)

FIGURE 16
INDEXES OF SPECIFIC INPUTS, SOUTHERN REGION



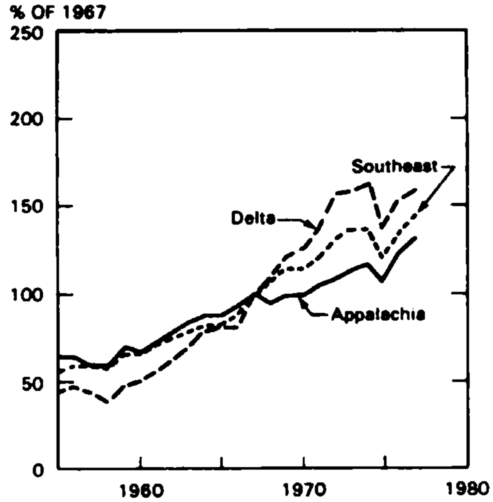
SOURCE (11)

FIGURE 17
CHANGES IN FERTILIZER USE, TOTAL NUTRIENTS



SOURCE (3)

FIGURE 18
REGIONAL DIFFERENCES IN USE OF AGRICULTURAL CHEMICALS



SOURCE (11)

is a major cost item in all areas of the South; however, cotton acreage is much smaller in the Southeast and Appalachia than in the Delta.

Credit Use

The generation of capital from farm business earnings or savings generally is inadequate to finance major changes in resource organization and use on farms. Increases in farm size, the increasing proportion of purchased farm inputs used in farming, and adoption of new technology all require larger and larger outlays of capital. Consequently, farmers have been increasingly dependent on credit to finance changes in the organization and operation of farms. The result has been marked increases in the use of credit by farmers since 1960. The debt load per farm more than doubled during 1970-77 in all regions of the South. The debt-to-asset ratio gained slightly during that period, in contrast to a decline in the U.S. ratio, as indicated on page 330.

Regional differences also occur in debt load per acre of land and per farm worker. For example, debt amounted to about $101 per acre in the Appalachian region in 1975, compared with $103 per acre in the Southeast and $118 per acre in the Delta region. The 1975 debt per farm worker in the Delta region was more than double the amount for the Appalachian region and exceeded the Southeast debt load by about 35 percent. The debt-to-asset ratio for the Delta region also exceeded the ratios for the rest of the South. These differences in outstanding debt reflect more emphasis in the Delta than in other areas of the South on farm enlargement, enterprise specialization, and investments in larger machinery and other technological innova-

	Changes in farm debt					
	Debt per farm			Debt-to-asset ratio		
Region	1970	1975	1977	1970	1975	1977
	Thousand dollars			*Percent*		
Appalachia	6.8	13.2	17.3	13.6	14.4	15.1
Southeast	12.0	23.6	28.1	14.8	15.5	15.9
Delta	13.7	22.9	28.1	16.4	16.3	16.9
United States	18.0	29.6	37.9	16.8	15.9	15.7

Source: (*2*).

tions. These types of changes in resource organization and use require increasingly larger outlays of capital.

SOUTHERN FARMS OF THE FUTURE

The structure of agriculture is a major concern of many people, both in and out of government, as we enter the last two decades of this century. The projection of present trends to the year 2000 may not be sufficient to describe changes in the structure of agriculture over the next 20 years, particularly within geographic regions. Yet, there is a need to anticipate possible new developments in agriculture that could affect resource organization and production. The purpose of this section is to indicate the nature of and reasons for possible broad changes in southern agriculture during the next 20 years.

Farm Enlargement

Present indications are that the trend toward fewer but larger farms in the South will continue. Regional data on average size and number of farms tend to support this conclusion. Other developments, however, are occurring with respect to size, indicating a different kind of resource organization in the years ahead. The emerging patterns seem to indicate the following:

1. A possible leveling out of the decline in the number of small farms or perhaps some increase in this size group (farms receiving less than $20,000 gross income from farming), resulting from increasing demand for land by people interested in part-time farms, retirement farming, or rural residences.
2. An increase in the number of large farms ($40,000 to $100,000 gross sales) organized around family units, where the family

owns a large share of the land but also "rents in" a substantial acreage.

3. A growing number of large farms ($40,000 to $100,000 gross sales) to very large farms ($100,000 or more gross sales) operated under a corporate or partnership form of organization.

Traditional medium-sized farms ($20,000 to $40,000 gross sales) probably will decline in number and importance. In most cases, the medium-sized farm would be too small to provide an adequate level of family income, assuming present economic conditions and/or those expected in the future. The income problem coupled with the difficulty of obtaining enough capital to enlarge the farming operation significantly probably will lead to the sale of many farms in this category by the owner upon retirement.

The result of this kind of development would be a substantial number of small farms depending largely on nonfarm income for a livelihood, and a significant group of large to very large family and nonfamily farms accounting for up to about 90 percent of agricultural production in the South. The impact would be greatest in the Delta and less significant in the Appalachian region and sections of the Southeast.

Factors contributing significantly to this kind of change include inflation, energy problems, and government programs (including tax policies, environmental regulations, and commodity programs). For example, government commodity programs tend to benefit the larger farm more than the smaller farm. The growth in off-farm employment opportunities in the South enhances the part-time farming option.

Production Mix and Location

All indications are that there will be increases in soybean acreage in most production areas of the South. Acreage density is much greater in the Delta than in the rest of the South. These trends are expected to continue, with soybeans remaining a major crop in all large production areas.

Corn production is expected to remain an important crop in most areas of the Southeast and Appalachian regions. There is a possibility of significant growth in hog production in these areas, thus increasing the demand for corn for feed. One possible result of increased hog production might be greater specialization in corn production, leading to increases in farm size.

A major change in the crop mix of the Delta involves a probable significant expansion of rice production in the years ahead. Assuming economic conditions remain favorable for such expansion, the result would be two major types of farms in Delta agriculture: rice-soybean and cotton-soybean farms. These types of farms, specializing in the production of two crops, enhance the possibilities of large-scale production; marked increases may be expected in the size of these farms over the next 10 to 20 years.

Little change is expected in the crop mix and location of production of major crops outside the Delta. Peanut and tobacco production is expected to continue in present areas of concentrated production. Possible expansion in peanut production will be a function of government programs in the future. Fruit and vegetable production is expected to continue as a mainstay of Florida agriculture. Possible changes in the years ahead depend on competition from production areas outside the United States, the availability of irrigation water, and the extent of soil salinity buildup over time through use of irrigation.

Production Technology

A major cost item in southern agriculture involves the use of agricultural chemicals, particularly for weed, insect, and plant disease control. A breakthrough in pest control technology would strengthen the competitive position of major crops in the South, especially cotton in the Delta, by reducing production costs. Some current experiments possibly could provide significant improvements in pest control as well as other forms of technology.

Another promising type of production technology is the "narrow-skip" or "Stoneville widebed" cotton planting pattern which is gaining acceptance in the Mississippi Delta. Utilizing a 60-inch skip alternating with two conventional 40-inch rows, this planting pattern reduces the per acre cost of producing cotton by an estimated 15 percent or more. These types of cost-reducing technology have the potential of influencing the competitive position of individual crops, and hence the crop mix, in a geographic area.

Factor Specialization in Production

There is evidence of a shift toward more specialization in production inputs. The management function becomes increasingly more crucial in the operation of a farm business as farm size increases. Thus, the farm operator becomes more dependent on other suppliers of resources.

The "renting in" of land, now a plausible alternative to many producers, is expected to become even more important in the years ahead. This practice separates the ownership of land from management. The use of custom services is a common practice on many farms, particularly in the application of agricultural chemicals and to a lesser extent in harvest operations. For example, a common practice in vegetable production is to contract out certain operations such as pest management and harvesting. This practice could become more widespread across the South, involving other enterprises in the years ahead.

Farms of the Future: An Example From the Mississippi Delta

An assessment of past and present changes in the structure and organization of agriculture raises many questions about the future of agriculture: some relate to individual farms; others relate to the whole of agriculture. Some insights to possible future development are provided by examination of farms that have been essentially innovative in the way they have grown and in the way they have organized their resources. An example or "model" from the Mississippi Delta is used to depict this type of farm organization.

One might characterize this model farm as a firm out on the "cutting edge" of agriculture. The farm operator is an innovator and early adopter of new technology—a skilled manager.

The example depicts a cotton-soybean farm operating 1,200 to 1,600 acres of cropland. The operator owns two-thirds of the land and "rents in" the rest of the acreage. The labor force includes one hired supervisor to oversee daily farm operations. The operator owns most of the machinery and equipment, particularly tractors and harvest machines, required for the farming operation. Custom services are used for insect control and fertilizer applications. The machinery complement includes one tractor per 500 acres of cropland, one cottonpicker per 250 acres of cotton, and combining capacity for handling up to 500 acres per combine.

Another characteristic of this model farm is the use of improved production practices and cost-reducing technology. Use of narrow-bed, skip-row cotton planting pattern is an example of a cultural practice that provides a substantial reduction in cotton production costs, compared with conventional planting patterns. Yield expectations for the farm are 750 pounds of lint cotton per acre and 30 bushels of soybeans per acre. The organization is geared to produce 40-percent cotton and 60-percent soybeans.

An assessment of this type of organization—combining a large resource base, management skill, and a strong equity position—suggests that it would have a substantial competitive advantage over smaller, medium-sized farms in the years ahead. Thus, the example is an indicator of the possibilities for growth and the way resources might be organized by a large number of Delta farms of the future.

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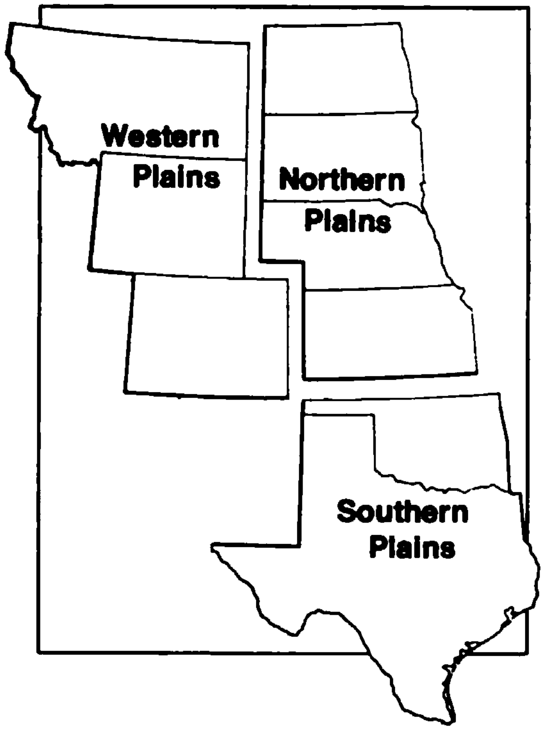


The Great Plains

William Franklin Lagrone

SUMMARY

Significant changes have been occurring in Great Plains farming, as in all other regions of the United States. For example, the number of Great Plains farms decreased 40 percent and average size of farm increased 63 percent during 1950-74. In 1974, there were 83,000 farms with less than 50 acres of land and 100,000 farms of more than 1,000 acres in the region. That year, two-thirds of U.S. farms with 1,000 acres of land or more were located in the Great Plains. Farming and ranching in the region is becoming increasingly concentrated in both acreage and sales. Part owners are the most important tenure group, and individuals operate 90 percent of the farms. The Great Plains States contain more than one-fourth of the farm total and real estate assets in the United States.

Cropland used for crops in the Great Plains accounted for 42 percent and grassland pasture for 52 percent of the 1974 U.S. totals, although land resources devoted to farming in the Great Plains have been relatively stable since 1950. Wheat, the number one crop, alone accounted for 42 percent of the crops harvested in 1974. Wheat, hay, corn, and grain sorghum together accounted for 86 percent of the crops harvested in 1974. The Great Plains States have about 45 percent of the beef cows in the United States to use the large acreages of grassland.

Labor requirements and farmworkers have declined as a result of fewer farms and especially the development of larger tractors and

other machinery. Presently, there is some indication that the number of hired workers is stabilizing.

The use of fertilizer, particularly available nitrogen, has become of significant importance in the Great Plains, accounting for 17 percent of total fertilizer (including filler) and 27 percent of all available nitrogen used in the United States in 1977.

Many forces are responsible for the changes, but the most important are natural and other resources, commodity programs, export demand, availability of credit, and feed grain production.

Soils of the Great Plains generally are among the most fertile in the world, with inadequate moisture the principal limiting factor. Rainfall varies from 10 inches per year in the driest part to 35 inches in the southeastern part. Mostly, the winters are cold and the summers hot.

Irrigation is important to many farmers in the Great Plains, and its development has been a major user of capital. The irrigated portion of the region uses both surface and underground water sources. Recently, there has been concern over declining water tables.

Wheat and cotton, as major crops of the Great Plains, have been significantly affected by commodity programs. Price floors set for protected products have allowed farmers to make decisions with some certainty, and farms have grown larger through purchase and rental of additional land. Wheat production costs are lowest and corn production costs second lowest in the Great Plains States. Costs of producing cotton are third lowest—after Arizona and California.

Export demand for wheat and feed grains has influenced the maintenance and expansion of production in the Great Plains. Export demand for sunflower oil has been high recently, and production has greatly increased—particularly in the Dakotas.

Feedlot development in the Great Plains has been based on abundant supplies of feed grains and the availability of feeder cattle from ranches in the region. In 1978, the Great Plains States fed 63 percent, compared with 46 percent in 1969, of all fed cattle produced in the United States. Although larger proportions of total cattle are being fed in the very large feedlots, farmer-feeders (less than 1,000 head fed annually) apparently will continue to feed a significant number of cattle.

In the future, the number of Great Plains farms is expected to continue to decline and average size of farm to become larger—with wealth and production concentrated in fewer hands. For all farmers, inflation, particularly higher energy costs, will result in attempts to increase size to maintain income.

Water will be available to irrigate the same number of acres in 1999 as in 1979. However, large acreages will be shifted back to dryland farming in some areas such as the Texas High Plains-South.

Other areas will increase irrigated acreages considerably.

The Great Plains States will continue to have a large cowherd for feeder cattle production and to feed for slaughter about two-thirds of the fed cattle produced in the United States.

INTRODUCTION

The Great Plains can be characterized best by its treeless nature, nearly level topography, and low and variable rainfall. The Great Plains is a vast area extending from Canada almost to Mexico and from the Rocky Mountains on the west to the western Corn Belt on the east. This region is a land of sandstorms, heat waves, hailstorms, torrential rains, tornadoes, blizzards, and numbing cold.

Farming in the Great Plains differs considerably from farming in the older areas of the East. Some of these differences are due to the way the area was settled and developed; some are attributable to the natural resources of the region. Adjustments in the numbers and sizes of farms, however, have been similar to changes in other regions because of the overall effect of technology and the availability of credit.

PAST AND PRESENT

The first agricultural use of the Great Plains was as a cattle kingdom, which had its origins in Texas before the Civil War. By 1876, cattle were raised in all the Great Plains States. This was the romantic period of great cattle drives and cowboys with six-shooters riding the range. Texas longhorn cattle grazed on large tracts of privately as well as publicly owned lands. The longhorn cattle, however, were soon replaced by better European-derived beef cattle from the northern ranges. Well drilling and windmills improved the availability of water for cattle.

In 1862, the Federal Homestead Law was passed, and large portions of the rangeland subsequently moved into private hands. The limit of 160 acres for a "homestead" was perhaps suitable for the humid East but entirely too small for much of the Great Plains, especially the areas of low rainfall. Ranchers circumvented this limit by buying additional land, "squatting," and simply using other land not owned. The Homestead Act and barbed wire, which was sold first in 1874, brought the beginning of the end to open-range ranching. Farmers began to move westward into the Great Plains from the eastern parts of the Great Plains States. Many migrants came from northern Europe and Russia.

Even in the early days of settling the Great Plains, water was of primary concern. In the beginning of settlement, windmills were used to water stock and small gardens. Irrigation was developed in some river valleys in the Great Plains proper. And, in the mountains of the western Great Plains States, irrigation in the valleys was possible from streams.

The Reclamation Act of 1902 authorized the construction of dams and reservoirs to store and release water for irrigation. One of the first projects built under the Act was constructed in eastern Wyoming to provide water for parts of Wyoming and Nebraska. Many other projects followed. Some were built with grants and loans from the Public Works Administration of the 1930's and early 1940's. Large increases in irrigation with ground water also occurred around 1940, particularly in the High Plains of Texas. At that time, there was abundant underground water of good quality only 50 to 70 feet below the surface. Irrigation has been an important factor in many areas ever since these developments in the thirties and forties.

Farmers used trial and error to learn. Many failed in the undertaking. Summer fallow and limited tillage facilitated by new implements were used to improve yields. Some of the successful wheat varieties, such as the famous Red Fife hard spring and hard winter Turkey and Kharkov, were of Russian origin. By 1889, cotton acreage had expanded to eastern and central Texas, but it was 1915 before cotton culture came to all of Oklahoma and west Texas. Parts of eastern Texas and Oklahoma had erosion problems similar to those in eastern States and in concert with the great drought of the thirties resulted in migration farther westward.

Farms Fewer, Larger

In much of the Great Plains, many of the technical aspects of farming, as well as some of the organizational and management features of farming, differ considerably from those in the older agricultural areas in the eastern part of the United States. However, farming in the Great Plains has undergone many changes roughly comparable to changes in farming throughout the country. For instance, changes in farming and ranching in the Great Plains have resulted in fewer but larger farms and ranches. The number of farms in the Great Plains decreased from 966,000 in 1950 to 568,000 in 1978. It is important to remember that these are net figures. During this period, many farms were abandoned. Conversely, a few new farms were begun. Examples of such farms are the large-scale cattle feeding lots that have been established in the Great Plains.

The decrease of 40 percent in the number of farms is somewhat less than the 50-percent decrease in the number of farms in the United States (figure 1). Almost 26 percent of the 568,000 farms had annual sales of less than $2,500. The decline in number of farms has slowed, however. The rate of decline in the seventies has been one-third of the rate in the 1950's, as indicated below:

Farm numbers, Great Plains

Year	Number	Decline Number	Decline Percent
	Thousands		
1950	966		
1960	747	219	23
1970	620	127	20
1978	568	52	8

Most of the land in the farms that "disappeared" was consolidated into other farms. Therefore, the increase in farm size (acreage) is as striking as the decrease in the number of farms (figure 2). Average farm size in the Great Plains in 1974 was 63 percent more than in the early fifties. The increase (in current dollars) of annual cash receipts per farm is even greater (figure 3). However, when inflation is taken into account, the relative change in cash receipts has been roughly comparable to the changes measured in acreage.

Farms Diversified, Concentrated

There is great diversity in size of farms and ranches in the Great Plains. For example, as recently as 1974, 10 percent of the farms in the region included less than 50 acres of land. On the other hand, nearly one-fifth (100,000 farms) had 1,000 acres or more of land (figure 4). These 100,000 farms accounted for two-thirds of the number of farms in the United States with 1,000 acres of land or more.

Area, of course, is not necessarily a good measure of size. Feedlots that have developed in recent years individually often involve relatively limited amounts of land but produce relatively large amounts of beef.

Concentration in large units as measured by acres increased over time, as indicated on top of page 340.

There is a substantial concentration of farmland in large units (figure 5). Such diversities and increasing concentration among larger farms are indicated by sales of farm products. Consistent with changes in much of U.S. farming, the most pronounced change in Great Plains farm numbers has been a decrease in the farms

Farm concentrations, Great Plains			
Size	1950	1974	Percent change
Acres	*Thousands*		
Less than 500	750	367	−51
500 to 999	107	92	−14
1,000 and over	80	100	+25

considered to be relatively small. The decrease in the sixties was large. In the seventies, the decline has continued but at a slower rate.

During 1959-69, the number of farms with sales of $2,500 to $20,000 declined by 142,000. On the other hand, the number of

FIGURE 1
NUMBER OF FARMS

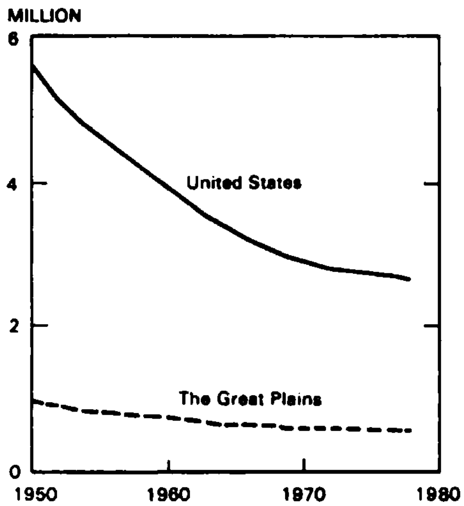


FIGURE 2
AVERAGE FARM SIZE

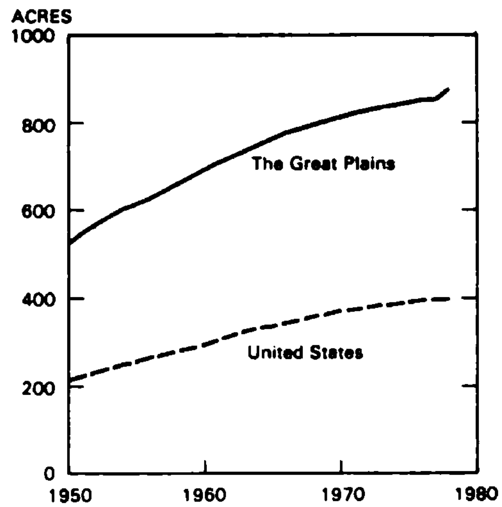


FIGURE 3
CASH RECEIPTS PER FARM

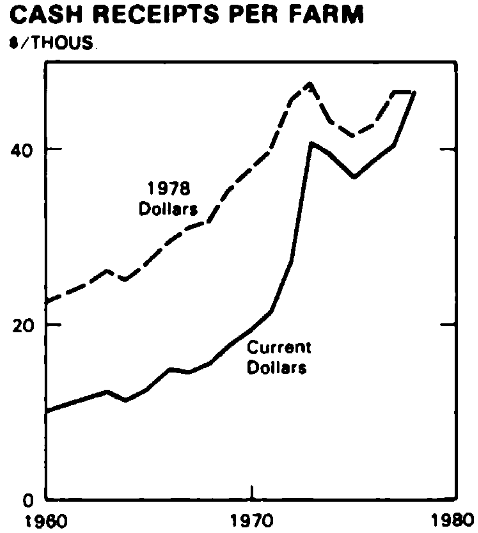
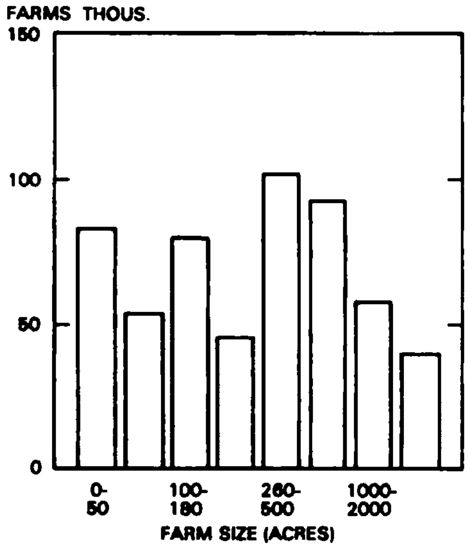
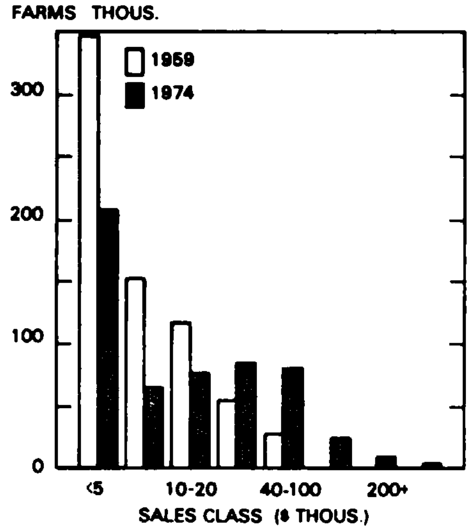


FIGURE 4
FARM SIZE DISTRIBUTION, BY ACRES, 1974



NOTE: FARMS WITH MORE THAN $2,500 SALES.

FIGURE 5
FARM SIZE DISTRIBUTION BY SALES, 1959 AND 1974



farms with sales of $20,000 or more increased. Inflation affected these numbers to some degree, but the index of prices received by farmers increased only 11 percent in the 10 years.

Changes in size distribution continued into the seventies (figure 6). However, direct comparisons of size distribution during 1969-74 provide limited insight because farm product prices increased 80 percent in these 5 years. Comparisons of farm numbers by sales classes adjusted for inflation illustrate the changes in the sixties and the smaller adjustments in the early seventies, as shown on top of page 342.

Operators Own Three-Fifths of Farmed Land

Approximately 60 percent of the land in farms in the Great Plains is owned by the operators. In many cases, however, farmers and ranchers operate land they own, as well as land they rent. In fact, in 1974, the number of full owners was almost identical to the number of part owners. The part-owner farms are much larger, however; in 1974, they accounted for 65 percent of all land in farms. Full tenants accounted for only 16 percent of all farms and ranches.

In the Great Plains, both the northern and western States have larger farms—if size of farm is measured by either acres or sales per farm—than do Oklahoma and Texas. Much of this difference is due to the inclusion in State data of large areas in Oklahoma and Texas which have non-Great Plains conditions and many part-time farmers. Were these areas eliminated, the sizes of farms in Oklahoma and Texas would be similar to those in other Great Plains States.

Classes of farms, Great Plains

Sales class	Number of farms			Sales class
Current dollars	1959	1969	1974	1974 dollars
		Thousands		
0- 10	499			0- 20
0- 10		366		0- 18
0- 20			353	0- 20
10- 20	117			20- 40
10- 20		108		18- 36
20- 40			86	20- 40
20- 40	55			40- 80
20- 40		82		36- 72
40-100			83	40-100
40 and over	27			80 and over
40 and over		51		72 and over
100 and over			36	100 and over
Total	698	607	558	

Individuals Operate Most Farms

The Census of Agriculture treats primary forms of business organization for the farming sector: individuals, partnerships, and corporations, plus a category designated other. In 1974, 90 percent of the farms in the Great Plains were operated by individuals, 8 percent by partnerships, and 2 percent by corporations, as shown below:

Business organization	Farm numbers[1]	Percentage distribution
	Thousands	*Percent*
Individuals	375	90
Partnerships	31	8
Corporations	7	2
Other	1	–

[1] Farms with $2,500 or more of sales in 1974.

RESOURCES

The Great Plains States account for two-fifths of the cropland and one-half of the grassland pasture in the United States. In 1974 land utilization in the Great Plains States was as follows:

Farmland uses	1,000 acres	Percent of land area	Percent of U.S. total
Cropland			
Used for crops	151,353	24	42
Idle	6,002	1	29
Used for pasture only	31,137	5	38
Grassland pasture	310,078	49	52
Forest land	83,024	13	12
Special-use areas	29,077	5	16
Other land	17,154	3	6
Total land area	627,825	100	28

Great Plains cropland accounted for approximately one-third and grassland pasture one-half of the total U.S. land area in 1974. Forest and special uses occupied the remainder. Of the States in the region, North Dakota had the highest proportion of total land area in cropland, followed closely by Kansas. The western States of Colorado, Montana, Wyoming, and Texas had the smallest proportion of cropland. These States have large acreages of grassland, forest land, and special areas in parks and other recreational uses. Western parts of Colorado, Montana, and Wyoming are in the Rocky Mountains and include cattle ranching but very little cropland. Physical and therefore farming conditions are quite different from those in the Great Plains areas of the region.

Associated with the decline in farm numbers and the increase in their average size has been substantial decreases in labor inputs and increases in capital items such as machinery. Use of water for irrigation also has increased. The amount of land devoted to farming has remained relatively constant, while on an individual farm basis it has increased.

Land Resources Stable

There has been little change since 1950 in land resources devoted to farming and in the proportion of land in cropland, pasture, and woodland in the Great Plains. Land in farms, accounting for more than three-fourths of the entire land area of the region, declined less than 3 percent during 1950-74. The proportion of farmland in cropland in 1974 was 37.4 percent, slightly more than in all but one of the Census years beginning with 1950. Percent of cropland harvested decreased during the period but by 1974 was 23.7 percent of farmland. Pastureland acreage, 54.2 percent of farmland in 1974, tended to decrease after 1964. Woodland acreage tended to vary during the period, possibly due to differences in definition.

Capital Goods Substituted for Labor

The use of labor has been declining on Great Plains farms, but there is some indication that labor numbers are stabilizing. In 1977, numbers for hired labor were slightly higher than in 1970.

The 1977 population of 1.3 million people residing on farms in the Great Plains was only 37 percent of the farm population in 1950. Only the Northeast and South regions had greater declines. The percentage of the U.S. farm population residing on Great Plains farms has not changed much since 1950, ranging from 15.5 percent in 1950 to 16.8 percent in 1977. In the Great Plains as a whole, family farmworkers have been of considerably more importance than hired farmworkers, as indicated below:

Type of farmworker	1960	1970	1977
		Thousands	
Family	915	665	589
Hired	335	193	196
Total	1,250	858	785

The decline in number of farms and especially the development of larger tractors and other machinery were major factors in reducing farmworker requirements. Texas, Colorado, Montana, and Wyoming have the largest proportion of total farm labor as hired labor. Frequently, labor of Mexican extraction has been available in these States. Family farm labor comprises the highest proportion of all labor in Nebraska, North Dakota, and South Dakota.

In general, nonfarm employment opportunities have not been as widely available in the Great Plains as in other areas (with some exceptions, such as in Texas). Outmigration to distant areas and other States has occurred as a result. In parts of the Great Plains, there has been a recent slowing of migration from rural areas.

Machinery an Important Input

Large increases in the use of capital items have been prominent changes in farming in the Plains. Growth in the value of machinery as a proportion of farm assets—despite sharp increases in land prices—is somewhat indicative of these increases. The value of machinery varied from 8 percent of the value of all farm assets in 1974 to 10 percent of these assets in 1977. The total value of machinery rose from $8 billion in 1970 to $17 billion in 1977. Kansas, Nebraska, South Dakota, and North Dakota have a relatively higher proportion of assets in machinery inventories than do the other States.

The four-wheel-drive tractor has been particularly adapted to Great Plains conditions. In addition, limited tillage implements such as the rod weeder and noble blade have been developed to conserve moisture. Large tractors have been used for rapid soil preparation and seeding to take advantage of transient but favorable weather conditions. Crops can be harvested quickly by combines and other large machines. Also, custom combines have followed the harvest from Texas to Canada.

Fertilizer Use Greatly Expanded

Fertilizer use in the Great Plains has increased seven times since the early fifties (total weight). Nitrogen use has increased 20 times since 1950-54. In general, increases in fertilizer use have been significantly greater in the Great Plains than in the United States as a

	Fertilizer use							
	Total fertilizer*				Available nitrogen			
Year	GP	US	GP	US	GP	US	GP	US
	Mil. tons		*Pct. of 1950-54*		*Thou. tons*		*Pct. of 1950-54*	
1950-54	1.2	22.5	100	100	.1	1.6	100	100
1960-64	3.0	28.6	244	127	.8	3.9	504	238
1970	8.7	41.1	701	183	2.1	8.1	1,458	500
1977	8.7	51.6	706	230	2.9	10.6	2,009	656

GP—Great Plains, US—United States.
*Total quantity purchased, including filler.

whole. This contrast is due primarily to the expansion of irrigation in the Great Plains, although considerably more fertilizer is used in dry-land farming.

Great Plains fertilizer use increased from 6 percent of total fertilizer use in the United States in the early fifties to 21 percent in 1970. This percentage declined to 17 percent in 1977, even though there was a small absolute increase. Part of this was due to an increase in average fertilizer formula and the use of more "straight" fertilizer materials. Use of available nitrogen increased from 9 percent of the U.S. total in 1950-54 to 27 percent in 1977. In the Great Plains, nitrogen has been the prime fertilizer element, although there has been use of some phosphate and limited use of potash.

Irrigation Important to Many Farmers

A major use of capital in the Great Plains has been in well drilling, pumps, and equipment for irrigation. Current (1979) estimates indicate that it costs about $51,000, including land-leveling, to irrigate 100 acres of land. A center pivot system, which can be used on more rolling and sandy soil, costs about $57,000 for 130 acres—an investment of $430 per acre. Estimated costs for selected years, as follows, attest to the rapid escalation by inflation of investment per acre for the gravity irrigation system:

Irrigation investment per acre	
Year	Dollars
1950	103
1960	138
1970	201
1977	420
1979	513

Irrigated land in the Great Plains almost doubled during 1949-74, as shown on top of page 347.

Most of this 1974 acreage is accounted for by the States listed on page 347.

North Dakota and South Dakota had the least land irrigated. Kansas and Oklahoma had the greatest percentage increases in irrigated land during 1950-74. The greatest total acreage increase in irrigated land in the same period occurred in Texas and Nebraska. Colorado, Montana, and Wyoming had about the same acreage of irrigated land in 1974 as in 1950. The usually dry climate and

Year	Acres of irrigated land	Percent of U.S. total
	1,000 acres	
1950	10,315	40
1954	11,862	40
1959	14,885	45
1964	16,189	44
1969	18,254	47
1974	19,387	47
1979*	24,000	

*Estimated.

States irrigated	Million acres
Texas	6.6
Nebraska	4.0
Colorado	2.9
Kansas	2.0
Montana	1.8
Wyoming	1.5
Oklahoma	.5
S. Dakota	.2
N. Dakota	.1

uncertain weather conditions in the Great Plains have stimulated irrigation. Yields and production—particularly of cotton, corn, and grain sorghum—have been increased greatly due to irrigation.

The importance of ground water to irrigation in the Great Plains is indicated by the following data (*9*):[1]

Estimates of source of water pumped		
Source	1974	1977
	Percent	
Ground water	80	83
Surface water	14	12
Both	6	5

[1] Italicized numbers in parentheses indicate references listed at the end of this chapter.

CHANGES IN WEALTH

The Great Plains States have slightly more than one-fourth of the farm assets in the United States, as indicated below:

Farm assets, Great Plains

Type		1970	1975	1977
Total assets	Billion dol.	86.0	142.6	175.1
Pct. of U.S. total	Percent	27.3	27.6	26.7
Real estate assets	Million dol.	59.7	105.4	133.6
Pct. of total assets	Percent	69.5	73.9	76.3
Pct. of U.S. total real estate	Percent	27.7	28.6	25.4

In the Great Plains, values per unit of land are lower than in the United States as a whole. This is due primarily to the large area of grassland and range, high transportation costs (because of the relative isolation from large population centers), and farming uncertainty caused by an unpredictable climate and variable product prices.

The percentage of total assets in real estate in the Great Plains and United States has increased since 1970. However, this has been affected more by land price increases in the United States than in the Great Plains States. Farm debt has been about evenly divided between real estate and nonreal estate, with less real estate debt in the northern Plains and more in the other Great Plains States. Proprietorship equities have amounted to more than 80 percent of total assets, with little relative change since 1970.

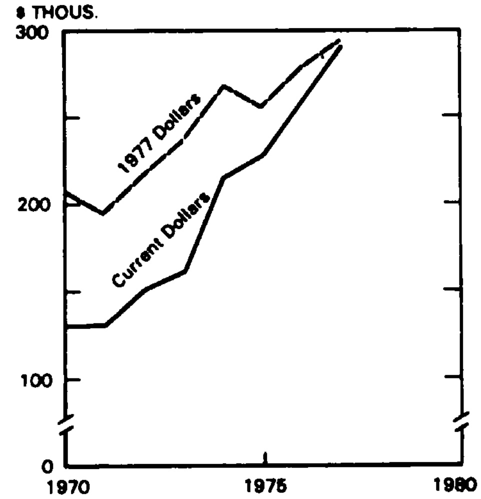
During 1970-77, physical assets in the Great Plains rose from $130,580 to $292,720 per farm, an increase of 124 percent (figure 6). On the basis of 1977 dollars, the increase was 44 percent. In only 2 years of this period, 1971 and 1975, did the increase in value fail to match the inflation rate.

FACTORS CAUSING CHANGE

There are many factors that have affected Great Plains farmer decisions—and the resultant ways that resources are organized and managed by them. Among the most important are:

- Natural resources of soil, climate, water, and grassland.
- Availability of capital goods.
- Export demand for major crops.

FIGURE 6
FARM PHYSICAL ASSETS,
AVERAGE VALUE, JANUARY 1



- Feed available for fattening cattle in feedlots.
- Commodity programs related to major crops.

In addition, national influences such as inflation, new technologies, and tax rules have influenced and conditioned farmers' actions in the Great Plains as they have in the rest of the United States.

Natural Resources

Soils

Soils in the region are capable of supporting a wide variety of crops and are among the most fertile to be found anywhere. In most farming areas, inadequate moisture is the limiting factor. Most of the northern Plains soils are glaciated with a mantle of outwash from the Rocky Mountains in the western areas, resulting in higher elevations in the western than in the eastern part. The topography of the Great Plains is the result of glacial till, stream deposits, and loessal movement. The major soils are the Chemozen, Chestnuts, and Brown soils, and they are the most productive in the area. In general, the darker colored soils are located on the eastern edge, and soils become lighter colored in the western areas of the Great Plains.

Climate

Rainfall varies from 10 inches per year in the driest part to 35 inches in the southern areas on the eastern edge of the Great Plains. Comparable amounts of rainfall are not equally absorbed throughout the area because of the greater evapotranspiration in the southern part. January average minimum temperatures vary from -5°F. in the north to 20°F. in the south. Summer average maximums vary from 85 to 95 degrees. However, high temperatures last longer in the southern areas than in the northern areas. This brief description indicates why cotton is limited to the southern Plains. Also, the climate is why small grains, and especially wheat, have been so well adapted to the Great Plains. Winter wheat is planted in the fall and matures under spring rains, missing the extreme heat of summer. Spring wheat in the northern Plains matures in a relatively short period of time because of long hours of daily sunlight. Sorghum, developed from Old World tropical grasses, is adapted to the dry climate from Nebraska southward. Sorghum is a crop which can more readily adjust to moisture stress than can corn. Also, sorghum is used as a forage crop as well as for grain. Corn has been confined to more eastern areas, although it is grown successfully in drier areas under irrigation.

Water

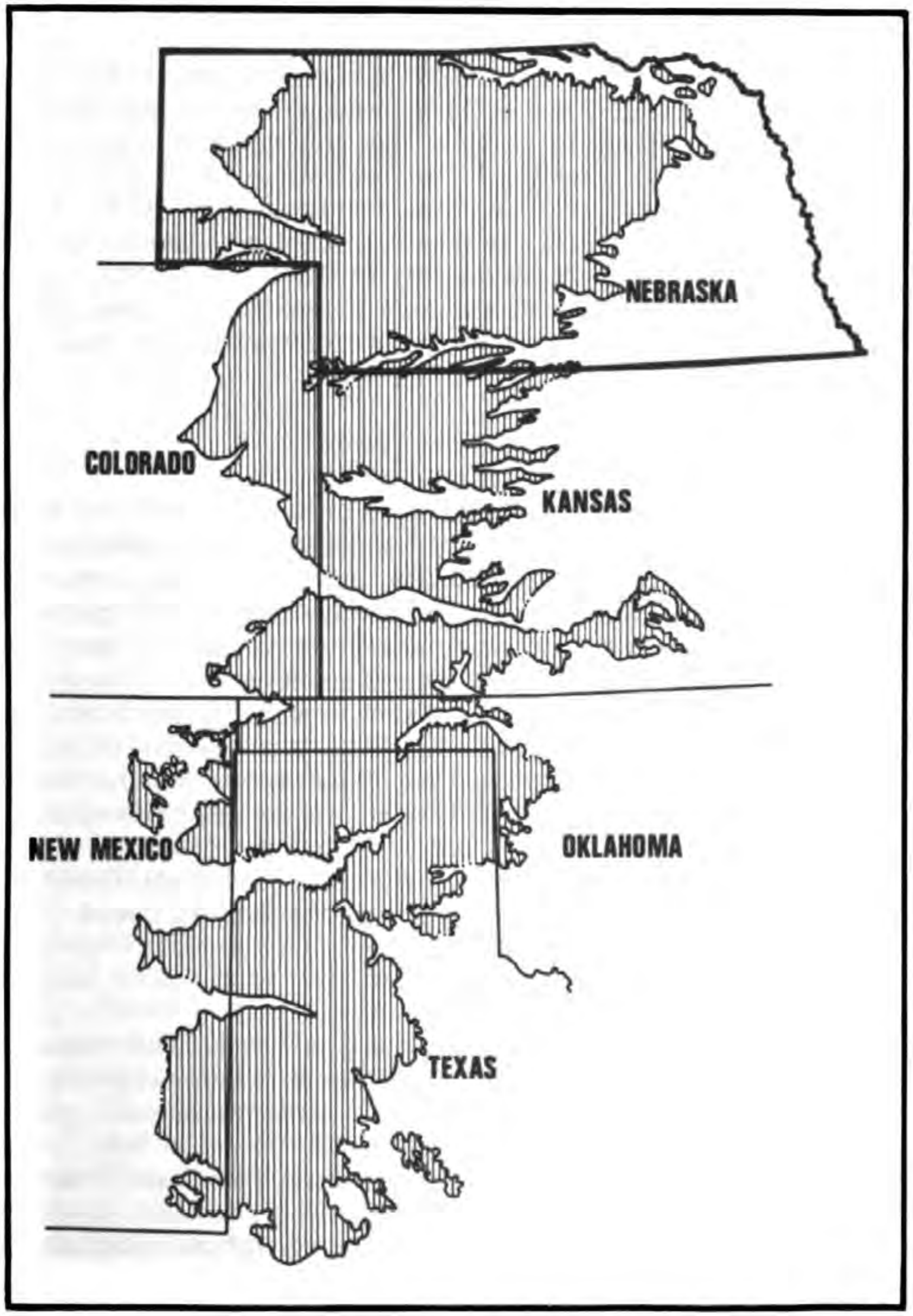
Farmland in the Great Plains is irrigated from surface sources and underground aquifers. The largest water-holding formation is the High Plains-Ogallala aquifer extending from northwestern Texas to Nebraska, with areas in eastern Colorado and New Mexico (figure 7). Although wells were sunk in the formation as early as the 1930's, the greatest development occurred after 1950. The nature of the formation with high-bench plain topography is such that recharge from streams usually is not significant. There has been a persistent increase in mining of the water of the Ogallala formation over time. This type of irrigation accounts for the major portion of the near-doubling of irrigated land during 1950-74.

Storage in the Ogallala was an estimated 2 billion acre-feet of water in about 1978. This ready supply had much to do with the increase in irrigation in the Great Plains. Over the past 10 years, there has been increasing concern over declining water tables and increasing costs of supplies.

Grassland

Grassland pasture accounts for 49 percent of the land area, 310 million acres in the Great Plains, which is 52 percent of the total grassland acreage in the United States. Much of this acreage is unsuitable for cropping. The quality of rangeland varies from good to very poor, depending on soil conditions and climate. Most rangeland grasses cure well in the late summer to provide excellent but low-protein grazing for cattle. Efforts continually are being made to reduce overgrazing, which has been a serious problem in the drier

FIGURE 7
OGALLALA AQUIFER



SOURCE: NATURAL RESOURCES COMMISSION, STATE OF NEBRASKA.

years. Depending on the resource situation, there are "straight" ranchers, farmer-ranchers, and "straight" farmers in the Great Plains. Some farmer-ranchers have ranches which are located at considerable distance from farming operations.

There were almost 20 million head of beef cows in the Great Plains in 1975—44 percent of all beef cows in the United States. Texas accounted for about one-third of the beef cattle in the Great Plains and 15 percent of the U.S. beef cows. Oklahoma and Nebraska are next in importance to Texas in beef cow numbers. The number of beef cows in the Great Plains decreased to about 17 million head by 1978 (a decrease of 13 percent, compared with 1975). South Dakota and Wyoming had the largest percentage decreases in their beef cow herds. The decreases during 1975-79 were slightly smaller in the Great Plains than in the rest of the United States. Cattle numbers declined because of low slaughter cattle prices and high feed costs.

Capital Goods

New machinery has facilitated the increase in size of Great Plains farms, more timely cultivation, and harvesting. Limited tillage implements have reduced both labor and energy use. The increase in fertilizer use has resulted in significantly higher yields per acre, particularly on irrigated acreage. In addition, pesticides have been used to control insects and weeds. The development of hybrid sorghums increased yields, which added significantly to the profitability and popularity of the crop. The introduction of hybrid sunflower seed has made this a "new" and expanding crop in the northern Plains (*2*). Development of the center-pivot sprinkler system has allowed irrigation, with little labor, of land that is too sandy or too steep to be irrigated with gravity methods. Credit has been available to most farmers to purchase these capital goods.

Exports

The Great Plains States produce three of the five U.S. classes of wheat, and all three classes have been important in the export trade. Percentages of Great Plains wheat and cotton production exported are shown on page 353.

In addition, feed grains, sunflower seed, soybeans, and Texas rice have been other crops affected by strong export demand. Sunflower oil is preferred for making high-quality margarine and salad oil (*2*). Commodity programs have been adjusted to fit export demand, and acreage limitations have been reduced or eliminated during periods of high export demand. Export demand, therefore, has influenced the

Wheat and cotton exports	1968-70 average	1974-76 average
	Percent	
Wheat, total	45	48
Hard, red winter	45	52
Hard, red spring	45	40
Durum	46	41
Cotton	30	39

maintenance and expansion of production and the introduction of relatively new crops. Total production of Great Plains wheat was 33 percent greater in 1974-76 than in 1968-70, as total export quantities were much greater.

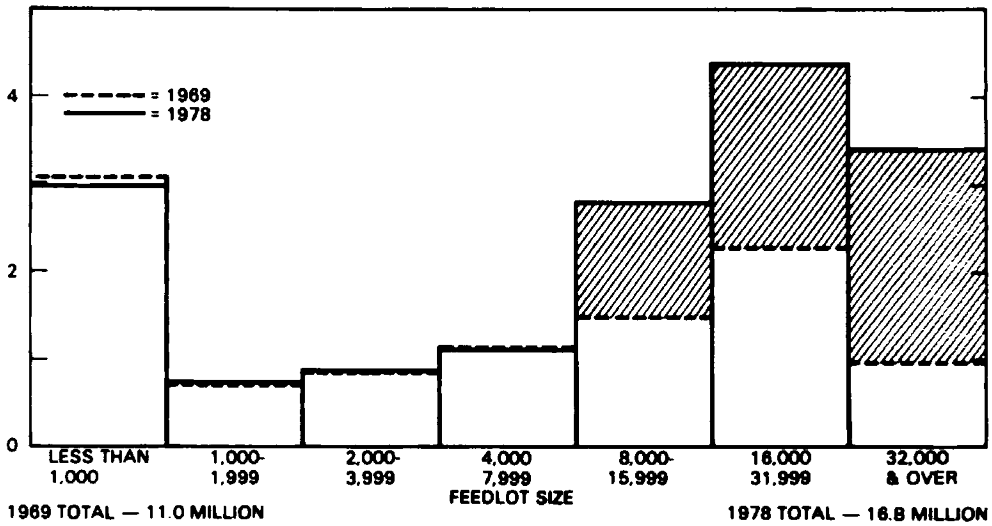
Feedlot Development

Feedlot development in the Great Plains has been based on two main factors: (1) abundant supplies of corn, grain sorghum, and barley; and (2) feeder cattle from Great Plains ranches. In the fifties, increased production of grain sorghum occurred in Texas and other southern Plains States as a result of government cutbacks in cotton and wheat acreages. These developments facilitated the development of feedlots to finish cattle for slaughter. Unlike Nebraska and other northern Plains States, Texas had few farmer feeders (with less than 1,000 head fed annually).

Therefore, large commercial feedlots tended to develop, rather than small feedlots. The farm business organization included partnerships, private companies, and cooperatives. Management searched for specialized skills in labor, large purchases of feed, adequate numbers of good feeder cattle, and successful marketing of slaughter cattle. Many offered custom feeding services to those with feeder cattle. Management of large feedlots is entirely different from the decisions required of a farmer-feeder marketing his own grain through livestock. The complexities of managing large feedlots are such that many failed in the developmental days due to adverse terms of trade in buying and selling, and large risks remain for present large feedlots.

In the Great Plains, the number of fed cattle as a proportion of U.S. numbers increased from 46 percent in 1969 to 63 percent in 1978. The increase was associated primarily with large lots (figure 8). In 1969, 28 percent of all fed cattle were in the less than 1,000-head group, compared with 18 percent in 1978. But, the absolute number

FIGURE 8
FED CATTLE MARKETED, BY SIZE OF FEEDLOT, 1969 AND 1978



of cattle fed in this group was practically the same, 3.1 million head in 1969, compared with 3 million in 1978. The number of cattle fed by farmer-feeders increased from a low of 2,011,000 in 1975 to 2,961,000 in 1978. The largest category of feedlots, 32,000 head and over, accounted for only 9 percent of cattle fed in 1969. By 1978, the share of cattle fed by this group of producers was 23 percent. At the same time, farmer-feeders increased the number of cattle they fed from 2 million head in 1975 to 3 million in 1978. Feed grain production in the Great Plains is sufficient to continue feeding the current two-thirds of the U.S. number of cattle fed.

Commodity Programs

Commodity programs have had a major impact on wheat, cotton, and feed grain production in the Great Plains. During past times of increasing demand, some areas of marginal wheat land have been brought into production. Commodity programs tend to freeze these areas into a pattern of permanent production. The history of commodity payments indicates that a substantially higher proportion of payments go to a small number of large producers than to a large number of small producers (*10*). In some of the earlier programs, feed grains were not included, and this resulted in significantly increased acreages of grain sorghum in the Great Plains—providing one of the foundations for establishment of large beef cattle fattening lots.

Commodity programs have set price floors for related products. These price supports have allowed farmers to make decisions with some certainty in regard to expected product prices.

Consolidation of Farms

Farms have grown larger in the Great Plains through purchase and rental of additional land. Land has been purchased from retiring farmers, via the settlement of estates, and from farmers and nonfarmers who decided that returns were too low or capital gains too high to justify owning land. The amount of land changing hands each year is less than 3 percent of the total amount of land in farms.

In past years, the availability of land for rental has been increased by retired landlords and absentee owners who have been interested in rental income and land appreciation. This may change, since the 1974 Census data indicated a significant increase, 15 percent, in land operated by full owners—while land operated by part owners had declined 5 percent and land operated by full tenants had declined 11 percent, compared with 1969. The 1978 Census will provide an indication of the permanence or reversal of this trend. For many years until 1974, land operated by part owners had continued to increase in importance.

THE FUTURE

Extension of trends indicates that the number of farms in the Great Plains will continue to decline and that their average size will be larger. Associated with these changes will be greater concentration of wealth and production in fewer hands. However, the rates of decline in farm numbers may continue to slow, and the eventual rates of decline will depend greatly on the decisions of small operators. On the one hand, there still are many people in the Great Plains who find it advantageous to farm on a small scale. Many but not all of these people have nonfarm sources of income. On the other hand, the combining of farm and nonfarm employment often involves commuting over long distances. And increased energy costs may stimulate these people to give up farming when they have an opportunity to do so.

Most future farming in the Great Plains will occur on dryland. Spring wheat and barley will continue as major crops in Montana, North Dakota, and South Dakota. Winter wheat will be grown in parts of Montana and South Dakota and southward in the other States of the Great Plains. Kansas and North Dakota will continue to be the number 1 and number 2 States in total wheat production. Cotton acreages in Texas and Oklahoma may be smaller than at present. Dryland grain sorghum will be important from Nebraska southward.

Limited conservation tillage will be more important, due to increased fuel prices. Ecofallow, a system of limited or no tillage and chemical weed control, may be important in the future. Availability and price of chemicals may be determining factors in the use of ecofallow. Export markets likely will determine future crop acreages in the Great Plains. Marketing and transportation facilities need future improvement and expansion.

Other major uncertainties about the future of farming in the Great Plains relate to irrigation and energy. There are two major questions: What amount of water will be available? How will energy prices affect the cost of pumping the water that is available?

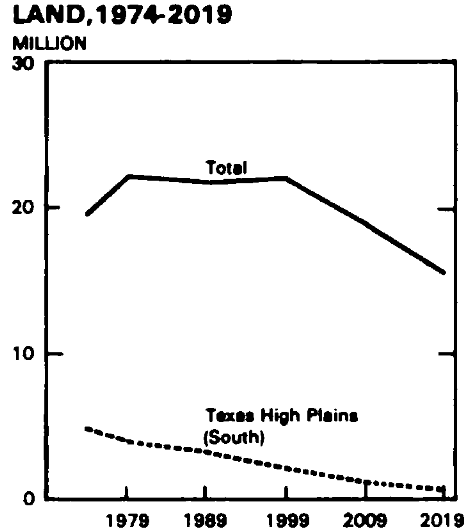
Studies focusing on future changes in irrigation suggest that water will be available to maintain irrigation acres at current levels at least until the year 2000. At the same time, the acreage irrigated in some areas, such as in the Texas High Plains-South,[2] that is dependent on ground water will decline. In such areas, land will revert to dryland uses. Increases in other areas, particularly in Nebraska, will offset these declines for the next 20 years.

Projections of the acreage of irrigated land indicate that further increases in total acreage will be very limited and probably the Great Plains has reached its maximum of total irrigated acreage. While the acreage increased from 19.4 million to 24 million acres during 1974-79, these studies indicate that it will dip slightly in the 1980's and then recover some in the 1990's—perhaps to 1979 levels (figure 9). This small decline is expected to occur because of the depletion of water in some areas before others can be developed.

Looking more to the future, irrigated acres are expected to decline to 20.3 million in 2009 and 16.7 million in 2019. The latter acreage

[2] Texas High Plains-South includes the Texas part of the Ogallala aquifer south of the Texas counties of Oldham, Potter, Carson, Gray, and Wheeler.

FIGURE 9
ESTIMATED ACRES OF IRRIGATED LAND, 1974-2019



is more than all irrigated acreage in 1964. That all areas will not be affected equally is indicated by the estimates of acreage for the Texas High Plains-South subarea indicated at the bottom of figure 10. These estimates indicate that the Texas High Plains-South will decline continually, reaching a level of 41 percent of 1974 by 1999 and only 7 percent, or 336,000 acres, by 2019.[3] These estimates reflect the following:

1. It is anticipated that 9.5 million acres of irrigated land will be maintained because of available water from reservoirs, streams, alluvium, deep strata, etc.
2. A decline in land irrigated by the Ogallala formation in the Texas High Plains-South—from 4.5 million acres in 1974 to 1.8 million in 1999 (*5*, *12*).
3. Other acreage irrigated by the Ogallala formation will increase from 5.4 million acreas to 12.4 million in 1999, after which the average is expected to decline to 6.9 million acres (*1*).[4]

There is no clear estimate of the level of energy costs which makes prospective acreages appear feasible.

Energy Requirements and Irrigation

The prospective depletion of the Ogallala aquifer is aggravated further by prospective higher energy costs. Estimates indicate the following mix of energy use for irrigation: electricity, diesel, natural gas, and propane.

At the present time, diesel fuel is the highest cost and natural gas by far the cheapest energy source for pumping water (figure 10). Electricity is second lowest but almost 2.5 times that of natural gas. Diesel fuel has increased greatly in price during 1979. Supply availabilities also are important to consider. For example, use of natural gas is limited because it is not generally available. Supplies of propane (LPG) generally have been available in 1979, but it is higher in cost than electricity.

Electricity may evolve as the primary source of energy for irrigation since nonpetroleum fuels can be used in the generation of electricity. Electricity is widely available, but it is increasing in cost. Since propane costs only slightly more than electricity, propane may be used more, especially so long as it is in good supply.

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[3] The estimates of irrigated acreages are not forecasts. They are illustrations of likely results based on the assumptions below and the literature cited. A six-State study by the Commerce Department's Economic Development Administration of the High Plains Ogallala aquifer will provide more definitive answers.

[4] In addition to (*1*), information came from personal communications with Gordon Sloggett, Economics, Statistics, and Cooperatives Service, U.S. Department of Agriculture, Stillwater, Okla.

Energy costs in producing crops are substantial; but they vary among regions of the country. Therefore, changes in energy costs will have different effects on the costs of irrigated crop production in the Great Plains than, for example, on crop production in the Corn Belt.

Nonland costs of producing corn are increased greatly if the cost of the energy component is doubled or tripled (figure 11). The Nebraska center-pivot irrigation system is impacted the most by rising energy costs because of distribution requirements. Illinois is affected least, since there is no irrigation in central Illinois (*6, 7, 8*). Central Illinois has a 35-cents-per-bushel advantage in nonland costs of production, compared with the Nebraska center-pivot system, and a 28-cents-per-bushel advantage, compared with the Nebraska gravity irrigation system (1979 energy prices).

Doubling of 1979 energy costs results in a 59-cents-per-bushel advantage for Illinois, compared with the Nebraska center-pivot system, and a 37-cents-per-bushel advantage, compared with the Nebraska gravity irrigation system. Tripling of 1979 energy costs results in an 83-cents-per-bushel Illinois advantage over the center-pivot system and 48 cents per bushel over the gravity irrigation system.

These advantages would allow Illinois to maintain corn production at lower corn prices—or would raise land values, compared with Nebraska. Nebraska farmers likely would try to enlarge operation size to recover the increased costs paid for energy.

There are no data readily available for the Texas High Plains-South, where irrigation wells actually are going dry. In this situation, energy requirements become progressively greater as wells are made deeper to obtain diminishing quantities of water. This combination of less energy efficiency and less water can make irrigation unprofitable.

Electricity Used

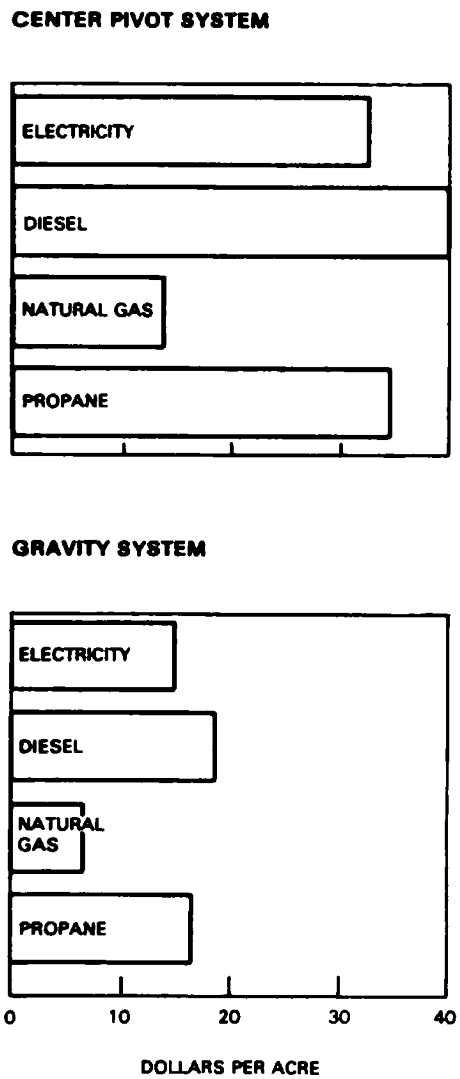
Some estimates have been made of energy used per acre-foot of irrigation groundwater pumped in 1974, as shown on page 360.

It seems apparent that Colorado and Nebraska represent the best situations and North Dakota, Oklahoma, and Wyoming the worst with respect to energy use for irrigation. The other States are between the best and worst in energy use.

Closing Comments

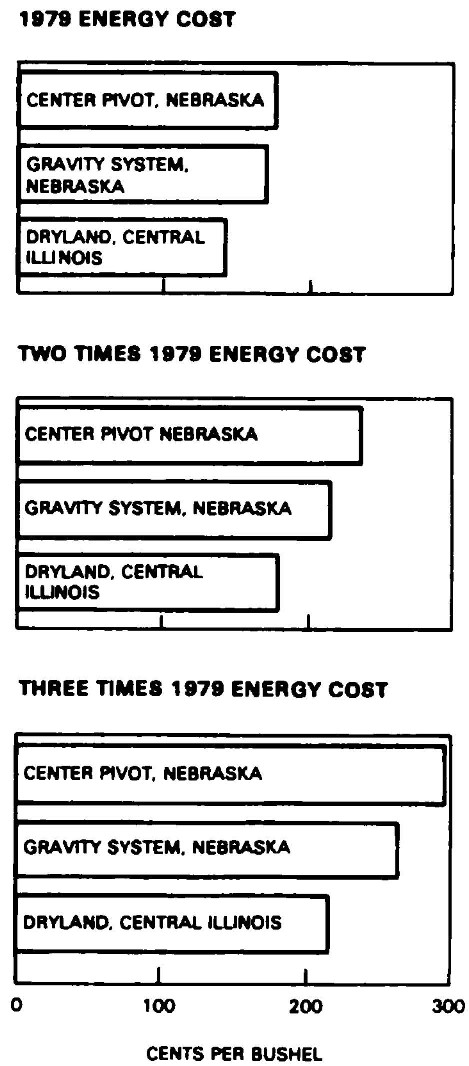
In conclusion, depletion of the Ogallala aquifer and higher energy prices will combine to reduce the economic life of irrigation reservoirs in many areas of the Great Plains. This will have substantial

FIGURE 10
COST OF PUMPING IRRIGATION WATER PER ACRE, CENTRAL NEBRASKA, 1979



SOURCE: ADAPTED FROM JOHNSON, BRUCE B., "IRRIGATION, ENERGY, AND CONSERVATION," STAFF PAPER 79-3, DEPARTMENT OF AGRICULTURAL ECONOMICS, UNIVERSITY OF NEBRASKA-LINCOLN, MARCH 1979

FIGURE 11
COST OF PRODUCING CORN PER BUSHEL, EXCLUDING INTEREST ON LAND INVESTMENT, CASH OR SHARE RENTS, WITH VARIABLE ENERGY COSTS



SOURCE: ADAPTED FROM JOHNSON, BRUCE B., "IRRIGATION, ENERGY, AND CONSERVATION," STAFF PAPER 79-3, DEPARTMENT OF AGRICULTURAL ECONOMICS, UNIVERSITY OF NEBRASKA-LINCOLN, MARCH 1979

State	kWh electricity	Pct. of Nebraska
Colorado	413	101
Kansas	560	137
Montana	641	156
Nebraska	410	100
North Dakota	696	170
Oklahoma	796	194
South Dakota	613	150
Texas	575	140
Wyoming	739	180

Source: *Energy Related Impacts on Great Plains Agriculture, 1976-2000,* Great Plains Agricultural Council, Publ. No. 82, University of Nebraska, Lincoln, 1976.

effects on farming. Lowered farm incomes will follow in those areas that are forced to change from irrigation to dryland farming. Land values will be lowered, and there will be efforts to obtain more land to expand operations under dryland conditions. This may maintain land values at levels higher than usual, at least in the short run. Farm numbers in affected areas will be significantly reduced, and agribusiness activities will be lessened because of fewer farms and inputs needed per acre of dryland. In the Texas High Plains-South area, cotton acreage likely would be reduced greatly, and there would be a significant increase in wheat acreage. A reduction in dryland grain sorghum acreage likely would be maintained. Estimates indicate that it takes five to six times as much dryland per farm to equal net income from irrigation (*4*).

Thus, the prospects for irrigation in the Great Plains are mixed. Some areas will be increasing and others decreasing irrigated acreage. Rising energy costs will continue to reduce the profitability of irrigation. However, irrigation is sufficiently more profitable than dryland farming to indicate that net irrigated acreage is expected to be about 24 million acres in the year 2000, approximately the same as in 1979. After 2000, irrigated acreage is expected to decrease.

The future of the cattle industry, both cattle raising and cattle feeding, will be related to the nature of future cattle cycles. In most cycles, cattle numbers have been increased to the point that as additional cattle reach market, prices fall and a liquidation phase follows—which serves to lower prices even more. Higher prices occur as liquidation is completed, and even higher prices result as heifers and cows are retained to rebuild herds.

These peaks and valleys of cattle numbers and prices have been characteristics of the cattle industry for many years. In the main, however, the amount of beef available to consumers per capita has been increasing.

Other major shocks to the fed cattle industry have been high prices for feed grains, occasioned by production decreases, and shifts in consumer demand from beef to other meats and meat substitutes because of high beef prices.

Studies made several years ago indicate that Great Plains grassland can provide grazing and farm forage to maintain beef cow numbers equal to the number on hand January 1, 1975 (*11, 3*). Similarly, feed grain production is sufficient to feed even more cattle than recent peak numbers. Limits to expansion will be imposed by risks inherent in the cattle business.

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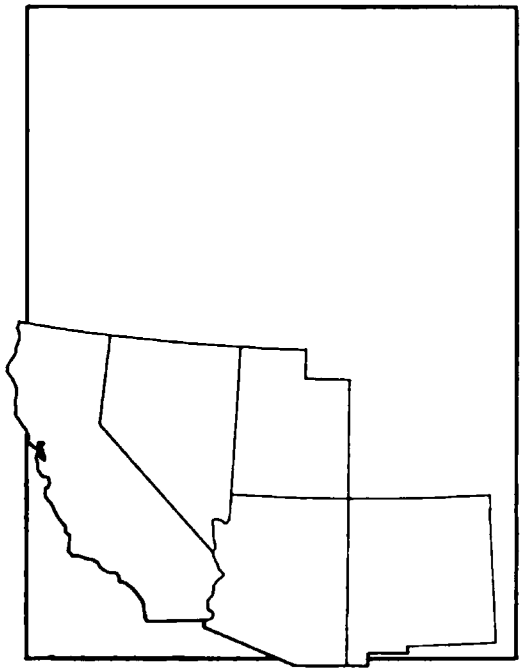


The Southwest

Stanley S. Johnson &
Edward V. Jesse

SUMMARY

Farming in the Southwest has become diverse and is done on a large scale. Diversity, as reflected by more than 200 commercially produced crops, is possible because of the Mediterranean climate in much of the region's agricultural area. Mild winter temperatures and fertile soils give the Southwest a strong comparative advantage in growing many common crops and a monopoly in producing numerous specialty crops.

Farm size in the region, as measured by resources controlled and output per farm, far exceeds the U.S. average. In 1974, crop value per farm was 3½ times the national average. Forty percent of Southwest farms exceeded 2,000 acres, compared with 17 percent for the United States. Corporate farms, while comprising only about 5 percent of the total in the region, control about a quarter of the harvested cropland there.

Causes of the large-scale nature of Southwest farming are rooted in its generally arid climate and consequent prevalence of irrigation. Nearly 85 percent of total harvested cropland was irrigated in 1974. Irrigation investment costs of $400 to $1,000 per acre and operating costs for irrigation equipment and water of $40 to $120 per acre serve as substantial financial barriers to prospective new entrants. High risks associated with specialty crop production, high and rising land values, and ever-higher costs of mechanized harvest equipment also serve to foster large farms in the region.

This persistent trend toward large-scale production units has tended to increase inequalities in income for those in the agricultural sector, with farmworkers and small farmers relatively disadvantaged. Other, more subtle implications of the changing structure include:

- *Increasing factor specialization, with utilization of custom operators, heavy external financing of real estate and operating expenses, and large labor bills.*
- *Active involvement of farm operators in cooperatives and other institutions of interdependency.*
- *More inelastic supply responses, especially insensitivity to falling commodity prices.*

Important emerging issues likely to affect future structural changes involve labor availability and cost, water availability and its quality and cost, energy constraints, and future environmental policy. For the most part, resolution of these issues likely will promote a continuation of the long-standing trend toward larger and fewer farms in the Southwest.

INTRODUCTION

Farming in the Southwest (New Mexico, Arizona, Utah, Nevada, and California) contrasts sharply with farming in other regions of the country. The Mediterranean climate of the Southwest's major producing areas fosters great diversity in crops and cultural practices. In California alone, 200 commercial crops are grown (*39*).[1] Rapidly expanding urban population centers in the region serve as ready markets, and well-developed rail and highway systems provide excellent access to eastern markets for the region's horticultural crops. Proximity to Japan and other countries in the Far East facilitates rising export sales from the Southwest.

Consistent with the diversity in crops, diverse farming and marketing configurations have evolved in the region. The nature of these developments, along with their causes and the probable direction of future changes, is discussed below. First, some aspects of the structure of farming common to most commodity subsectors are discussed. Key forces likely to alter or reinforce the present structure are identified. Next, changes in production technology, marketing, and demand leading to structural changes within individual commodity sectors are discussed. A "model farm" approach is employed. This considers how typical operations are organized and notes operations which may serve as a future structural model.

[1] Italicized numbers in parentheses indicate references listed at the end of this chapter.

GENERAL STRUCTURAL CHARACTERISTICS

The most distinguishing general feature of Southwest farming is large size, measured in resources controlled and output per farm. The prevalence of irrigation directly and indirectly affects the structure of farming in this region in several ways. Changes in structure have involved producer cooperation, increasingly inelastic supply responses, and more uneven income distribution to sector participants.

Within this region, California farm product values overshadow those from the other States. But structural characteristics are fairly consistent across all States in the region.

Present Structure

Southwest farms are nearly double the size of average U.S. farms. However, Southwest financial assets per farm are more than three times the average for the United States as a whole. At the same time, the debt load of Southwest farmers exceeds the load in the rest of the Nation by 2½ times. The debt-equity ratio for farms in the region

Table 1—Balance sheet of the farming sector, Southwest Region and United States, 1970 and 1977

Item	1970		1977		Change, 1970 to 1977	
	SW	U.S.	SW	U.S.	SW	U.S.
	Thou. dol. per farm				*Pct.*	
Assets:						
Real estate	256	73	328	179	28	144
Crop and livestock inv.	23	12	28	19	20	62
Machinery and motor vehicles	15	11	28	27	92	144
Household	7	3	6	5	−10	64
Financial assets	28	8	42	12	53	58
Total[1]	329	107	433	242	32	127
Liabilities:						
Real estate	33	10	54	21	63	111
Nonreal estate	25	8	40	17	64	101
Total	58	18	95	38	64	111
Proprietor's equity	270	89	338	204	25	129
Debt/asset ratio (Pct.)	17.7	16.8	21.9	15.7	23.7	−6.5

[1] Total calculated with unrounded numbers.
Source: (*45*).

in 1977 was 21.9 percent, in contrast to 15.7 percent for other farms in the United States (table 1).

Changes in the value of farm assets during 1970-77 reveal some narrowing of the size difference between Southwest and U.S. farmers. Both assets and debt per farm in the Southwest were three times the national average in 1970. In all asset categories, nominal as well as relative increases in asset values were less for the Southwest than for the United States. The difference in rate of gain in real estate value was particularly large. In contrast, per farm debt of Southwest farms increased $37,000, compared with an increase of only $9,000 for the United States. Consequently, over the 8-year period, the farm debt-to-asset ratio improved slightly for the United States as a whole but deteriorated considerably in the Southwest. These differences are associated largely with the 1972-74 agricultural boom. Incomes of grain farmers outside the Southwest were impacted more favorably than prices for many of the products emphasized by farmers and ranchers in the Southwest. This led to more rapid land appreciation and greater machinery and equipment investment outside the region.

Per farm market value of farm production and crops also points to significantly larger farms in the Southwest than in the United States. Southwest average farm receipts in 1974 exceeded the national average per farm by $80,000 (table 2). Looking only at crop production, the value of crops sold per farm in the Southwest was 3½ times the U.S. average. Crop value per acre in the region was more than three times the national level, reflecting the high incidence of specialty crop production particularly in California and Arizona. By value, the Southwest marketed 13 percent of U.S. crop production in 1974 from less than 4 percent of U.S. harvested cropland.

Table 2—Farm receipts, 1974[1]

State/region	All farm products		Crops sold		
	Total	Per farm	Total	Per farm	Per acre
	Mil. dol.	*Thou. dol.*	*Mil. dol.*	*Thou. dol.*	*Dol.*
New Mexico	508	656	154	35	166
Arizona	1,056	244	491	174	467
Utah	328	38	91	12	89
Nevada	131	81	43	31	82
California	7,361	145	4,718	113	575
Southwest	9,382	128	5,497	94	469
United States	80,598	48	41,450	27	140

[1] Farms with 1974 sales greater than $2,500.
Source: (*42*).

Table 3—Distribution of cropland harvested, 1974[1]

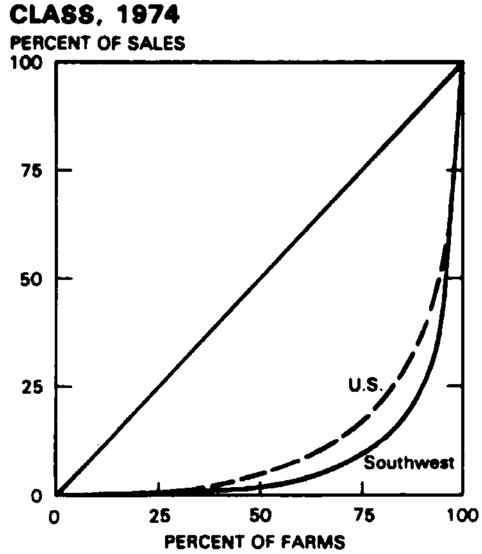
Farm size	Southwest	United States
Acres	*Percent*	
1- 179	13	12
180- 259	4	8
260- 499	11	22
500- 999	15	24
1,000-1,999	18	17
2,000 and more	39	17

[1] Farms with sales greater than $2,500.
Source: (*42*).

Of more interest than the average size data is the distribution among size classes. The Southwest actually has a slightly larger proportion of small farms (less than 180 acres) than the United States (table 3). This also reflects the prevalence of specialty crop production. However, the more distinctive difference in farm size distribution are revealed in the large-size categories. More than 55 percent of Southwest farms exceeded 1,000 acres in 1974, compared with 34 percent for the United States.

The highly skewed nature of the distribution of farm size is manifested in an even more highly skewed distribution of sales (figure 1). In the region, 3.3 percent of the farms had more than $500,000 in sales and produced 59.6 percent of the cash receipts to farming in 1974. The comparable U.S. figures were 0.5 and 22.5 percent. Expressed in absolute terms, these figures indicate that less than 3,000 Southwest farmers generated larger gross returns than 96,000 counterparts in the other regions of the country.

FIGURE 1
DISTRIBUTION OF SALES BY SIZE CLASS, 1974



There is little difference between the Southwest and the rest of the United States in tenure arrangements, as indicated below:

Farms by tenure	Southwest	United States
	Percent	
Full owners	33	28
Part owners	51	56
Tenants	16	16
	100	100

However, the distribution of farms by type of business organization in the Southwest differs substantially from the distribution for the United States. Partnerships and corporations are much more important in the Southwest, comprising about 18 percent of all farms, compared with 10 percent for the United States (table 4). Corporate farms controlled nearly a quarter of Southwest cropland in 1974 and, together with partnerships, accounted for 46 percent of the harvested cropland. That year, only 18.6 percent of all U.S. cropland was under partnership or corporate control.

The role of the large corporate farm has varied according to crop and area. Conglomerate-controlled farms produce some of almost all

Table 4—Distribution of farms and harvested cropland, by type of organization, 1974[1]

Type	Southwest		United States	
	Number	Percent	Number	Percent
	Thou.		*Thou.*	
Farms:				
Individual/family	47.6	81.5	1,380	89.5
Partnership	7.4	12.6	134	8.7
Corporation	3.0	5.3	24	1.6
Other	.3	.6	3	.3
Total	58.0	100.0	1,541	100.0
Acres of harvested cropland:	*Mil.*		*Mil.*	
Individual/family	6.3	53.3	240	81.1
Partnership	2.7	22.7	39	13.3
Corporation	2.7	23.4	16	5.3
Other	.1	.6	1	.3
Total	11.7	100.0	296	100.0

[1] Farms with sales greater than $2,500. Total completed from unrounded numbers.
Source: (*42*).

crops, yet they are minor factors in production of most crops. In the southern San Joaquin Valley, there are giant producing-processing-marketing farms operated by such conglomerates as Tenneco, Getty, and Superior, the oil companies. Many other large farms exist, but basically they are farming operations only. These farms produce a large variety of crops, many of them tree fruits and nuts and vegetables. One particular industry is dominated by large firms—production of lettuce and other cool-weather vegetables grown in the Salinas and Imperial Valleys. One of the largest lettuce firms is a conglomerate, Sun Harvest (United Brands), producing up to 10 percent of the market (*53*); another equally large grower-shipper (Bud Antle) recently merged with a conglomerate. Thus far, there are few giant farms or conglomerates involved in production of another sizeable vegetable crop, fresh market tomatoes. Each crop and/or growing area needs to be examined individually as to the significance of a giant or conglomerate firm on structure.

Changes in farm size in the Southwest have not paralleled U.S. changes. For the United States as a whole, the number of farms and land in farms both have declined steadily since 1950, while average farm size has consistently increased (table 5). In the Southwest, farm numbers reached a minimum and average farm size peaked around 1970. Changes since 1970 in the Southwest are accounted for partially by an increase in part-time farmers—either retired or with primary off-farm employment.

Factors Underlying Existing Structure

Numerous forces have acted in combination to yield the structure of Southwest farming presently observed. For the most part, these

Table 5—Farm numbers and farmland, Southwest and United States, 1950, 1970, and 1978

Region	1950	1970	1978	Percent change, 1950 to 1978
Number of farms (thousand):				
Southwest	210	99	110	-48
United States	5,648	2,949	2,680	-53
Land in farms (million acres):				
Southwest	151	148	144	-5
United States	1,202	1,102	1,072	-11
Acres per farm:				
Southwest	719	1,495	1,309	+82
United States	212	374	400	+89

Source: (*42*).

Table 6—Cropland irrigated, 1974[1]

State/region	Harvested cropland	Irrigated cropland	Percent of cropland irrigated
	Million acres		
New Mexico	.9	.7	75
Arizona	1.1	1.1	100
Utah	1.0	.7	69
Nevada	.5	.5	99
California	8.2	6.9	84
Southwest	11.7	9.9	84
United States	296.1	35.9	12

[1] Farms with sales greater than $2,500.
Source: (*42*).

forces are associated with the generally arid climate of the region and the prevalence of irrigation. In those areas where irrigation is impractical or impossible, Southwest farming is limited to ranching or dryland production of small grains during the rainy season. Large scale is necessary in both cases because of the extensive nature of the production processes. When irrigation is used, large investment requirements act as a financial barrier to entry and underlie substantial scale economies.

The percentage of total cropland irrigated ranges from 75 to nearly 100 percent among the States in the Southwest. The region had only about 4 percent of total U.S. harvested cropland in 1974, but 27½ percent of the Nation's irrigated cropland.

Large investment and operating costs are involved for typical methods used in the Southwest (table 7).

The high investment costs assume a minimum 160-acre area, implying substantial irrigation development costs for typical-sized units of operation. Moreover, annual costs are at levels requiring very high gross return per acre to recover irrigation as well as other costs

Table 7—Irrigation costs, Southwest, 1978

Method	Investment	Annual overhead	Annual operating costs
		Dollars per acre	
Flood (purchased water)	425	44.35	87.10
Center-pivot sprinkler	985	116.00	10.35
Wheel-line sprinkler	570	75.45	92.70
Furrow (field crop)	500	51.10	93.55
Drip	800	114.00	90.30

Source: (*14*).

of production. This has resulted in heavy regional specialization in high-value fruit and vegetable crops. The relatively high price risk associated with these crops is another factor contributing to large size. Small-scale farmers are less able to withstand successive seasons of low income, given the level of investment required.

In addition to factors directly or indirectly related to irrigation, technological change has contributed to the large scale of Southwest crop farming. Size breeds size in agriculture. Southwest farmers have been financially capable of rapidly adopting cost-reducing technology which has, in turn, increased the minimum efficient scale of operation. Moreover, organizations of large producers have been able to influence mechanization research at land-grant universities, which has accelerated the innovation process and contributed to increases in farm size.

The evolution of processing tomato production in California is a good illustration of the effect of technological change on structure. Prior to 1960, processing tomatoes were produced by many small, nonspecialized growers dependent solely on hand labor for harvesting the crop. With introduction of the mechanical tomato harvester in the early 1960's, two scale-inducing forces emerged. First, the high cost of the machine (about $25,000) represented a financial constraint to small growers. Second, the seasonal capacity of the machine was about 75 acres, and operation below capacity resulted in high unit fixed costs. The industry became increasingly concentrated with the rapid adoption of the harvester. Recent adoption of a harvester-mounted electric tomato sorting unit promises to have further scale-increasing effects, as the innovation further reduces harvest labor through substitution of capital.

Implications of Existing Structure

The structure of farming in the Southwest has far-reaching effects on income distribution within the sector as well as the input supply and product marketing sectors of the region's agricultural economy. The income inequality among farmers already has been noted. Large farmers have successfully exploited technical and pecuniary economies to size, enhancing their income and wealth position relative to smaller farmers unable to utilize the same technology and, in particular, farm laborers. Less obvious ramifications include the effects of structure on factor specialization, interdependencies among farmers and between farmers and marketing agents, and supply response.

Factor Specialization

With increasing farm size, farm operators have tended to specialize in the management function, relying on outside entities for provision of other factors of production (land, labor, and capital). The extent of factor specialization in the Southwest is greater than in other parts of the United States (table 8). More than half of the average 1974 Southwest farmland base consisted of rented land, compared with the U.S. average of 40 percent. While owned land per operator in the Southwest is only about twice the U.S. average, total land farmed is nearly three times as large.

Machinery and equipment value per acre in the Southwest falls far short of the U.S. average, reflecting heavier use of custom operators in the region. In 1974 in the Southwest, annual machinery hire and custom work per harvested crop acre was $17.24, compared with the U.S. average of $4.42. Another indicator of greater external financing in the Southwest is the debt-asset ratio, which in 1977 was 21.9 percent in the region, compared with 15.7 percent nationwide.

Compared with other areas, substantially less farm labor is provided by owners and their families in the Southwest. The regional hired labor bill in 1977 totaled $1.9 billion, 26 percent of the U.S. hired labor charge. Of the total 1977 farm work force in the region, 69 percent was hired, compared with 31 percent owner and family. Comparable U.S. figures were exactly the reverse (*43*).

The identity of the specialized providers of land to Southwest farming is not very clear. There are some very large landholders who personally operate little if any of their owned property (e.g.,

Table 8—Landownership and machinery and equipment investments, 1974[1]

Investments	Southwest	United States
	Acres	
Average per farm:		
Owned	701	320
Rented	735	215
Total	1,436	535
	Dollars	
Machinery & equipment:		
Per farm	31,756	25,932
Per acre	45	81

[1] Farms with sales greater than $2,500.
Source: (*42*).

Southern Pacific Railroad), but more land probably is rented to farm operators by retired farmers and small landholders with urban employment.

The importance of lending institutions differs by type of loan. For real estate loans, individuals holding mortgages and land contracts are the most important lenders, followed by the Federal Land Bank system and life insurance companies. USDA's Farmers Home Administration (FmHA) and private banks are minor factors in real estate lending, both absolutely and relative to other parts of the country. Few regional differences exist in the distribution of nonreal estate loans among lenders (table 9).

Much has been written about hired farm workers in the Southwest, with much of the writing critical of working conditions and employer-labor relations. Few hard data exist to document or refute most of these charges. It is known that large numbers of seasonal workers are required to harvest the region's specialty crops, and much of the labor supply consists of migrant workers as indicated below:

Farm labor, California, September 1977

	Thou.
Total employment	380.5
Farmers and unpaid family workers	74.1
Hired	306.4
Regular	110.8
Seasonal	195.6
Local	141.7
Intrastate	33.3
Interstate	20.0

Source: (*8*).

Seasonal workers typically earn low incomes, frequently working only a few months each year. Many are women and most are of Mexican descent (*40*).

Interdependencies

Because of their small number and dependence on irrigation, Southwest crop producers are more actively involved in formal organizations to facilitate marketing and input acquisition than their counterparts in other farming areas. Numerous irrigation and drainage associations (over 100 in California) exist to distribute surface water supplies to agricultural users. These typically operate as

Table 9—Agricultural loans outstanding, by type of lender, January 1, 1978[1]

Type of lender	Southwest		United States	
	Amount	Percent	Amount	Percent
	Bil. dol.		*Bil. dol.*	
Real estate debt:				
Individuals and others	2.9	44	21.7	34
Federal Land Bank	1.7	26	21.4	34
Life insurance companies	1.6	23	8.5	13
FmHA	.2	2	4.0	6
All banks	.3	5	7.8	12
Total	6.6	100	63.3	100
Nonreal estate debt:[2]				
Production Credit Associations	1.4	28	13.6	27
All banks	2.6	54	25.7	50
Individuals and others[3]	.9	18	11.7	23
Total	4.9	100	51.0	100

[1] Totals and percentages computed with unrounded numbers.
[2] Not including Commodity Credit Corporation loans.
[3] Estimated individual State data not available.
Source: (*43*).

cooperatives or quasi-cooperatives under several State enabling statutes. The associations permit member-users to jointly control allocation and timing of irrigation water.

Single marketing cooperatives dominate handling of many of the fruit and nut and specialty crops grown in the region, and many have developed brand names known to customers throughout the world (Sunkist, Diamond, Sun Maid). Single cooperatives also are important in cotton (Calcot) and rice (California Rice Growers Association), while several different cooperatives compete with private firms in handling and processing other field crops and vegetables. Purchasing cooperatives, with the exception of fertilizer, are relatively less important in the Southwest than in other parts of the country. In 1975-76, net business of all farmer cooperatives in the region (marketing, farm supply, and service) was $4.6 billion, 11½ percent of the U.S. total.

Bargaining associations, usually organized as cooperatives, have become increasingly important in setting prices for the region's crops. They are especially prominent in commodities characterized by high concentration on both the buyer and seller sides of the market (processing tomatoes, garlic, and onions; raisins and dried fruits; processing apricots, pears, and peaches).

Formal interdependence also is exemplified through extensive use of marketing orders in California and Arizona. Orders are used widely to jointly finance production and marketing research, advertising, and other promotion activities; standardize containers and quality specifications; and stabilize supply and price within and across seasons. Presently, 16 Federal orders are in effect in California and Arizona, and 36 California orders operate under State legislation.

Structure and Supply Response

The concentrated structure of the crop production sector in the Southwest underlies more inelastic short-run commodity supply relationships than would exist under more dispersed conditions. Adjustments to changing prices (particularly falling prices) are slow for three primary reasons: high fixed costs of production, extensive specialization of assets, and the importance of corporate farming.

Mechanization of harvest of many crops has significantly altered fixed/variable cost ratios. As a result, mechanical farms alter harvest rates very little with changing prices. Even if prices fall well below expectations held at planting, harvesting will continue so long as returns cover variable costs and contribute something to overhead. With rising prices, once-over mechanized harvesting precludes more intensive picking rates.

Equipment and other asset specialization slows longer term supply adjustments. Midwestern farmers can make substantial adjustments in crop mixes upon changes in relative price relationships. Most cultural and harvest equipment for small grains, soybeans, and corn is interchangeable among crops. In contrast, rice harvesters, tomato harvesters, and sugar beet diggers have no alternative uses. Shifts among crops are influenced heavily by physical depreciation rates and assembly rates of specialized equipment manufacturers.

Corporate farm operations likely adjust output levels more slowly than individual farmers, largely because of multiple firm objectives. Conglomerate firms, for example, may be more adaptable to chronic agricultural losses because of loss-spreading tax advantages. Separation of decisionmaking from farm operation suggests supply decisions based on aggregate financial performance rather than individual commodity profits and losses.

ISSUES AFFECTING FUTURE STRUCTURAL CHANGE

Several forces are at work which could alter the structure of Southwest crop farming. But these forces are not consistent in the direction of their effect on structure. Issues relating to water, labor, energy, and the environment are especially important.

Water availability and quality are of crucial importance. Acting to hold down concentration and promote a "family farm" structure are the Bureau of Reclamation's proposed regulations to modify the 160-acre limitation concerning maximum farm size and residency requirements for farmers receiving irrigation water from federally funded water projects. These controversial rules, if applied, could break up existing large-scale farming operations in certain parts of the Southwest.

Market pricing of water is a frequently debated issue. Present allocation policies involve a publicly financed subsidy to agricultural users. Unrestricted competition among alternative water users likely would result in a substantial increase in irrigation water costs to farmers dependent on surface sources. Because of their wealth positions, access to financing, and size economies, large farmers would be more capable of paying higher water charges under market pricing arrangements. This could lead to a more concentrated crop production sector in the Southwest.

Similarly, future increases in costs associated with declining water quality probably would lead to greater concentrations of salt carried in irrigation water. Heavy concentrations of salt in irrigation water have become a serious threat to many Southwest farmers, particularly in parts of California. Planned drainage canals to permit leaching of salt likely will be publicly financed in part, but on-farm costs for installing drainage tiles and additional water costs for leaching will have to be borne by individual farmers.

The large seasonal labor force in the Southwest has become more militant and powerful. With unionization has come efforts by farmers to reduce labor needs through mechanization. As already noted, this has tended to increase concentration among farmers. To the extent labor supplies become more uncertain or costly, mechanization and concentration would be expected to increase.

The future spread of farmworker unions or increases in their power cannot be forecast accurately. One union, the United Farm Workers (UFW), is a strong force in California, but many employers continue to actively oppose the organization. Moreover, some farm workers appear dissatisfied with the UFW, as evidenced by two elections in 1979 in which the union was "decertified" as a bargaining agent.

National policy to rationalize the U.S. position on migrant workers has less far-reaching effects on agriculture. Efforts to restrict undocumented farmworkers will affect labor supply and costs. While numbers are not available, illegal aliens, largely from Mexico, undoubtedly comprise a significant share of the seasonal farm labor force.

One potential labor issue which could slow farm concentration trends concerns restrictions on publicly supported mechanization research and taxes on machinery which displaces labor. Public concern about the labor displacement effects of technological change are growing, as manifested by California legislation on the subject in 1978. The success of proposed plans to require social impact statements covering mechanization research and to indemify displaced farmworkers is unpredictable.

The effect of potential energy shortages on structure is unclear. If shortages result in highly elevated prices for fuel and petroleum-based fertilizers and pesticides, concentration likely would be increased as large farmers could more easily absorb the higher costs. Rationing of energy-related inputs based on historical usage could alter crop mixes toward high value specialty crops, for which farm sizes generally are smaller.

More stringent environmental standards applied to the production sector would tend to increase average farm size in the region. Costs of adopting "best management practices" to reduce nitrogen runoff, for example, could more easily be borne by larger farms, and it is likely that there would be economies of size associated with required capital expenditures.

* * * * *

Additional perspectives of the way farms and ranches are organized and managed can be obtained by examining groups of those producing similar agricultural products. Four groups characterized by their products are discussed. These groups are farms producing field crops, fruits and nuts, vegetables, and livestock.

Illustrations depend heavily on observations in California. This emphasis is not meant to suggest that other States are unimportant in farm production. At the same time, California dominates crop production in the region (table 2), and farms in Arizona, the State with the second largest production of agricultural products in the region, are structurally similar to farms in California.

Farms in each area of California were chosen to illustrate typical crops and regional problems; yet, there are many combinations other than the ones identified. Large farms especially depart from typical two- to five-crop combinations to produce many crops, such as a combination of field, fruit, and vegetable crops.

FIELD CROPS

Cotton

Cotton was the highest valued crop in California, New Mexico, and Arizona in 1977. The region produced 29 percent of U.S. cotton on 17 percent of the cotton acres in 1978 (*51*). Historically, the

Southwest has had much higher yields than the other regions, at times reaching over two bales per acre or double the U.S. average.

Changes in Location, Farm Size, and Tenure

There have been relatively few changes in the location of cotton acreage in the last 30 years in California. The proportion of cotton grown in each county has remained fairly steady since the introduction of cotton to Imperial County in 1949. Arizona cotton acreage has changed little in location and was a substantial producer prior to World War II. Two counties considerably increased acreage after World War II: Cochise, in the southeast corner of the State, grew no cotton prior to the war, and Yuma also in the southeast corner, had all but ceased production during the war.

Cotton farm numbers have decreased steadily in California since 1949, except for an initial increase in Imperial County during 1949-64. The decline has been largest in the last 10 years, dropping 40 percent during 1964-74. Average acreage per farm has increased. In 1949, the average acreage in California was about 103 acres, and in 1964, 112 acres. By 1974, the average size had increase to 287 acres.

The location of cotton and associated annual crops in the San Joaquin Valley of California has changed somewhat over time. Many of the early crops were grown on the east side of the southern part of the San Joaquin Valley, from Merced County southward. Gradually, as water became available and soil problems were overcome, annual crop culture tended to move westward in Madera and Fresno Counties. The move to the west was pushed by increasing acreages of perennial crops on the east side, especially grapes. In the last 10 years, since the California aqueduct brought surface water to the west side of Fresno and Kern Counties, the crop pattern there has changed. Growers on Fresno County's west side signed a water contract with the U.S. Bureau of Reclamation, under which they have received low-cost water, while agreeing to the 160-acre limitation provision. The area is dominated by cotton and field crops. In contrast, Kern County growers to the south signed a water contract with the State. It charges more than the Federal Government, supposedly enough to cover the full cost of the water, but imposes no acreage limitation.

The cropping pattern on the west side of Kern County is new, too, for there was no water available previously, and the land was owned by large companies, many in oil. Very large farms are typical in the area. The cropping pattern has been to grow high-value crops such as tree crops, although cotton also is important. Cotton also is important in eastern Tulare County (especially on large farms in the Tulare Lake Basin), Kings County, and on Kern County's east side.

Part ownership is the most common form for farms in California, followed closely by full ownership, with 42 and 39 percent of all cotton growers represented, respectively. Tenancy is least common, representing 19 percent of all growers (*42*).

In type of organization, individual or family-operated farms are by far the most numerous. Partnerships are next most common, followed by corporations. However, the type of organization categorized by acres shows a much more even proportion. Of 1.24 million acres in 1974, 40 percent were individually owned, 29 percent partnership owned, and 30 percent corporation owned (*42*).

Financial data on cotton-type farms is presented in table 10, contrasting farms with sales in 1974 of over $100,000 with those having sales between $40,000 to $99,999. The estimated 1974 value of land ranged from $942 to $1,304; this range of values agrees with informal field crop land value estimates of $905 to $1,215 for 1974 (*14*), and with cash grain farmland values in the same table. Average debt per acre was low and about half the farms were debt free. Income per acre was high, reflecting that 1974 was a good year for prices. The smaller farms enjoyed nearly the same total income as the larger ones, a situation brought about in part by income from nonfarm sources.

Causes Underlying Changes

The major technological change concerning cotton in this century that has affected farm structure is the mechanical cottonpicker, which was introduced around 1946. By 1960, 43 percent of the U.S. cotton crop was machine-harvested; by 1970, the total was 95 percent. Labor displacement was high; labor requirements per acre in California in 1959 were 99 man-hours for hand-picked and 3.3 man-hours for machine-picked cotton (*46*). In addition to changing the mix of resources used in production (i.e., less labor and more capital), the picker stimulated producers to increase the size of their land operations. The mechanical harvester changed cotton culture from a labor-intensive to a labor-extensive crop, due to the decrease in harvest labor requirements. Growers could then plan on the cotton enterprise as another field crop rather than as one with high seasonal labor needs. For small growers, an increase in cotton acreage was needed to fully reflect the economies of using the harvester. Further, increases in acreage by all growers were no longer constrained by the difficulty of managing large numbers of harvest workers.

Postwar changes in acreage were constrained by the acreage allotment program in 1950 and during 1954-70, and by set-aside requirements after 1970. Through the late 1950's and 1960's, changes in total acreage of cotton in the region as well as cotton

Table 10—Financial data on major types of farms, California, 1974[1]

Item	Cotton farms		Fruit and tree nut farms		Cash grain farms		Vegetable and melon farms	
	$100,000 and over	$40,000 to $99,000	$100,000 and over	$40,000 to $99,000	$100,000 and over	$40,000 to $99,000	$100,000 and over	$40,000 to $99,000
Irrigated acreage (harvested)	906,311	84,904	827,464	303,633	1,173,434[2]	213,367[2]	822,143	17,834
No. of farms represented	712	436	2,640	3,906	1,008	619	1,167	292
Value of land and bldgs. (mil. dol.)	853.8	110.7	2,458.6	1,104.6	1,173.8	276.7	1,528.9	57.0
Value per acre (dol.)	942	1,304	2,971	3,638	1,000	1,297	1,860	3,196
Debt (mil. dol.)	119.5	11.4	456.4	170.7	127.3	16.8	141.7	2.1
Debt/acre (dol.)	132	26	173	562	108	79	172	118
No. of farms reporting debt	406	175	1,976	1,976	473	228	454	80
Pct. of farms not reporting debt	57	40	55	51	47	37	39	27
Value of sales (mil. dol.)	385.9	28.0	909.3	264.1	403.6	41.9	1,005.2	19.6
Value of sales/acre (dol.)	425.84	330.08	1,098.87	869.70	343.95	196.31	1,222.61	1,099.36
Production expenses (mil. dol.)	277.0	19.6	712.4	186.1	249.4	26.2	752.0	14.2
Production expenses/acre (dol.)	305.70	231.67	860.89	612.87	212.49	122.74	914.63	794.72
Total return to operator labor, management, and equity								
Total return (mil. dol.)	108.9	8.4	196.9	78.0	154.2	15.7	253.2	5.4
Total return/harvested, irrigated acre (dol.)	120.13	98.40	237.98	256.83	131.46	73.57	307.98	304.64
Other income (mil. dol.)	10.0	2.7	35.2	41.9	10.1	5.0	12.4	1.5
Total operator income (mil. dol.)	118.9	11.1	232.1	119.9	164.3	20.7	265.6	6.9
Total operator income/acre (dol.)	131.14	130.24	280.50	394.77	140.02	97.02	323.06	386.90

[1] Source: (*42*)
[2] Total harvested acreage, including dryland farmed.

acreages on individual farms were in direct response to provisions of annual programs. Cotton allotments per farm typically constituted 20 to 30 percent of total cropland; each grower then had to determine other crop acreage.

The new technologies and management practices stimulated a continuation of the increase in average farm size. Economies-of-scale studies in the 1960's indicated that efficient use of machinery was obtained between 600 and 1,400 acres (*9, 13, 31*). Since that was many years ago, economies likely occur well beyond this range of acres.

Cotton farm example.—This example of a cotton farm is an actual operation on the west side of Fresno County, consisting of 480 crop acres.[2] Of this acreage, 320 are owned and 160 leased. Two-thirds of the acreage is in cotton, and the remainder is in sugar beets. The grower, in the area only 8 years, plans to expand his operation to 1,000 or more acres, a size he considers minimally acceptable for efficient use of management and capital. Land in the area sells for about $2,500 per acre (open land), and real estate loans have been available at 10-percent interest. On the other hand, 3- to 5-year leases are common.

The grower prefers to own equipment, although he sometimes leases land preparation equipment during peak operation periods. His rule of thumb is to lease equipment needed less than 3 months each year. The leasing of equipment, especially large tillage equipment, apparently is new. At least two leasing firms are present in the area. Another equipment decision this year concerned the upgrading of equipment for storing cotton in the field. His reason for the capital expenditure is that the good cotton yield this year will tax the capacity of cooperative gins used, requiring many growers to store seed cotton in the field. As an inducement to store cotton in fields, the government pays growers $8 per bale. Each gin hauls field-stored seed cotton at no grower cost. This grower considers that other growers are reluctant to increase gin capacity, citing high costs and potential new Occupational Safety and Health Administration restrictions on gin dust as two factors.

The operator of the example farm considered current uncertainty over settlement of the 160-acre limitation provision as a major dilemma to growers in the area. He noted that average farm size in the Westlands Water District (the primary west side water district) declined from 4,500 acres in 1967 to 2,200 in 1977. The sale of two large firms was a major factor in the decrease; this grower obtained his land from one of these disbanded firms.

This grower benefits by having a water contract with the U.S.

[2] Private communication with grower.

Bureau of Reclamation. He obtains irrigation water at a relatively low cost ($15.40 per acre-foot of water delivered to the farm gate). However, he is not able to obtain enough water to grow high-water-use crops such as cotton on all the acreage. He (like most other growers in the area) supplements his surface water with water from a deep well, pumping from 500 feet. Thus, his decision on crop mix is influenced by the low surface water and high ground water cost.

Alfalfa

The Southwest produced 13 million tons of hay of all kinds in 1977, about 10 percent of the Nation's hay crop. A large part of this hay crop was alfalfa—87 percent. Regional production of alfalfa has been stable over the years; the average during 1974-77, was 4.3 percent more than in 1959-62.

Farmers in two States sell little of their alfalfa: Utah and Nevada growers use about 75 percent of all the hay they produce. Farmers in the other States sell a large part of their hay crops—70 to 73 percent (*47*). These are longstanding marketing trends, at least since 1958 (*18*). Since California is the dominant producer, only the utilization of the crop from that State is discussed.

Of total 1977 California hay production (6,669,000 tons), 70 percent was fed by dairies (*11*). Other uses of alfalfa are for cattle on feed, range cattle and calves, and sheep and lambs. Alfalfa sales are to dealers, other growers, feedlots, or at auctions. In California, 70 percent of 1977 sales were to dealers, with the remaining 30 percent to growers (*52*). In contrast, Arizona and Utah hay sales were mostly to other growers—81 and 93 percent, respectively, while Nevada and New Mexico sold 40 and 36 percent, respectively, to dealers, and 21 and 39 percent, respectively, to feedlots.

Changes in Location, Farm Size, and Tenure

Alfalfa is grown commercially in almost every county in California, but certain regions dominate production. The San Joaquin and Imperial Valleys produce 74 percent of the State's crop. Imperial County, at the extreme southern end of the State, has the greatest single concentration of alfalfa acreage. This area has advantages: proximity to beef feedlots and southern California dairy markets, and the crop is important in rotation with grains and vegetables. As the Los Angeles area has become urbanized, dairies increasingly have shifted north into the San Joaquin Valley. The Sacramento Valley and the remainder of southern California each have about 10 percent of the production, while the northern counties have 6 percent and the coast counties 1 percent of production.

Southern California production is sufficient only for dairy use, while the central coast is a net importer of alfalfa. All other areas produce in excess of dairy demand. The northern counties are strongly surplus producers, but are relatively close to central coast markets. The high cost of transportation for alfalfa puts locational cost pressure on dairy operators to move closer to sources of supply.

There were 6,442 farms in California producing alfalfa in 1974, a decline of one-third since 1964 (*42*).

Technological Changes

In California, harvest technology has changed considerably over the last 20 years. These developments have facilitated increases in farm size. In 1960, the self-propelled swather began to replace mowers; by 1970, this trend was about complete. In the same period, the self-propelled bale wagon became standard for picking up and stacking bales. The typical harvest technology for bales is to swath, followed later by a side-delivery rake to turn the windrows. A self-propelled baler then bales, and the bale wagon picks up and stacks the bales. Commonly, bales for sale are placed by the roadside; there the bales can be seen, storage is not needed, and extra handling is avoided. A study in 1967 indicated that, for all hay, yields in the Pacific and Mountain States were higher than for all other regions, and labor use per ton was lowest (*15*).

One of the most significant changes affecting alfalfa use has been the development of cubing. Commercial production started in California in 1962; by 1973, a high of 679,000 tons of cubes were produced, representing 10 percent of the State's alfalfa crop. Cube production declined in the State to 397,000 tons in 1978, a result of decreasing domestic disappearance, even though exports have increased (*44*). Exports of cubes have risen rapidly from 8,000 tons in 1968 to a high of 176,833 tons in 1978. The latter figure was 45 percent of total California cube production.

For cube production, both self-propelled and stationary machines are used. In 1978, 95 self-propelled units produced 67 percent of the cubes (2,800 tons per unit), while 23 stationary units produced the rest (5,200 tons per unit). The trend, however, is to increase stationary cube use. The field machine has the advantage of lower cost and can be moved to the location where the hay is cut. But the stationary machine can operate 24 hours a day and is not dependent on weather.

Processing Tomatoes[3]

During the last two decades, California has been the largest producer of tomatoes in the United States. The California share of

[3]Much of this material is from (*1*).

U.S. production has been increasing, rising from 52 percent in 1951 to 55 percent in 1960 and 67 percent in 1970. In 1978, growers in the State produced 5.3 million tons of tomatoes for processing, 83 percent of U.S. production.

California is the only State in the Southwest region to produce tomatoes on any significant scale. The combined acreage in the other States in the region in 1974 was 0.6 percent of the California acreage.

Grower-processor contractual arrangements are common for processing tomatoes, as 99 percent of California's tomatoes were under contract in 1976. A grower bargaining association negotiates with processors on contract provisions; the membership of the association is large enough that the negotiated price becomes representative for the industry. The negotiated price approach represents a change from before 1974, when the grower price was announced by a representative firm, without negotiation. The association can bargain for price, but it cannot control acreage.

Changes in Location, Farm Size, and Tenure

The main change in location of production has occurred on the west side of Fresno County in the San Joaquin Valley. During 1960-70, Yolo and San Joaquin Counties together produced about half of the State's production. By 1975, however, Fresno County was the largest producer, followed by Yolo and San Joaquin.

There also has been a major change in farm size since World War II. In 1954, average farm size was 32 acres, already a sizeable acreage, compared with about 5 acres in the East and Midwest. By 1959, acreage per farm had almost doubled, and doubled again by 1969. By 1974, the average acreage per farm was five times that in 1954.

Tomatoes for processing are an alternative crop for field crop growers, and thus the tenure arrangements are similar to those for grains, alfalfa, and sugar beets.

Technological Changes

The major technological changes in the processing tomato industry were introduction of the mechanical harvester in the 1960's and development of varieties compatible with the harvester. Harvesting machine adoption was accomplished essentially during 1965-69. A recent stage of innovation for the machine was the introduction in 1976 of an electronic sorter to replace the manual sorter. The new sorter has been widely accepted although diffusion rate data are not available. A recent survey of tomato growers indicated that most growers would adopt an electronic sorter within 5 years (*40*). Labor displacement by the harvester is high; initially, the ratio was 3:1, but gradually increased to 7:1 (*55*). With the addition of electronic sorting capabilities, the ratio increased to 20:1 over hand-harvest technology. A more conservative estimate indicates that labor use per ton harvested in 1976 was 26 percent of that in 1960 (*1*).

Another form of harvest technology was to change container size to facilitate handling. With hand workers, the field box was used. There was a rapid shift from field box to bins (1,000-pound capacity) in the 1960's. Later, when it was found that bulk containers could be used without undue damage to the tomatoes, there was rapid adoption of handling in bulk-type gondolas (30-ton capacity).

Mechanical and plant breeding innovations have been accompanied by innovations to achieve uniform maturity and related requirements of uniformity in emergence, stand, and growth (*41*).

Processing technology also has changed. Asceptic storage of partially processed products is common in California. This kind of storage permits delays in final processing and allows increased flexibility, although at a high initial investment cost. Another innovation by one processor has involved satellite processing facilities near the production area to perform initial processing steps (*21*). This decentralized processing allows disposal of waste products at the point of harvest.

Introduction of the mechanical harvester was the major factor in the locational shift of tomato production to California and the accompanying increase in farm size. The harvester brought stability to the California industry at a time when the loss of Mexican contract workers in the mid-1960's caused fear of a hand-harvest labor shortage. Use of the machine also lowered the cost of production. Many other States were not able to compete as well since the machine was not adaptable to adverse harvest conditions.

The change in location within California to include Fresno County was due to several factors. One was an opening of the county's west side to surface irrigation water under the California Water Plan. Other factors included ability of the market to adjust to long hauls from fields to distant processing plants and favorable returns from tomatoes, compared with other crops in the area.

The large farms of California tomato growers are due to economies of size. The efficient use of machine harvesters required larger farming units.

Grains

The combined value of farm sales of wheat, rice, barley, corn, and grain sorghum account for about 7 percent of total farm receipts in the Southwest region. This percentage understates the importance of these types of crops to the region, however, since some grains are fed to livestock on farms where the grain is produced.

Changes in Location, Farm Size, and Tenure

As examples of grain grown in the region, consider wheat and barley. These grains are grown throughout California and are planted on a sixth of total crop acreage. In earlier years, the crops were largely dry-farmed, so the Imperial Valley and Arizona had few acres planted. In 1965, about 72 percent of California's wheat was dry-farmed. Since then, there has been a shift to irrigated acreage, especially in the Imperial Valley. By 1979, slightly over half of the wheat and barley crops in California were irrigated, and Southern California had a third of the State's acreage.

Another major grain crop in California is rice. The State grew 19 percent of all U.S. rice in 1978. Most of the acreage is confined to the heavy soils with ample water supplies in the central part of the Sacramento Valley. However, the acreage of rice grown per farm is large, averaging 377, 53 percent more than the average for all other producing States in the same year. The number of California farms growing rice (1,360) has not changed greatly since 1954.

A tenure survey of rice growers in 1969 indicated that a majority of the operators were part owners (*17*). Over half of all land in their farms was leased. The increasing concentration of rice acreage in the most suitable area of the Sacramento Valley has forced growers wishing to expand rice acreage into leasing of land, a factor in the trend toward fewer full owner operations.

Agricultural Census data on cash grain farms in the State indicate a major increase in average farm size. In 1950, there were 5,771 farms averaging 653 acres per farm; by 1974, there were 3,020 farms of 972 acres each, an increase of 49 percent. In 1974, a third of the cash grain farms had sales over $100,000 and controlled two-thirds (69 percent) of the acreage. The modal farm size class was 500 to 999 acres. In tenure, 57 percent of these farms were partly owned, 21 percent tenant-operated, and 22 percent wholly owned. Most of these farms were operated by individual families (62 percent), and they controlled 45 percent of the acreage.

The financial data in table 10 indicate that cash grain farms had land values consistent with the values of cotton-type farmland. Less than half of the farms reported farm debt. The average farm debt also was similar to that reported for cotton farms. Both the large and medium sizes of farms made a profit in 1974.

Technological Changes

A major technological change in wheat farming has been the introduction of successive varieties of so-called Mexican wheat. These varieties began to supplant the low-quality white varieties as early as the 1960's. Over 90 percent of the wheat planted in 1978 was of the red or durum types of the new wheat varieties. Higher wheat yields have led to the substitution of wheat for barley by growers. California wheat acreage reached a high of 950,000 acres in 1976 while barley acreage dropped 50 percent, to 1,010,000 acres.

Two main types of technological change have occurred in rice production–one mechanical and the other biological. The major mechanical innovation was development of the rice combine. This combine also facilitiated the increase in farm size. The other innovation was development of improved rice varieties, using varieties developed by the International Rice Research Institute (IRRI). This research effort in California is new, beginning in 1969-70. The program is a continuing one, with some new plant materials already introduced and many more planned. Rice planting, chemical application, and, to some extent, fertilizer application–all by air–constitute another type of technical change.

Example of a rice operation.–A rice grower was interviewed who, along with other family members, farms 3,000 acres in an adobe soil area of the northern Sacramento Valley.[4] He plants 2,400 acres of rice and is fallowing the remaining 600 acres. While alternative crops could be seed oats, vetch, wheat, or corn, specialization of the type used is best in heavy soils such as adobe. All of the interviewee's land is owned, although half of the rice farmland in the State is leased (*17*). Given the high cost of land, this grower fears that he may not be able to continue as much fallowing as he considers necessary. Equipment is owned even though leasing it is an option. The operator prefers owning to leasing because he does not want to be dependent on leasing firms. Tracklayers are the prime-movers, since tracks last considerably longer than tires in the area's soils. Sixteen-foot combines are used for harvesting, although many growers have turned to speedier 10-foot reels. The grower indicated uncertainty about the "thresh-ability" of new short-stature varieties and possible large crop losses associated with high-speed threshing. For economies of size, he considered 600 to 1,000 acres as an efficient size, although 300 acres would be minimal.

While rice operations (like wheat and barley) are not labor-intensive, this grower indicated problems in securing and keeping competent workers, especially considering the importance of workers

[4] Private communication with grower.

experienced in operating expensive equipment. He said there is a trend for growers to provide full-year employment to keep workers.

A laser is used with land leveling equipment to obtain more precise leveling of fields. Fertilizer use has increased during the last 10 years, reflecting the increasing incidence of continuous rice production with less crop rotation. Weed control, once considered a minor problem in rice, has become more difficult. In this area, rough seeded bullrush is common and can be controlled only by applications of MCPA. The grower fears loss of this chemical through a ruling of the Environmental Protection Agency.

Crop loans are obtained from the Production Credit Association and private banks in the area although many farms in the area are self-financed. Growers have complained that banks are tightening credit standards. Some banks are requiring farmers to have checking or savings accounts as a condition for loans.

SAN JOAQUIN VALLEY FRUIT AND TREE NUT FARMS

The San Joaquin Valley contains over 60 percent of the State's acreage of fruit and nut crops. Three counties, Fresno, Kern, and Tulare, contain 38 percent of the State's acreage. The acreage is not spread uniformly over the valley, but is concentrated in areas of appropriate soils. Historically, these crops, especially grapes, have been planted on the east side of the valley. As areas on the west side were developed with new surface water supplies, extensive new plantings of fruits and nuts were made. All fruit and tree nut crops in the valley are irrigated.

Census data on California fruit and nut farms (which apply generally to the San Joaquin Valley) indicate significant overall changes, but these are less extreme than for field crops. There were 22,286 fruit and tree nut farms in 1974; this number was down only 34 percent from 1950. During 1950-74, acreage increased 13 percent to 2.5 million acres, and average farm size almost doubled to 113 acres.

In 1974, almost half of the acreage was in farms with annual sales in excess of $100,000. These farms averaged 454 acres in size, although the median was in the range of 140 to 179 acres. Fruit and nut growers grew few other crops, and 88 percent of the irrigated harvested acreage was in specialty crops.

The financial data in table 10 show the average value of fruit and nut land to be the highest of all cropland, due to high orchard development costs. These land values compare favorably with those estimated by the California Department of Food and Agriculture (*42*). Only half of the farms reported farm debt, and the average debt per acre was considerably higher for the smaller farms. Net income per acre from farming was similar for both the large and medium sizes of farms. Yet, due to other income, especially from off-farm work, the medium-sized farms had greater income per acre.

Fruit and nut crop farms have had major changes in acreage and location in the region. There have been large increases in tree nut farm acreages, while some fruit farm acreages have declined.

A comparison of certain fruit and tree nut operations may serve to typify changes affecting structure. Nut crop and wine grape growers planted heavily in the 1960's and 1970's, increasing production significantly. In contrast, citrus growers increased acreage only slightly, while those with peaches reduced acreage.

One of the big innovations in resource use has been the planting of fruit and nut crops in very large blocks. A significant part of the recent expansion of fruit and nut acreage has been due to plantings by large growers. Where plantings previously were in the 10's up to 100's of acres, the new plantings were sometimes in the 1,000's. As a consequence, appropriate methods of managing these large blocks had to be learned.

Further, the crop when bearing gave (or will give) the very large growers a significant share of the market. Already, several large farms have begun to pack and market nut and other crops on their own, moving outside previously existing marketing channels. Large wine grape growers in many cases have set out their new acreages especially for mechanical harvesting, accelerating the pace of wine grape mechanization. Some of the new acreages were set out by wineries, integrating further into the growing of grapes. Large independent grape growers had to seek contracts with wineries to assure markets for their new grape production. The profitability of such new plantings has been hindered by an oversupply of grapes and low grower prices.

Differences in cultural practices dictate different labor requirements for these crops, which, in turn, affect farm size expansion possibilities. Almonds and walnuts are mechanically harvested, freeing management from labor supervision and permitting farm size to expand to capture the economies of the harvester. Cling peaches, grapes, and citrus require large numbers of workers. Peach growers need workers to prune, thin, and harvest the crop, although about 15 percent is mechanically harvested Wine grape producers also need labor for pruning and harvesting although about 20 percent of the crop is harvested mechanically, and the citrus crop is hand-harvested. Consequently, labor requirements are greatest for the three latter crops.

There are peak requirements for seasonal hired labor to do pruning, thinning, and harvesting. While occasional shortages occur, such labor has been in plentiful supply for many years. A large proportion of the seasonal hired labor is of Mexican ancestry, with an indeterminate but important number of the workers being undocumented (illegally in the United States). Elimination of undocumented workers likely would leave agriculture very short of labor.

The fruit and nut growers have long practiced factor specialization. The operator performs the usual cultural practices, such as cultivation and irrigation. Seasonal labor for pruning, thinning, and harvesting may be obtained from a labor contractor, or the grower may do his own hiring. The contractor provides the labor crew and supervision and may have his own equipment, freeing the operator from labor supervision. Operations such as fertilizing and chemical application (herbicides and pesticides) are largely custom operations. There are restrictions on handling and applying chemicals, and they are dangerous to handle, giving rise to the use of licensed custom applicators. Mechanical harvesting is a custom operation for many smaller growers.

The results of changes in resource use are that the scale of enterprise has become large. There are no significant economies of size research findings other than a 20-year-old peach study to indicate how large an operation must be to achieve full economies from the machinery mix. This study indicated that 80 acres were sufficient to achieve the size economies in 1960 (*12*). It would be expected that the optimal size has increased somewhat since, except that orchard equipment size is constrained by the need to work in restricted tree and vine rows.

The three major tree nut crops in the Southwest region are almonds, walnuts, and pistachios. These tree nuts are similar in that they are grown in California and constitute most or all of U.S. production of those crops.

Almonds

While there have been major changes in the acreage of all tree nut crops in the last 20 years, change in almond acreage have been the greatest. Almonds have increased in both acreage (from 90,000 bearing acres in the 1950's to over 300,000 bearing acres in 1978) and yields (from 0.45 ton per acre in the 1950's to 0.9 ton in 1976 and 1977). As a result, total production of almonds rose from 40,000 tons in the 1950's to about 255,000 tons in 1977, a sixfold increase (*3*).

The location of almond production also has changed significantly since 1950. At that time, the major production areas were the Sacramento Valley and central coast area. Since then, acreage in the central coast area has dwindled while that in the Sacramento Valley has increased although its share of State production has dropped. The main changes in location have been to the northern and southern areas of the San Joaquin Valley, where 72 percent of the State's acreage is now. Kern County alone has over 62,000 acres, or 18 percent of the acreage (*3*).

There are several reasons for the increase in acreage and shift in location—including price, tax incentives, availability of new irrigated land in the San Joaquin Valley, and mechanical harvesting. The number of farms growing almonds decreased from 14,248 in 1950 to about 6,500 in 1978.[5] Average almond acreage per farm in 1978 was estimated to be 52 acres. This average included eight very large growers in or near Kern County with holdings of 3,000 to 10,000 acres each. Two of the largest operations are organized as management companies for many investors. A major factor in tree nut farm size increases is that the harvest is mechanized.

Walnuts

The acreage of walnuts increased substantially in the 1960's and early 1970's to 202,000 acres by 1978 due to favorable returns to growers, mechanization, and tax-loss farming interests. Perhaps the reason very large growers have not entered walnut production, as in almonds, is the requirement for good soil and more careful cultural practices (*20*). Walnut yields have increased since World War II due to a shift in location and improved cultural practices (*25*). The location shift was from southern California to the San Joaquin and Sacramento Valleys, a change encouraged by higher yields and pressure of urbanization in southern California.

The capital-intensive feature of machine-harvesting (*3*) probably is a main factor permitting management of large blocks of trees. Reed (*37*) estimated that economies of size are received largely at about 200 acres, although further economies have been obtained at larger sizes. There is little data on the number of growers and average farm size. The 1964 Census of Agriculture reported 13,042 growers in the State, down 50 percent from 1950. By 1974, there were 4,817 farms growing walnuts, averaging 33.6 acres per farm.

Pistachios

Pistachio production on a sizable scale is a recent occurrence in California. As late as 1975, the bearing acreage was only 420 acres.

[5]Private communication with California Almond Growers Association.

However, heavy plantings of pistachios in the early 1970's increased total acreage to 28,000 in 1978. Due to the long maturation period of 7 years, bearing acreage in 1978 still was only 3,146 acres. Due to the biennial bearing of pistachios, yield trends are not yet apparent. Two counties, Kern and Madera, in the southern San Joaquin Valley have most of the acreage.

A unique feature of the structure of farms growing pistachios is that most are very large. It was reported that, by 1973, eight growers had planted 86 percent of the acreage. The crop can be harvested mechanically, although the nuts require rapid handling and drying after harvest (*36*).

The pistachio nut industry has the problem of developing markets for the nuts as the planted acreages mature. All prior consumption in the United States has been via imports. When all trees are mature, domestic production could be double present U.S. consumption, indicating the magnitude of the marketing need (*34*).

Grapes

California is the leading grape-producing State in the country, producing 4 million tons of grapes on 622,000 acres in 1978.

The grape industry has been characterized by a large number of growers. In 1950, there were 32,000 farm units reported as producing grapes. This number declined substantially during the ensuing two and one-half decades. In 1974, only 9,200 units were reported, a decrease of 71 percent (*42*). Major uses of grapes are for wine, raisin, and table purposes. Data on farm numbers by grape types are available only through 1969.

The raisin industry is characterized by small growers; in 1950, there were 12,165 farms growing raisin varieties, averaging 17.9 acres per farm. By 1969, this number had decreased 66 percent to 4,116 farms averaging 42 acres in size. The primary producing area historically has been in the southern San Joaquin Valley and centered in Fresno County.

The primary production areas for table grapes lie in the San Joaquin Valley, especially Tulare and San Joaquin Counties. Although still in a small producing area, growers in Riverside County in the south recently increased production, since they can produce for the early market season. There has been a decided reduction in the number of farms growing table varieties since 1950, decreasing 88 percent by 1969. Average acreages of table grape varieties grown per farm increased from 8.5 acres in 1950 to 55 in 1969.

There also has been a significant drop in the number of wine grape farms—down 60 percent during 1950-69. The average size of wine grape farms also has risen, increasing from 19.6 acres in 1950 to 45.7

acres in 1969. Some changes in the location of wine grape farms also have occurred since 1950. Then, San Bernardino County (in southern California) was the large grape producer, growing 18 percent of the wine-type acreage. Since 1950, the county has produced few such grapes. The southern San Joaquin Valley counties are most important now, as are Napa and Sonoma Counties on the north coast and San Joaquin and Stanislaus Counties in the northern San Joaquin Valley. Important new areas of production are in Monterey County (33,000 acres in 1976) and parts of the west side of the San Joaquin Valley which receive surface water for irrigation. Generally, the production areas for premium wine grapes are considered to be on the north coast, along with Monterey County. Farms in the interior of the San Joaquin Valley produce grapes for the standard table wines and dessert and other fortified wines.

Mechanization of the wine grape harvest is a recent innovation. Grape harvesting machines are in common use in the States of New York, Michigan, and Washington, being especially suitable for nonalcoholic processed grape products. The harvest machines also are used on 10 to 15 percent of the grapes for wine in California, mostly varieties which are easier to pick and those that command lower prices (*22*).

The grape harvest machines have caused substantial problems. While the machines greatly reduce labor requirements, they beat the vines and cause the berries to shatter. Consequently, there are problems of vine damage which can affect future yields, crop loss through the machine, loss of wine quality due to premature fermentation caused by excessive juicing of grapes in the field, and potential wine quality loss due to off-tasting juice from macerated leaves.

The breakeven acreage for hand and machines systems has been estimated to be 220 acres at an 8-ton yield (*22*). Growers will be encouraged to increase acreage or perform custom harvesting to capture the economies of the harvest machine. Machine harvest technology is applicable to raisin grapes but has not been adopted.

Citrus

In 1977, California and Arizona produced 24 percent of the U.S. crop of oranges, 15 percent of the grapefruit, and 89 percent of the lemons. The citrus acreage is located in the southern San Joaquin Valley, southern California coast, and desert regions of the two States. Significant location changes have occurred in the industry since World War II. A large proportion of orange and lemon acreage was shifted from southern California to the San Joaquin Valley, thus relocating about half of the industry. A minor change was the growth of the lemon industry in Arizona. The primary reason for this change was increasing urbanization in southern California. The small grapefruit acreage has remained in the Coachella Valley in southern California.

There were 4,341 farms growing oranges in California in 1974 (*42*). Average orange acreage per farm was 41.6 acres at that time. However, half of the acreage was on farms of 100 acres and over, averaging 278.7 acres each. The citrus harvest has not been mechanized.

Peaches

California produces most of the clingstone peaches and one-fourth of the freestones in the United States. The State dominates the peach canning industry. However, due to declining consumer demand, overproduction of peaches has been a major problem. To solve this problem, clingstone peach growers have utilized marketing controls in several forms, production diversion, credits for tree removals, and green-dropping (forced removal of immature fruit), although there are no restrictions on new plantings. A significant acreage decline to a low of 41,100 acres took place during 1976-78. Freestone peach acreage also declined, dropping 40 percent to 22,230 acres during 1960-78.

There were about 1,350 growers each of clingstones and freestones in 1974, down about 50 percent from 1960 (*42*). Average holdings of peaches per farm in 1974 were 48.1 acres of clingstones and 18.3 of freestones. Growers commonly grow both types of peaches. Other crops grown on peach farms include almonds, walnuts, and grapes.

As the number of acres of peaches has declined, so has the number of processors. In 1978, the number had decreased to 16, of which 4 did a majority of the canning (*2*). As the number of canneries has declined, growers have lost access to them since those remaining would not accept new customers.

Clingstone peach growers have utilized machine harvesting since the early 1970's. In 1977, 21 percent of the crop was mechanically harvested (*2*). The breakeven acreage between hand and machine harvesting was 37 acres in 1973 (*19*). However, increasing use of the machine has been discouraged by processors due to product damage by the machine.

Examples of Perennial Crop Production

A grape grower in Fresno County with 230 acres of grapes was interviewed to provide insights on specific operations. Crop acreage is mostly of the multipurpose variety, Thompson seedless. Of his total acreage, all but 30 acres are owned. He typifies the stability of many perennial crop growers in that he has maintained this size of operation for 10 years, gradually increasing his ownership interest. His multipurpose variety has enabled him to shift from winery to raisin end use, whenever he considered the change economic. Actually, he has not shipped to the winery since 1972. His asset position is such that he normally needs no outside financing. However, 2 bad raisin years out of the last 3 caused him to again require outside crop financing. He hires his own crew of seasonal workers, needed for pruning in the winter and harvesting in September. A nucleus of the crew returns each year.

He has helped to develop techniques to mechanize the raisin harvest through the severed cane technique (cutting bearing canes prior to harvest to aid in berry separation) and the consequent use of machines to harvest the grapes and lay them on a continuous paper tray. When the pickup machine is more reliable, he intends to harvest a significant part of his grapes by this method.

In contrast to the stability of this and many other perennial crop growers, consider the case of a farm management company which began pistachio production in the early 1960's (*33*). The company controlled 3,700 acres of trees in 1975, most of them nonbearing. This operation is typical of several large farms which have faced the long maturation period of pistachios (7 years). Such firms lack knowledge of cultural operations or reliable yield history, and have no previous U.S. domestic supply experience.

CALIFORNIA VEGETABLE FARMS

The primary vegetable growing areas in California are the Salinas Valley on the central coast for summer production of cool-weather vegetables and Imperial Valley in the southern desert for winter production. Spring and fall production comes from the short-season areas of Arizona and the west side of the San Jaoquin Valley. Due to different climates in each area, a continuous harvest of vegetables is possible. To continually supply the market, many vegetable grower-shippers have integrated their operation to include more than one or all producing areas.

The 1974 Agricultural Census report on vegetable farms applies generally to the Salinas and Imperial Valleys. The number of farms classed as vegetable farms had decreased sharply since 1950. The number of farms in 1974, 1,120, was only 23 percent of the number in 1950. Vegetable farm acreage almost doubled during the same time period, with a resulting trebling of average farm size from 152 to 533 acres per farm. In Monterey County (Salinas Valley), average irrigated acreage per farm (all crops) was 305 acres in 1974, and for Imperial County, 714 acres.

In 1974, vegetable farms generally had a high value of sales, since farms with gross sales over $100,000 that year numbered 57 percent but controlled 95 percent of the acreage. Average irrigated harvested acreage of this group was 704 acres in the State. Land operated by the larger growers typically was leased (72 percent), and part-owner and tenant-operated farms dominated the tenure pattern. Almost half of the farms were operated by individuals, and another 31 percent by partnerships. Few crops other than vegetables were grown, as vegetables were grown on 75 percent (average) of total cropland.

Table 10 indicates that the value of land per acre was considerably greater than field cropland. Since much of the desired vegetable land is in scarce supply, land values are high. However, relatively few growers indicated any farm debt. Income per acre was higher in 1974 than for field crop farms. Small farms earned more per acre than did large farms, although there were only a few farms represented in the category.

Lettuce

Lettuce is the third most valuable crop grown in California. It is grown on 160,000 acres. The crop is highly perishable, and continuous production is necessary to provide it year-round. Almost all lettuce is produced domestically by shifting from one growing area to another as the seasons change. Two producing regions in California dominate lettuce production—the Salinas Valley from April to October and the Imperial Valley from December through March. Other areas produce lettuce largely in the spring and fall during time periods between those used in the two larger areas. These areas are the western San Joaquin Valley, Santa Maria, and Blythe, Calif., and central and Yuma, Ariz.

The number of lettuce growers in California has decreased greatly since World War II. In 1974, the number was 333, down considerably from 1,078 in 1959 and 1,710 in 1949 (*42*). Average acres are large and vary among regions; lettuce farms in Monterey County (Salinas Valley) had an average of 505 acres, 666 in Imperial Valley, and 393 acres on the San Joaquin Valley's west side.

These data on growers include both independent growers who contract with shippers and integrated grower-shippers. One source indicated that half of the California production was grown by farmers under contract with shippers. The remaining lettuce is grown by a smaller number of vertically integrated lettuce grower-shippers, estimated to comprise a majority of the 75 shippers in California in 1975 (*23*).

The number of lettuce shippers operating in California and

Arizona in 1974-75 was estimated to be 93. The top eight shipping firms handled 31 percent of the U.S. lettuce, and the top three firms handled 20 percent of national sales (*23*).

Regionalization of the U.S. lettuce industry was made possible by improvements in refrigeration and transportation, in addition to improved crop culture practices. The initial growth of the industry came when it was possible to ice railcars and a fleet of such refrigerated cars was available. A wooden crate containing 48 heads was used, and crushed ice was placed between three layers of lettuce. This "package icing" was performed in the packing shed, but the rail cars also had ice bunkers. On arrival at an eastern market, the heads would be in a solid cake of ice, hence the term "iceberg lettuce." Increases in shipments began slowly, beginning in 1920 in the Imperial Valley. By the late 1920's, both the Salinas Valley and central Arizona were significant shippers. Other smaller producing areas entered later, including the Santa Maria area and Ventura County in California and New Mexico. A vacuum tube, now the common method to cool lettuce, allowed the produce to be harvested in the field. Typically lettuce today is harvested in the field by hand, packed into cartons containing 24 heads, and transported to and cooled in vacuum coolers. Trucks have largely displaced railcars for transporting lettuce. In 1978, trucks hauled 93 percent of the Nation's lettuce (*50*). A recent innovation is the rail-truck combination, in which truck trailers are hauled by rail for part of the trip (piggy-back), allowing the flexibility of truck hauling beyond the rail destination. The change away from rails is causing concern over the increased use of energy.

Lettuce harvest labor productivity has increased during the last 10 to 15 years. While the steps in harvesting unwrapped lettuce have not changed, changes in organization have occurred. Perhaps the most important change has been to use a piece-rate basis for wages, rather than the earlier hourly rates. As a consequence, output per worker increased from 5 to 6 to 14.7 cartons per hour during 1963-73. However, to achieve the latter output, the number of cuttings dropped from 3 to 4 down to 2 or less (*24*).

While most of the lettuce packed is unwrapped, wrapped lettuce has gained 17 percent of the market (*23*). The technology of harvesting wrapped lettuce is not sophisticated or especially efficient. Labor productivity was a low 5.4 cartons per person hour in 1973 (*24*). An advantage of source-wrapped lettuce is that all wrapper leaves are discarded in the field eliminating an eventual garbage problem. A further produce form is shredded lettuce; less than 1 percent of the lettuce is marketed in this form.

An experimental mechanical harvester has been developed, and several commercial models are under construction. The technology developed permits the heads to be mechanically selected, cut, trimmed, and carried up to the mobile platform. At this early stage of machine development the industry can pack the lettuce either on or off the platform, or bulk-pack it. Packing on the machine could increase labor productivity per worker by a third; loose-packing into bulk containers could increase worker output by about 2½ times, for handling is delayed until the product reaches the receiver (*24*).

Strawberries

Shipments of 776 million pounds of strawberries were reported in the United States in 1977 (including shipments from Mexico). Some 522 million pounds (67 percent of the shipments) were produced in California (*49*). No other States in the Southwest region had any reported strawberry production. California dominates the strawberry market. Growers there produced 77 percent of reported U.S. fresh shipments and 54 percent of all shipments for processing in 1977 (*49*). California's share of U.S. strawberry production rose from 3.6 percent in 1934 to 20.7 by 1952. This proportion rose to 33.6 in 1960 and to the present 80 percent. A major factor in this change has been large increases in yield. California's yield in 1977 was three times greater than Florida's and seven times greater than the Pacific Northwest's.

The cool, coastal parts of California are the areas of concentrated strawberry production, one in the south and one along the central coast. While the two major areas currently have about the same acreage, the central coast dominated in the 1950's and early 1960's.

Strawberries are grown in California on small farms, averaging 15.9 acres of berries per farm in 1974. Acreages generally are smaller in the central coast area than in the south, ranging from 13.9 acres per farm in Monterey County in the north, to 64.4 acres in Ventura County in the south.

Tenant-operated farms are common for strawberries, comprising 55 percent of the acreage and 43 percent of the farms in 1974.[6] Part owners had 30 percent of the acreage and 20 percent of the farms. Full owners were numerous (37 percent of the farms) but had only 15 percent of the acreage. There has been little change in tenure since 1964 (*42*).

Most of the farms growing strawberries were individually or family operated in 1974 (78 percent) and had the most strawberry acreage (43 percent). Partnerships were the next most common (32 percent of the acreage), followed by corporate organizations (21 percent).

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[6] These data are for all berries, but strawberries are grown on 86 percent of the farms and take 91 percent of the acreage (*42*).

Strawberry culture is highly labor intensive. Technological change has occurred in biological and cultural practices rather than in mechanical areas. New varieties have permitted high yields and an extension of the harvest season. Cultural practice changes include such techniques as use of drip irrigation in the water-short south and use of soil fumigation to permit annual planting. The consequence of the direction of technological change has been to keep farm sizes small.

LIVESTOCK PRODUCTION

Livestock and poultry are important to agriculture in the Southwest. Nearly 40 percent of farm receipts in the region in 1975-77 were from livestock and poultry. The relative importance of the different species is indicated by average annual receipts for the 3-year period, as follows:

Annual receipts, Southwest, 1975-77	Million dollars
Cattle and calves	2.1
Dairy products	1.3
Hogs	.1
Eggs	.4
Turkeys	.1

While there are many farms and ranches with very small numbers of animals and birds, the majority of production is on large units. The concentration of production is illustrated by the following information and data on California.

Dairy

In 1979, there were 2,864 commercial dairies. They adveraged 300 cows per herd.[7] In contrast, average herd size was 171 as recently as 1970, when there were nearly twice as many herds.

The dairy industry is greatly affected by Federal and State milk marketing regulations. The effect of the regulations is to limit entry of new producers. While anyone who can afford the capital investment can operate a dairy, the new entrant cannot quickly obtain a producer base and quota for Grade-A (fluid milk) production that

[7] Unpublished data from the California Department of Food and Agriculture.

pays the highest return. Further, the entrant needs a market for his milk; marketing cooperatives may be closed to new members at that particular time.

The location of dairy production has changed over time, shifting from the Los Angeles area to the San Joaquin Valley due to the pressures of urbanization. Over half of the milk cows in California in 1978 were located in the San Joaquin Valley (*6*). A concentration of dairies remains east of Los Angeles in the Chino Valley with about 20 percent of the State's milk cows.

Beef Cattle Farms

California is deficit in beef production, with only 49.4 percent of the beef consumed in the State from locally fed animals. There are two parts of the California beef cattle industry, the feeder cattle and feedlot sectors. Census data for 1974 indicate there were 8,950 feeder cattle growers[8] with beef cows and heifers that had calved, averaging 109 beef cows per farm. This was double the 1964 number of farms, which averaged only 58 cows per herd.

During the early 1960's, the number of cattle marketed from feedlots increased sharply to 2 million head, then declined in the 1970's. The total number of feedlots in California dropped from 410 in 1971 to 130 in 1978 (*48*), a decline of 68 percent, with most of the decrease in smaller feedlots. Feedlots handling under 4,000 head declined by 64 percent during 1962-72 (*30*). By 1978, there were 107 feedlots in California that fed over 1,000 head during the year, constituting 6 percent of the number of feedlots of that size in 23 major States (*48*). The average number of cattle marketed per lot was 13,150 head.

Feedlots in California and Arizona have been owned largely by corporations. In 1975, 65 percent of the feedlots had a corporate structure, with 38 percent of these organized as a standard family corporation (*16*).

In location, the largest number of California cattle in feedlots is in the Imperial Valley in the far south (53 percent in 1979) (*48*). The San Joaquin Valley and southern California contain another 38 percent.

Custom feeding by feedlots has been typical of western feedlots since at least 1957 (*28*). An overexpansion of feedlots in the early 1970's was due to custom feeding via a tax-induced flow of investor capital (*10*). By 1975, custom feeding accounted for 58 percent of total marketings in California and Arizona, mostly by large feedlots (*16*). The reasons for custom feeding are a lessening of risk and a

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[8] Farms with sales over $2,500.

reduction in capital requirements by the feedlot owner. The risk in custom feeding lies in not finding enough customers to operate the lot at a profitable capacity.

Sheep and Lambs

The sheep and lamb industry in California has declined during the last 20 years. The number of ewes 1 year and older decreased from 1.4 million head in 1961 to 0.8 million head in 1978 (*26*). Reed (*38*) suggests that competition for rangeland from beef cattle has been a factor in the decline, along with labor and predator problems.

The number of sheep and lamb farms was estimated at 4,000 in 1978, down 25 percent since 1969 (*4*). However, the 1974 Census number of farms with sales of $2,500 was 2,261. The average sheep and lamb herd was 693 in 1974 up from 605 in 1969.

Poultry

The poultry industry consists of three sectors: eggs, turkeys, and broilers and fryers. California is self-sufficient in egg production and produced 12.5 percent of U.S. production in 1978. Egg production has increased during the last two decades, rising from 6.1 billion in 1961 to 9 billion in 1976 (*26*). However, egg production per bird has remained constant; the increase was due to a larger number of layers (*26*). Farms producing eggs are large in size. Of the 2,498 farms reporting some hens and pullets of laying age in the 1974 Census, 78 farms had 57 percent of the birds. Of these 78, the average number of hens and pullets per farm was 323,500 in 1974. Major egg producing areas are in southern California, plus Stanislaus and San Joaquin Counties in the northern San Joaquin Valley.

California produced 4 percent of the broilers and layers in the United States—575.3 million pounds in 1978. Major broiler production areas are the San Joaquin Valley and San Bernardino County in southern California. Broiler production has increased rapidly since 1961, rising by over 50 percent to 122 million broilers produced in 1978 (*5*). According to the 1974 Census, there were 284 farms growing broilers in 1974, averaging 63,000 birds per farm.

There were about 17 million turkeys produced in 1978, 12 percent of the U.S. market. The State is self-sufficient in turkeys. The 1974 Census indicates there were 278 farms raising turkeys, averaging 6,444 birds per farm.

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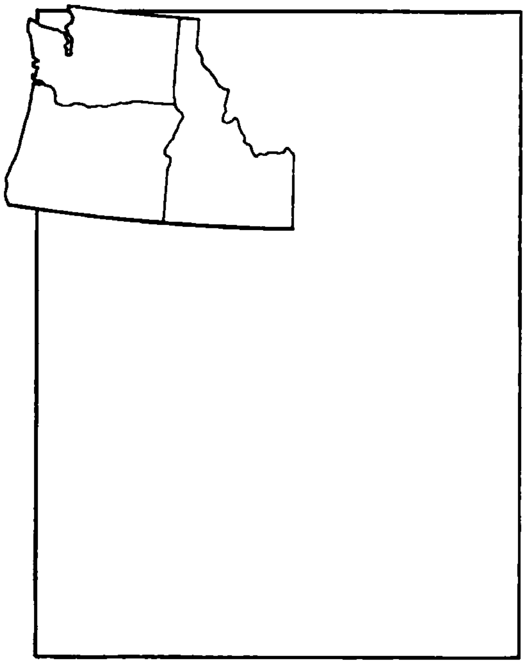


The Northwest

Donn A. Reimund

SUMMARY

Changes in Northwest agriculture center on the growth of irrigated farming in the intermountain irrigated areas of the three States (Idaho, Oregon, and Washington) and the declining agricultural land base in the western parts of Washington and Oregon. During 1964-74, the value of agricultural production in the irrigated area rose from 59 to 65 percent of the Northwest total, while value in the western Washington-Oregon area declined from 26 to 19 percent. The proportion of total value of production in the dryland farming area remained stable at slightly over 15 percent. Crop production has increased relative to livestock and poultry production. Crops accounted for two thirds of the value of agricultural output in 1974, compared with 59 percent in 1964.

The number of farms in the region decreased by more than 30 percent during 1964-74, with over half of the decrease occurring in the western Washington-Oregon area. Expanded farm size was a major contributing factor to the decline in the number of farms.

The Northwest contains about 5 percent of the total U.S. farmland and accounts for about the same percentage of total farm product sales. The region is a major producer of several important commodities, including wheat, barley, potatoes, apples, and sugar beets. In addition, the region is a major producer of a number of minor and specialty commodities.

During 1959-74, total farmland in the Northwest decreased from

55 to 49 million acres, about the same rate of decrease as the national average. Cropland acreage increased slightly in the region during this period, however, in contrast to a decline nationally.

Agriculture is relatively more important to the region's economy than it is to the national economy. During 1974-76, farm income accounted for 4 percent of total personal income in the Northwest and just over 2 percent in the United States. In the same period, farm proprietorships accounted for 3.5 percent of Northwest employment and 3.1 percent of national employment. Agriculture-related industries also are a larger part of the region's economy than of the Nation's.

The more important factors affecting the organization of Pacific Northwest agriculture include water resource policies, Federal commodity programs, technology, Federal labor policies, market location, and population growth and urbanization.

One-half of the irrigated acreage in the intermountain irrigated portion of the region was developed under Bureau of Reclamation projects, and the structure of farming in this area has been heavily influenced by acreage and residency requirements of the Reclamation Act of 1902. However, Federal water resource development currently appears to be in a state of retrenchment. Policies of the three States generally have been conducive to the development of water resources, and have not discouraged large-scale private irrigation developments. As a result, several large-scale irrigated farms have been developed along the Columbia and Snake Rivers in Washington and Oregon.

Wheat, barley, and sugar beets are the main commodities produced on Northwest farms that are or have been subject to Federal commodity programs. These programs have affected the structure of the region's agriculture primarily by reducing risk and influencing the acreage and mix of crops produced.

Technological innovation probably has been the most pervasive of all forces affecting the structure of agriculture in the Pacific Northwest. Important innovations include tractor and machinery technology, irrigation technology, plant breeding, crop storage, and food processing. Innovations in all these areas had a large role in the growth and development of the region's potato industry. The structure of most other commodity subsectors in the Northwest has been affected by technological advances in one or more of these areas.

Many Northwest crops are labor-intensive. Tree fruit and berry crops, particularly, require large amounts of harvest labor. Consequently, the region is somewhat more subject to Federal policies concerning the use of migrant and child labor on farms than most other agricultural areas. Recent policies regulating and restricting the *employment of foreign farm workers and children as fruit and berry pickers have resulted in spot labor shortages, and are causing some restructuring of the region's agriculture.*

The distance of the Northwest from major population centers has been a determinant of the types of commodities grown in the region. Transportation costs to move Northwest products to markets in the East and Midwest are greater than for products produced closer to these markets. Consequently, the region is a major supplier to national markets of only those commodities in which it has a sufficient production advantage to overcome this transportation differential. The resulting commodity mix, in turn, has been an important factor in the structural development of the region's agriculture, influencing farm size and the development of regional marketing institutions and strategies.

Population growth affects agriculture in two ways. First, it increases the demand for nonfarm uses of agricultural resources, particularly land. Second, it increases total demand for farm food and fiber products. Both of these effects are apparent in the Pacific Northwest.

Rapid population growth in western Washington and Oregon has created problems related to the transition from agricultural to nonagricultural uses of land and to conflicts between farm and nonfarm interests arising from certain cultural practices used by farmers. Problems resulting from urban expansion into agricultural areas have been most apparent in Oregon's Willamette Valley. During the last decade, the population of the Western States, including the Northwest, increased at a rate about double the national average. This westward population shift has increased the size of markets in which the Northwest has a comparative advantage for many of its farm products, and has partially offset the locational disadvantage the region faces in the national marketplace.

Water resource policies, population growth, market development, and interregional competition should be the primary factors influencing the future development of Northwest agriculture.

Changes in Federal water resource policy, specifically the requirement that new projects be cost effective, may result in a larger proportion of future irrigation development being undertaken by private interests. This would foster a marked increase of large-scale farming ventures in the Northwest's irrigated subregion, in contrast to the family farm structure that developed under past policies. The current debate over enforcement of the Reclamation Act's acreage limitation provisions also may affect the structure of farming in the irrigated subregion. If a policy of strict enforcement of the current acreage limitations on Federal irrigation projects is adopted, it would impede further farm enlargement. It appears likely that a policy may *be adopted to preserve the family farm character of the projects, but allow individual farms to attain sufficient size to capture economies of size and efficiencies inherent in new technology.*

Because of the different crop mix on large and small irrigated farms, policies affecting farm size can have an impact on the economic growth of the subregion. The larger farms produce a higher proportion of intensive crops (those with high gross values per acre), which are the basis for the subregion's developing food processing industry.

Ability to develop and expand markets for the more intensive field, fruit, and vegetable crops produced in the region will be a key factor determining the extent and direction of future growth in Northwest agriculture. Rising costs of petroleum fuels, largely through their impacts on transportation costs, will improve the competitive position of production areas near the major population centers relative to more remote producing areas such as the Northwest. On the other hand, the region's heavy reliance on hydrogenerated electricity for industrial energy may improve its competitive position in food processing relative to regions that are dependent on fossil fuels for industrial energy.

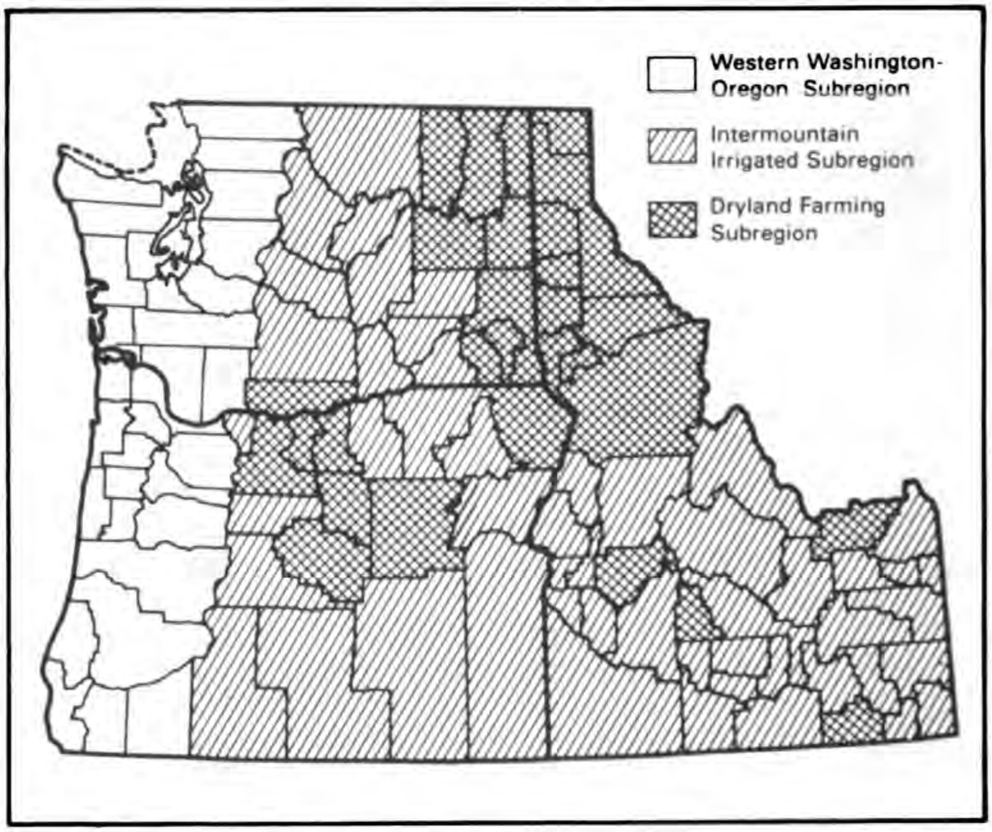
The development of export markets, primarily in the Far East, for Northwest farm commodities that traditionally have not been exported offers good potential for market expansion.

Recent population trends, principally the high growth rate of the Western States relative to that of the United States as a whole, have enhanced the competitive position of Northwest agriculture. Assuming that these trends continue, substantial growth will occur in the market area in which the Northwest has a locational advantage for many of its agricultural products. This will reduce the locational disadvantage that traditionally has been a major problem for Northwest agriculture.

THE REGION

The Northwest consists of the States of Idaho, Oregon, and Washington. These States make up the major portion of the area drained by the Columbia and Snake Rivers and their tributaries. The region has distinct climatic zones because of the mountain ranges dominating its topography. Annual precipitation ranges from 80 to over 100 inches in the coastal areas of Oregon and Washington to 10 inches or less in parts of the intermountain areas of the three States. The wide range of climatic conditions has led to wide diversity in the types of agriculture in the region. Crop production in the region can be divided into three major subregions (figure 1).

FIGURE 1
NORTHWEST FARMING SUBREGIONS



Western Washington and Oregon

In this area west of the Cascade Mountains, agriculture is concentrated largely between the Cascades and the Coast Range; the Willamette Valley in Oregon is the primary crop production area. Annual rainfall normally ranges between 40 to 50 inches and is heaviest during winter and the early spring months. Major crops in this area include vegetables, berries, grass and other seeds, tree nuts and fruits, wheat, and a number of specialty crops such as hops, mint, and ornamentals. Dairy and poultry products are the major livestock commodities produced in this area. Land between the Cascades and Coast Range includes Seattle and Portland and is the most heavily populated area in the Northwest. In 1974, the western Washington and Oregon subregion contained 8 percent of the Northwest's farmland and slightly over one-third of its farms. Average farm size was 138 acres.

Intermountain Irrigated Area

This is the area east of the Cascade Mountains where average annual rainfall is 15 inches or less. Crop production is concentrated along the Columbia River and its tributaries in central Washington, the Snake River Valley in Idaho, and adjacent areas of north-central, eastern, and south-central Oregon. Much of this area is unsuitable for crop production without irrigation, while other parts of it will support dryland crop production. The major crops produced include tree fruits, potatoes, sugar beets, dry beans, hay, wheat, vegetables, and specialty crops such as hops and mint. Beef cattle and sheep are the leading livestock enterprises. Nearly 60 percent of the Northwest's farmland and about half its farms were located in this subregion in 1974, and farms averaged 740 acres.

Dryland Farming Areas

This area consists of the parts of the three States east of the Cascade Mountains where annual precipitation is sufficient to produce crops without irrigation. Rainfall varies from 15 to 25 inches per year. In the driest parts of the area, crops are produced in a summer fallow rotation, but annual cropping is possible in the higher rainfall sections. Crop production is concentrated in the southeastern part of Washington, adjacent counties of northern Idaho, and in the Columbia Plateau of north-central Oregon. Wheat is the major crop produced in this area, with other important crops being barley and dry peas. The major livestock enterprise is beef cattle. This subregion had one-third of the Northwest's farmland and 16 percent of the farms in 1974, with average farm size 1,308 acres.

NORTHWEST AGRICULTURE IN PERSPECTIVE

The three Northwest States account for about 5 percent of total U.S. farmland and farm product sales. These percentages have remained quite stable during the past 20 years. The region is relatively more important in crop than in livestock production, producing about 6 percent of the total value of U.S. crops, compared with about 3 percent of the value of livestock and poultry output.

Although the Northwest produces a relatively small percentage of total U.S. agricultural output, the region is a major production area for several important commodities–including wheat, barley, hay,

Table 1—Selected crops produced in the Northwest, value of receipts, and percent of total receipts, 1970 and 1977

Commodity	1970		1977	
	Pacific Northwest receipts	Percent of U.S. receipts	Pacific Northwest receipts	Percent of U.S. receipts
	Mil. dol.	*Pct.*	*Mil. dol.*	*Pct.*
Wheat	246	12	558	11
Greenhouse and nursery	44	5	114	6
Hay	61	10	165	11
Potatoes	200	30	444	37
Grapes	9	3	19	2
Apples	63	23	226	36
Sugar beets	75	19	75	15
Barley	57	19	72	14
Vegetables	87	5	180	5
Berries	33	24	48	17
Hops	24	93	47	95
Mint	21	75	56	88
Dry edible beans	22	13	52	15
Dry peas	17	98	15	100
Field seeds	NA	NA	120	51
Cherries	25	41	45	33
Pears	28	40	114	52

NA = not available.

potatoes, apples and other tree fruits, and sugar beets.[1] In addition, the region is a major production area for a number of minor and specialty commodities, including grass seeds, mint, hops, and berries (table 1).

Importance of Agriculture to Economy

Agriculture is relatively more important to the economy of the Northwest than it is to the total national economy (table 2). Farm income comprised 4 percent of total personal income in the Pacific Northwest during 1974-76, compared with a little over 2 percent for the United States. In the same period, farm proprietorships accounted for 3.5 percent of Pacific Northwest employment and 3.1 percent of national employment.

In addition to income and employment generated directly by farming, agriculture provides the basis for a significant amount of

[1] The future of sugar beet production in the Northwest is uncertain at present. The largest sugar beet processor in the region, operating three processing plants in Washington and Idaho, ceased operation after the 1978 season. Sugar beet processing generally has been unprofitable in the Northwest as well as other beet-growing regions since the sugar support program was terminated in 1973. No beets were grown for these plants in 1979.

Table 2—Farm income and employment in the Northwest and United States, 1970-76

Year	Northwest farm income as a proportion of:		United States farm income as a proportion of:	
	Total income	Employment	Total income	Employment
		Percent		
1970	2.92	4.18	2.11	3.62
1971	2.90	4.10	2.05	3.54
1972	3.72	3.94	2.35	3.39
1973	5.52	3.72	3.72	3.21
1974	5.68	3.55	2.67	3.11
1975	3.87	3.47	2.38	3.14
1976	2.37	3.33	1.75	3.03
1974-76 average	3.97	3.45	2.26	3.09

nonfarm economic activity including supplying of farm inputs, processing agricultural commodities, and assembly, storage, distribution, and export of agricultural commodities. These related activities are relatively more important in the Northwest economy than in the national economy. For example, the food processing industries provided 14 percent of both the manufacturing employment and value added from manufacturing in the three Northwest States in 1972. The comparable figures for the United States were 8 percent of manufacturing employment and 10 percent of value added.

ORGANIZATION OF AGRICULTURAL RESOURCES

Changes in Farmland and Land Use

Total land in farms in the Northwest has decreased since 1950, while cropland has increased The rate of decrease in farmland during the period was much less than the national decrease of 14 percent. Farmland acreage in the Northwest increased during 1950-59, however. During 1959-74 farmland acreage in the Northwest decreased by 12 percent, bringing the rate of decline more nearly into line with the national rate (table 3).

In contrast to the national trend, the acreage of cropland in the Northwest increased by 4 percent during 1950-74. Cropland decreased by 8 percent nationally during this period (table 4).

The decline in the Northwest total agricultural land base has been shared by all subareas of the region. During 1964-74, the land in farms in the region decreased by about 5.6 million acres. The intermountain irrigated area had the largest absolute decrease in land in farms. However, the western Washington and Oregon area had the

Table 3—Land in farms, Northwest and United States, 1950, 1959, and 1974

Year	Land in farms	
	Northwest	United States
	Million acres	
1950	50.9	1,161.4
1959	55.2	1,123.5
1974	49.2	1,017.0

Source: (*9*).[2]

largest percentage decrease, losing one-third of its agricultural land (table 5). About one-fifth of the loss occurred in the counties comprising the metropolitan areas of Seattle, Portland, and Tacoma.

Although there has been an overall increase of cropland acreage in the entire region since 1950, it has remained stable at slightly over 19 million acres since 1964. Within the subregions, however, cropland in the area west of the Cascade Mountains decreased by about 300,000 acres (12 percent) during 1964-74 and increased slightly in both the intermountain irrigated area and the dryland farming area (table 6).

The intermountain irrigated area contains over half of the Northwest's total cropland and 87 percent of its irrigated land. Less than half of the cropland in the subregion, however, is actually under irrigation. About 5 million acres were irrigated in 1974, an increase of about 100,000 acres from 1964. The acreage under irrigation increased in Washington and Idaho and declined in the Oregon portion of the subregion (table 7).

The large acreage of nonirrigated cropland in the irrigated area indicates the potential for continued growth of irrigated agriculture in the Northwest. The extent to which this potential is realized

Table 4—Cropland, Northwest and United States, 1950, 1959, and 1974

Year	Cropland			
	Northwest		United States	
	Million acres	Percent of farmland	Million acres	Percent of farmland
1950	18.5	36.3	478.3	41.2
1959	19.1	34.6	448.1	39.9
1974	19.3	39.2	440.0	43.2

Source: (*9*).

[2] Italicized numbers in parentheses indicate references listed at the end of this chapter.

Table 5—Changes, land in farms, Northwest and subregions, 1964, 1969, and 1974

Subregions	1964	1969		1974	
	Land in farms	Land in farms	Change from 1964	Land in farms	Change from 1964
	Mil. acres	*Mil. acres*	*Pct.*	*Mil. acres*	*Pct.*
Western Washington and Oregon	6.0	4.7	−21.7	4.0	−33.3
Intermountain irrigated area	31.1	28.8	−7.4	28.6	−8.0
Dryland farming area	17.5	16.5	−5.7	16.4	−6.3
Total Pacific Northwest[1]	54.9	50.0	−8.9	49.2	−10.4

[1] Subregions may not add to regional total due to rounding.
Source: (*9*).

depends on both Federal and State water development and use policies, and on the growth and development of markets for crops grown under irrigation in the region

The major types of agricultural land other than cropland are woodland and improved pasture west of the Cascades and rangeland east of the Cascades. The region's shrinking agricultural land base has been in these woodlands and pasturelands, which decreased by 6.3 million acres or nearly 20 percent during 1964-74. Most of the absolute decrease, about 3.7 million acres, occurred in the irrigated areas. The largest percentage decrease, however, occurred in the area west of the Cascades, which also was the only area of the region to lose cropland. The decline in noncropland acreage in the western Washington and Oregon area during 1964-74 was about 1.5 million

Table 6—Changes in cropland, Northwest and subregions, 1964, 1969, and 1974

Subregion	1964	1969		1974	
	Cropland	Cropland	Percent change from 1964	Cropland	Percent change from 1964
	Mil. acres	*Mil. acres*	*Pct.*	*Mil. acres*	*Pct.*
Western Washington and Oregon	2.4	2.2	−8.3	2.1	−12.5
Intermountain irrigated area	10.9	11.2	+2.8	11.2	+2.8
Dryland farming area	5.9	6.1	+3.4	6.0	+1.7
Total Pacific Northwest[1]	19.2	19.6	+2.1	19.3	+0.5

[1] Subregions may not add to regional totals due to rounding.
Source: (*9*).

Table 7—Changes in irrigated acreage, Northwest intermountain irrigated subregion, 1964 and 1974

State	Land irrigated 1964	Land irrigated 1974	Change from 1964	
	Thou. acres		*Thou. acres*	*Pct.*
Idaho	2,738	2,763	+25	+0.9
Oregon	1,132	1,082	−50	−4.4
Washington	1,007	1,129	+122	+12.1
Total subregion	4,877	4,974	+97	+1.2

Source: Census of Agriculture (*9*).

acres or 40 percent. This loss was primarily the result of population growth in the area, and indicates the continuing pressure of nonagricultural uses on farmland in the Puget Sound and Willamette Valley areas. The dryland farming areas have had the smallest decline in their noncropland agricultural base—1.1 million acres or 10 percent during 1964-74.

Changes in Crop and Livestock Production

Changes in Northwest crop and livestock production are related primarily to the growth of irrigated farming and, to a lesser extent, the declining agricultural land base in the western parts of Washington and Oregon.

During 1964-74, the value of agricultural production in the irrigated area rose from 59 to 65 percent of the Northwest total, while the western Washington-Oregon area declined from 26 to 19 percent (table 8). Comparable values in the irrigated subregion increased for both crop and livestock production. The same values decreased in the western Washington-Oregon area. The proportion of the total value of production in the dryland farming area remained stable during the decade, at slightly over 15 percent, while its crop share increased and that of livestock declined.

For the region as a whole, crop production has increased relative to livestock and poultry production (table 9). In 1974, crops accounted for two-thirds of the value of agricultural output, compared with 58 percent in 1964. This shift from crops to livestock in the region is the result of an expansion of crop acreage rather than a decrease in livestock output. Harvested acreage increased 10.7 percent, from 11.4 million to 12.6 million acres (table 10). The percentage of total cropland harvested increased from 59.3 percent in 1964 to 65.3 percent in 1974. Abnormally high crop prices, especially for wheat, and the lack of a wheat set-aside requirement

Table 8—Proportion of value of agricultural production in Northwest subregions, 1964, 1969, and 1974

Commodity groups and years	Proportion			Total
	Western Washington and Oregon	Irrigated areas	Dryland areas	
		Percent		
All commodities:				
1964	25.9	58.8	15.3	100.0
1969	23.4	63.0	13.6	100.0
1974	19.3	65.1	15.6	100.0
Crops:				
1964	21.0	61.4	17.6	100.0
1969	20.1	63.5	16.3	100.0
1974	14.6	66.1	19.3	100.0
Livestock and poultry:				
1964	32.4	55.3	12.3	100.0
1969	26.9	62.5	10.6	100.0
1974	28.8	63.1	8.1	100.0

Source: (*9*).

were partly responsible for both the high proportion of crop value and the increased harvested acreage in 1974.

The changes in crop acreages and livestock numbers are consistent with the shifts in value of production among the Northwest's subregions.

The acreage of wheat increased over 45 percent during 1964-74. Wheat is produced in all three Northwest subregions, but the largest acreage is in the dryland farming area, where it is the principal crop. Although most of the wheat acreage increase was in this subregion, a significant portion occurred in the irrigated areas. Irrigated wheat production increased by nearly 700,000 acres, over one-third of the

Table 9—Proportion of value of crop and livestock production in the Northwest, 1964, 1969, and 1974

Year	Crops	Livestock & poultry	Total
		Percent	
1964	57.5	42.5	100
1969	51.1	48.9	100
1974	66.7	33.2	100

Source: (*9*).

Table 10—Change in harvested acres of major Northwest crops and livestock numbers, 1964 and 1974

Commodity	Harvested acres or head				Change 1964-74
	1964	Harvested acres	1974	Harvested acres	
Thou. acres or head	*No.*	*Pct.*	*No.*	*Pct.*	
Total harvested cropland	11,410		12,629		+10.7
Wheat	3,904	34.2	5,687	45.0	+45.7
Other grain	1,890	16.6	1,419	11.2	−25.9
Hay	3,382	29.6	3,046	24.1	−9.9
Potatoes	300	2.6	464	3.7	+54.7
Vegetables	281	2.5	360	2.9	+28.0
Berries	36	0.3	25	0.2	−31.7
Orchard and vineyard	259	2.3	252	2.0	−2.3
Other crops	1,358	11.9	1,375	10.9	+1.3
Milk cows	483	–	391	–	−19.1
Beef cows	1,535	–	1,816	–	+18.3
Laying hens	7,550	–	7,408	–	−1.9
Sheep and lambs	1,844	–	1,207	–	−34.6

Source: (*9*).

total wheat acreage increase. Idaho had the largest expansion of irrigated wheat acreage.

Wheat acreage in the Northwest, as in other wheat-producing regions, is responsive to the wheat commodity program as well as to price. Because a high percentage of Northwest wheat is exported, acreage response is more sensitive to export than to domestic price changes. Changes in the wheat program, along with worldwide supply shortages and high prices, were responsible for the large acreage expansion. Northwest wheat acreage has remained at a high level since 1974, averaging 5.7 million acres during 1975-77.

Other grain, primarily barley, generally is produced as a secondary crop on wheat farms in the dryland area of the Northwest. Consequently, there is an inverse relationship between wheat and barley acreage, with an expansion of wheat acreage resulting in a contraction of barley acreage. This relationship is the main factor behind the decline in other grain acreage.

Growth in the acreage of intensive crops (those with high gross values per acre—mainly potatoes, vegetables, and orchard and vineyard crops) is responsible for the irrigated subregion's increasing share of the value of crop production. The gross value per acre from these crops is high relative to that of the more extensive grain and forage crops. For example, the gross value per acre of the 1978 late potato crop in the Columbia Basin was $1,195, compared with $289 for irrigated wheat. Potatoes were harvested from 7.4 percent of the irrigated acreage in the Columbia Basin but accounted for 20.9

percent of the crop value. Wheat, in contrast, was harvested from 15.8 percent of the irrigated crop acreage but accounted for 10.1 percent of total crop value.

The acreages of potatoes and vegetables in the Northwest have increased substantially, with all of the increased potato production and a large part of the vegetable increase occurring in the irrigated areas. Although the acreage of orchard and vineyard crops in the entire region changed little during 1964-74, it increased substantially in the irrigated area of Washington and declined in Oregon, primarily in the Willamette Valley. This was a movement of orchard acreage from one subregion to another within the Northwest. Because of the high values per acre of crops of these types, relatively small changes in acreage amount to substantial shifts in the shares of value of production.

In the western Washington-Oregon subregion, the major changes in cropland use have been contractions in perennial crop acreage and expansions of annual crop acreage.

In Oregon's Willamette Valley, the major crop-producing area of the subregion, tne amount of land in orchards and berries decreased by nearly 20 percent during 1969-74. while vegetable acreage increased by 25 percent and wheat acreage by over 200 percent. The large increase in wheat acreage was a response to the high prices in 1973 and 1974.

Production of horticultural specialty crops also has been increasing in the western Washington-Oregon subregion. Although the acreage devoted to horticultural specialties is small, 13,547 acres in the two States in 1974, the value of production per acre is very high. Nearly 10 percent of the gross value of 1974 total agricultural production in the subregion was from nursery and greenhouse products.

Changes in Farm Numbers and Size Distribution

The number of farms in the Northwest decreased by 35,149 (30.6 percent) during 1964-74. This decrease was common to all three major Northwest subregions (table 11). Over 60 percent of the decrease, however, occurred in the western Washington-Oregon subregion, the one having the largest percentage loss of farmland. Expanded farm size was a factor contributing to the decline in farm numbers. In all subregions, the decrease in number of farms exceeded the decrease in farmland acreage. The average number of acres per farm in the region as a whole increased from 477 in 1964 to 616 in 1974; by subregion the average change was: western Washington-Oregon–119 to 138 acres; intermountain irrigated area–652 to 740 acres; and dryland farming area–1,048 to 1,308 acres.

The decline in number of farms was common across the acre size

Table 11—Changes in number of farms, Northwest and subregions, 1964 and 1974

Subregions	1964	1974	Change
	No.	*No.*	*Pct.*
Western Washington-Oregon	50,592	28,612	−43.4
Intermountain irrigated area	47,694	38,717	−18.8
Dryland farming area	16,706	12,514	−25.1
Total Pacific Northwest	114,992	79,843	−30.6

Source: (9).

range. However, farms with smaller acreage declined proportionally more than larger farms, so the proportion of large farms increased (table 12).

Tenure and Ownership of Agricultural Resources

Nearly two-thirds of the farmland in the Northwest is owner-operated, and nearly 60 percent of the farmers are full owners. However, there are substantial variations in tenancy among the several types of farms in the region (table 13). Types of farms that require large investments in permanent improvements on the land, such as trees or buildings, have below-average ratios of rented-to-total land, while those that do not have high requirements for fixed improvements have above-average rented-to-total land ratios. Farms producing annual crops—such as cash grains, vegetables, and other field crops—have the highest proportions of rented land, and the lowest are on fruit and poultry farms.

Table 12—Distribution of farms by acre size, Northwest subregions, 1964 and 1974

Acre size	Subregion					
	Western Washington-Oregon		Intermountain irrigated area		Dryland farming area	
	1964	1974	1964	1974	1964	1974
	Percent of farms					
1-49	54.9	48.7	34.3	32.8	16.9	14.1
50-99	18.3	19.5	14.3	14.1	8.2	7.8
100-219	15.7	17.4	20.1	18.0	15.4	15.0
220-499	7.6	9.1	13.4	14.5	19.1	17.8
500-1,999	3.1	4.6	11.8	13.6	30.0	31.6
2,000 and over	0.4	0.6	6.2	7.1	10.5	13.7
Total[1]	100.0	100.0	100.0	100.0	100.0	100.0

[1] May not add to 100 due to rounding.
Source: (9).

Table 13—Tenancy on Northwest farms, 1974

Type of farm	Proportion of land rented	Tenancy status of farm operators		
		Full owner	Part owner	Tenant
		Percent		
Cash grain	44.4	41.0	42.7	16.3
Sugar crop, potato, hay, and other field crops	32.6	51.4	35.9	12.7
Vegetable	44.9	44.0	40.9	15.4
Fruit and tree nut	12.4	82.4	14.0	3.6
Horticultural specialty	27.4	79.6	12.4	8.0
General crop	35.2	48.8	41.6	9.6
Livestock except dairy, poultry, animal specialty	30.3	66.4	27.6	6.0
Dairy	25.1	59.3	32.9	7.7
Poultry	13.6	79.8	13.0	7.3
Animal specialty	25.3	80.5	12.0	7.5
General livestock	24.8	60.7	36.2	3.1
Farms not classified by SIC*	18.2	76.4	21.5	2.0
All farms	35.2	58.5	31.7	9.8

*SIC = Standard Industrial Classification.
Source: (*9*).

Part-owner farms are larger than either full-owner or tenant-operated farms. Average sales of Northwest part-owner farms in 1974 were $110,853, compared with $46,297 for full-owner farms and $79,302 for tenant-operated farms. The real estate value per farm was $398,140 on part-owner farms. On full-owner and tenant farms, land and building value was $144,434 and $230,969, respectively. Part-owner farms, although less than a third of all Northwest farms, account for over half of the region's farm sales and farm real estate value (table 14).

Form of Business Organization

In 1974, about 88 percent of Northwest farms were operated as sole proprietorships, 8 percent as partnerships, and 4 percent as

Table 14—Distribution of Northwest farm product sales and farm real estate value, by tenure of operator, 1974

Tenure status	Farm product sales	Farm real estate value
	Percent	
Full owner	38.7	36.2
Part owner	50.2	54.1
Tenant	11.1	9.7

Source: (*9*).

corporations. The sole proprietorships, however, controlled 70 percent of total farm real estate value and accounted for 60 percent of farm product sales value. Farms operated as corporations controlled nearly 15 percent of farm real estate value and accounted for one-fourth of farm product sales (table 15).

Corporate farms in the Northwest generate about 54 cents in sales per dollar of farm real estate assets, compared with 25 cents for sole proprietorships and 31 cents for partnerships. This difference results from more intensive use of resources by corporate farms and because they are more concentrated in intensive types of agriculture. Forty-one percent of corporate farms are classified as other field crop (primarily potato), fruit, horticultural specialty, or poultry farms—all intensive types of farming. These types of farms, however, are only 30 percent of all farms in the region.

Most of the corporate farms in the region are family-operated and differ from sole proprietorship and partnership farms primarily in that they are considerably larger. Family-operated farms are incorporated for several reasons, among which are facilitation of intergenerational transfer, tax advantages, and limited liability.

Although most corporate farms in the Northwest are family operations, there are several large-scale farming corporations in the region that concentrate on potato and grape production in the irrigated farming area. These large farms often are vertically integrated with processing and distribution operations.

PROFILES OF SELECTED NORTHWEST CROP FARMS

Profiles of several of the major types of crop farms in the Pacific Northwest are presented to characterize the operation of individual farms in the region. Profiles were developed for Washington cash grain and irrigated field crop and fruit farms, Idaho irrigated field

Table 15—Northwest farms, by form of business organization, 1974

Form of business organization	Farms	Farm product sales		Farm real estate value	
	Percent	Percent of total	Value per farm	Percent of total	Value per farm
			Dollars		*Dollars*
Sole proprietorship	88	60	48,116	72	191,049
Partnership	8	14	122,354	14	400,066
Corporation	4	25	455,080	14	827,875
All farms	100	100	70,006	100	233,373

Source: (*9*).

crop farms, and Oregon vegetable farms. Two sales classes for each farm type were treated—$100,000 and over gross sales and $40,000 to $100,000 (except the Washington fruit farm, for which the $20,000 to $40,000 sales class was used). Complete farm profiles are shown in table 16.

Major conclusions that can be made from the profiles are:

- There is little difference between large and small farms with regard to crop enterprises and land use.[3]
- Large farms have significantly higher per acre sales and returns to operator management, labor, and equity than small farms.
- The largest farms carry significantly higher debt loads than smaller farms.
- Sales and net returns to operator management, labor, and equity per dollar of owned assets are significantly higher on large farms.
- Annual operating expenses per dollar of sales are higher on small farms than on large farms.

These findings suggest that significant economies of size exist in most of the major farm types in the Northwest, and partially explain the increase in average farm size in all subparts of the region. The findings also suggest that the large farms make more efficient use of their resources than do the small farms. To verify the existence and determine the nature of economies and efficiencies related to farm size requires data on production technologies and practices employed and input and product market ties by size of farm. These data are not available. Because of innovations that have occurred in Northwest agriculture during the last 15 to 20 years, research on the impacts of recent technological innovations and market changes on farm size is necessary.

Assuming that farms with gross sales of $100,000 and over are representative of the "leading edge" Northwest crop farms, we can speculate on what the full-time commercial farm in the region may consist of in the future. Regardless of farm type, it will have the following characteristics:

- Total owned assets of $500,000 to $700,000[4], real estate assets of $400,000 to $500,000, and other assets of $100,000 to $200,000.
- Total debt of $75,000 to $150,000.

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[3]The exception is Washington and Idaho irrigated field crop farms, where the large farms are primarily potato farms and the small farms alfalfa hay farms.

[4]The values shown here were derived from data reported in the 1974 Census of Agriculture and consequently are low in relation to current values. This is particularly true in the case of real estate assets. The real estate values reported in the Census probably are closer to the current owner's acquisition value than to current market value, which may be two to three times higher than the value reported.

Item	Washington cash grain		Wash. irrigated field crop		Idaho irrigated field crop		Washington fruit		Oregon vegetable	
	$100,000 & over	$40,000-$99,999	$100,000 & over	$40,000-$99,999	$100,000 & over	$40,000-$99,999	$100,000 & over	$20,000-$39,999	$100,000 & over	$40,000-$99,999
					Acres					
Land Inventory										
Total acres operated	2,900	1,330	960	400	1,140	380	215	65	590	150
Cropland acres	2,070	930	630	240	840	270	160	35	480	125
Acres harvested	1,300	530	570	200	740	220	150	25	440	100
Cropland not harvested	770	400	60	40	90	50	10	10	40	25
Pasture, range, woodland	785	390	310	155	290	100	25	25	80	20
Other land	45	10	20	5	40	10	30	5	30	5
Land tenure										
Acres owned and operated	1,370	660	540	260	820	260	200	60	340	100
Acres rented in	1,595	720	460	160	390	135	30	10	260	55
Acres rented out	65	50	40	20	70	15	15	5	10	5
Crop enterprises										
Wheat	1,050	440	160	50	170	40			115	20
Other grains	200	65								
Hay & field seeds			90	120	120	90			30	5
Potatoes			110		200	30				
Vegetables									255	70
Orchard							135	20		
Other crops	50	25	210	30	250	60	15	5	40	5
					Dollars					
Assets										
Land owned	378,840	169,690	386,860	157,360	517,090	157,300	436,020	96,590	298,900	124,426
Machinery & equipment	96,900	48,000	108,960	41,140	121,960	44,840	61,190	15,470	86,980	38,870
Livestock	11,650	5,890	16,140	7,950	21,160	9,600	1,200	600	5,290	1,800
Total owned assets	487,390	223,580	511,960	206,450	660,210	211,740	498,410	112,600	391,170	165,096

(Continued)

Table 16—Profiles of major types of crop farms, Northwest, 1974—*Continued*

Item	Washington cash grain		Wash. irrigated field crop		Idaho irrigated field crop		Washington fruit		Oregon vegetable	
	$100,000 & over	$40,000-$99,999	$100,000 & over	$40,000-$99,999	$100,000 & over	$40,000-$99,999	$100,000 & over	$20,000-$39,999	$100,000 & over	$40,000-$99,999
					Dollars					
Debt										
Real estate	49,400	19,080	76,410	29,000	73,510	20,930	78,380	13,440	52,440	14,040
Nonreal estate	22,000	6,890	40,810	7,800	48,690	8,310	36,320	3,180	19,430	4,250
Total	71,400	25,970	117,220	36,800	122,200	29,240	114,700	16,620	71,870	18,290
Value of sales										
Grain	188,800	60,570	50,310	10,200	63,900	11,250			23,080	4,660
Field seeds and hay			40,740	33,900	19,750	11,650			5,240	540
Other field crops			280,000	17,600	246,620	35,370			19,820	840
Vegetables									166,180	53,340
Fruit							216,000	27,060		
Other crops	11,100	2,870	14,620	1,760	5,850	1,480	4,550	530	11,070	2,800
Livestock	7,000	2,760	7,200	3,370	13,210	5,250	880	310	1,530	940
Total sales	206,900	66,200	392,870	66,830	349,300	65,000	221,430	27,900	227,020	63,120
Gross/acre	71.34	49.77	409.24	167.08	306.40	171.05	1,029.91	429.23	384.78	420.80
Crop sales/acre harvested	153.77	119.70	511.50	317.30	454.18	271.59	1,470.33	1,103.60	512.25	621.80
Production expense										
Variable cash crop expense	100,000	33,340	242,150	37,720	200,260	34,490	158,520	16,930	136,240	37,720
Variable cash livestock expense	4,000	1,780	5,920	2,080	8,120	3,000	540	230	1,035	845
Land rental	42,360	19,120	29,845	10,380	26,110	9,040	1,080	360	15,315	3,240
Landownership	7,790	3,500	6,930	2,810	6,690	1,950	5,920	1,100	4,370	1,190
Machinery & equipment ownership	12,110	6,000	13,620	5,140	15,245	5,605	7,650	1,930	10,870	4,860
Total expense	166,260	63,740	298,465	58,130	256,425	54,085	173,710	20,550	167,830	47,855

(Continued)

Table 16—Profiles of major types of crop farms, Northwest, 1974—*Continued*

Item	Washington cash grain		Wash. irrigated field crop		Idaho irrigated field crop		Washington fruit		Oregon vegetable	
	$100,000 & over	$40,000-$99,999	$100,000 & over	$40,000-$99,999	$100,000 & over	$40,000-$99,999	$100,000 & over	$20,000-$39,999	$100,000 & over	$40,000-$99,999
					Dollars					
Returns to operator labor, management and equity										
Total return	40,640	2,460	94,406	8,700	92,875	10,915	47,720	7,350	59,190	15,265
Crop return	37,640	1,480	93,125	7,410	87,785	8,665	47,380	7,270	58,595	15,170
Total return/acre	14.01	1.85	98.34	21.75	81.47	28.72	221.95	113.80	100.32	101.77
Crop return/harvested acre	28.95	2.79	163.38	37.05	118.63	39.39	315.87	290.80	133.17	151.70
Other income										
Net farm related	1,870	960	4,260	1,420	3,350	1,060	720	230	2,700	840
Nonfarm	2,680	3,190	2,320	3,350	2,670	2,230	5,820	7,260	2,250	3,390
Total other income	4,550	4,150	6,580	4,770	6,020	3,290	6,540	7,490	4,950	4,230
Total operator income	45,190	6,610	100,986	13,470	98,895	14,205	55,260	14,840	64,140	19,495
					Number					
Number of farms represented	1,633	1,814	754	449	1,171	1,026	450	880	261	194

- Total sales of $200,000 to $400,000, and primary commodity sales of $175,000 to $300,000.
- Returns to operator management, labor, and equity of $50,000 to $100,000.

About 15 percent of all Northwest farms were in the $100,000 and over sales class in 1974 and accounted for over two-thirds of the value of the region's farm output.

FACTORS AFFECTING RESOURCE ORGANIZATION

Many factors affect the organization of agricultural resources and structure of farming in the Northwest. Largely, these are the same factors that affect farming in other regions of the country. Because of the unique characteristics of the Northwest, however, the relative importance of these factors may differ substantially from other regions. For example, the importance of irrigated agriculture places water resource policy in a much more important position relative to the growth and development of the region's agriculture than to the agriculture of the Nation as a whole. Some of the important factors that have impacted on the Northwest's agriculture in the past or will have major roles in directing its future development include:

- Federal and State water resource policies.
- Federal commodity programs.
- Technology.
- Federal labor policies.
- Population growth and urbanization.
- Location of major markets.

Water Resource Policies and Programs

Over half of the irrigated acreage in the intermountain portion of the Northwest was developed via Bureau of Reclamation projects. Consequently, Federal water resource policies and programs have been of major importance in the development of this part of the region. The Reclamation Act of 1902 is the basis for Federal water policy in the Western States.

Provisions of the Act that affect the structure of farming concern acreage limitations on farm owners and operators—limitations on leasing and residency requirements. A basic intent was to develop a system of small owner-operated family farms in the irrigated parts of the Western States. The maximum individual ownership unit generally has been established at 160 acres. However, operating units may exceed 160 acres, since separate ownership units may be acquired for each member of a family. Farm operators are allowed to lease up to

160 additional acres per individual. Through ownership and leasing, a married farm operator with no children can operate up to 640 acres within the rules and regulations of the Bureau of Reclamation.

Although the Bureau of Reclamation recently became involved in a controversy regarding enforcement of Reclamation Act provisions concerning allowable size of ownership and operating units and residency requirements, reclamation projects in the Northwest generally have adhered quite closely to legal restrictions.[5] Data on the number and size distribution of operating and ownership units in the Columbia Basin Project in Washington are shown in tables 17 and 18. These distributions probably are representative of other projects in the region. Federal water resource policies have thus been a major factor in the development of arid portions of the Northwest, and in determining the structure of irrigated agriculture in the region.

Further development of the intermountain irrigated areas of the Northwest depends on the direction of Federal water policies. Federal water resource development appears to be in a state of retrenchment. Several water projects in the West, although none in the Northwest, have been canceled or scaled down, and a 1977 Administration ruling placed future water projects on a strict cost-accounting basis.[6] Future irrigation projects may be deferred. Although the impact of this shift in Federal water policy will not be as immediate or severe in the Northwest as in other western regions, it does signal the eventual phasing out of Federal reclamation projects in the region. This could slow the growth of irrigated agriculture.

Table 17—Number and size of farming operations, Columbia Basin Project, 1958, 1965, 1968, and 1973

Irrigable acres	Number of farms			
	1958	1965	1968	1973
Less than 80	566	319	306	428
80 to 160	995	950	806	823
161 to 319	377	641	633	633
320 to 640	76	244	317	330
641 to 999	12	35	42	53
1,000 or more	0	12	21	23
	2,026	2,201	2,125	2,290

Source: (*8*).

[5] *The U.S. Department of the Interior's Proposed Rules for Enforcement of the Reclamation Act of 1902: An Economic Analysis*, U.S. Department of Agriculture, Economics, Statistics, and Cooperatives Service, ESCS-04, February 1978.

[6] In 1977, there were over 816,000 acres of irrigable land in Bureau of Reclamation projects in the Northwest that were not yet receiving water (*12*).

Table 18—Number and size of landownership units, by irrigation district, Columbia Basin Project, 1976

Irrigation district	Number of owners	Acres per owner
East Columbia Basin	2,775	48
South Columbia Basin	1,776	106
Quincy-Columbia Basin	1,980	115
USBR Well Licensing Program*	144	200
Total Columbia Basin	6,675	87

*USBR = U.S. Bureau of Reclamation.
Source: (8).

Assuming that Federal water development in the region ceases, the alternatives are either a severe slowing of the region's development or an increase in private irrigation development. The latter would foster a farm structure dominated by large-scale corporate farms, which is vastly different from the moderate-size family farm structure promoted through Bureau of Reclamation development. Policies of the three States generally have been conducive to the development of their water resources, particularly in the Columbia-Snake River system. The three States are more abundantly endowed with water resources than are other Western States, particularly those in the Southwest. There is a strong incentive for the Northwest to rapidly develop its water resources internally to prevent potential appropriation of Northwest water by States to the south. In light of these policies and needs, the three Northwest States have not discouraged private development of large-scale irrigated farming operations. Several large-scale irrigated farms, up to 20,000 acres or more, have been developed by private interests along the Columbia and Snake Rivers in south-central Washington and north-central Oregon. The State of Washington has reacted to the rapid development of large-scale farming operations in the area by establishing a 25-year limit on individual permits for irrigating more than 2,000 acres. Oregon has not initiated any policies to restrict or regulate large-scale private irrigation development, but it has passed legislation to allow for State bonding of private water development.

Federal Commodity Programs

Federal commodity programs have affected the structure of Northwest agriculture by reducing risk and influencing the acreage and mix of crops grown on farms in the region. Wheat, barley, and sugar beets are the main commodities produced in the Northwest that are or have been subject to Federal commodity programs. Wheat is produced as the primary crop on dryland farms, and as a rotation crop on irrigated farms. Barley usually is produced as a secondary crop on dryland farms, while sugar beets are produced exclusively on irrigated farms.

Of the three programs, the wheat program has had the most impact on farm structure in the region through its effect of reducing price risk. Price stability resulting from the program has created an environment that is conducive to increasing farm size, given that other size-increasing factors are favorable.[7] Consequently, although technological factors–such as the introduction of the four-wheel-drive tractor–have motivated farm enlargement in the Northwest dryland farming area over the past decade, the wheat program has provided the stability needed to encourage farmers to undertake the financial investment for farm expansion.

Because barley is produced primarily as a secondary crop in the Northwest, the feed grain program probably has had little impact on changing farm size. Its most important effect would be on the crop mix on dryland farms, as the level of barley production is a function of the relationship between the wheat and barley programs.

Under the sugar program which was in effect through 1973, sugar beet allotments were distributed through processors by production contracts with growers. Consequently, the program's impact on farm structure was indirect. Its major effects in the Northwest were to increase crop diversification by providing an alternative cash crop and, because of a virtually guaranteed price and market, improve farmers' access to debt capital. The loss of sugar beet production in Washington and a large part of Idaho due to the closing of three sugar beet refineries after the 1978 season apparently has had little effect on farm structure in the area. The slack created by the closings has been absorbed by increased acreages of other commodities.

Federal Labor Policies

Many of the crops produced in the Pacific Northwest are labor-intensive. Tree fruit and berry crops particularly require large amounts of harvest labor. Consequently, the region is more sensitive to Federal policies concerning the use of migrant and child labor on farms than most agricultural areas. Recent policies regulating and restricting the employment of foreign farm workers and children as fruit and berry pickers have resulted in spot labor shortages, and are causing some restructuring of the region's agriculture.

The most prominent example of restructuring brought about by labor policies is the berry industry in Oregon's Willamette Valley.

[7] Since very little wheat land in the region is available for purchase, most farm expansion occurs through leasing.

Children 12 years of age and under traditionally have picked a high proportion of the strawberries and cane berries such as (raspberries and blackberries) produced in the Valley. In the early 1970's, the Labor Department ruled that children under 12 years of age could not be employed as farm laborers, including berry pickers. This caused reduction in the supply of berry pickers and forced growers to look for alternative methods of harvesting their crops. A mechanical picker has been perfected for harvesting cane berries, but strawberries still are picked by hand. A mechanical strawberry picker has been developed, but varieties grown in the area are not adaptable to mechanical harvest. Work is continuing on developing strawberry varieties that can be harvested mechancially.

As a result of the labor shortage and competition from California and Mexico, strawberry production has declined. A large portion of the remaining strawberry acreage is harvested by consumers on a pick-your-own basis. The initial investment (about $30,000) and capacity (35 to 40 acres) of the mechanical cane berry harvester preclude its use on small berry patches, with the result that many small berry growers must decide to expand, drop berry production, or convert to a pick-your-own operation.

Technology

Technological innovation probably has been the most pervasive of all the forces affecting the structure of agriculture in the Pacific Northwest. Important innovations include tractor and machinery technology, irrigation technology, plant breeding, introduction of new crop storage, and food processing. As an example of how technology has affected Northwest agriculture, the effects of technology on the growth and development of the potato industry in the region are examined. And some of the more important innovations in other sectors of Northwest agriculture are highlighted.

During 1950-77, potato acreage in the Northwest increased 127 percent, from 231,000 to 525,000 acres, while production increased 357 percent, from 45.5 million to 162.7 million hundredweight. The region's share of total potato production increased from less than a fifth to nearly half of the national total (table 19).

Development of processes for manufacturing dehydrated and frozen potato products, which opened a new market for potatoes, was the key factor in the expansion of the Pacific Northwest potato industry. During 1957-75, the quantity of potatoes processed increased from 41 million hundredweight to 154 million hundredweight (table 20). Without technological innovations and growth in food processing, the Northwest potato industry could not have expanded nearly as rapidly or as much as it did. The region is at a

Table 19—Northwest potato production, 1950-77

Year	Production	Acres harvested	Yield	Share of U.S. production
	Thou. cwt.	*Thou. acres*	*Cwt per acre*	*Pct.*
1950	45,551	231	196.8	17.6
1960	60,991	304	200.3	23.7
1970	123,479	467	264.1	37.9
1977	162,699	525	309.6	46.2
1975-77 average	162,336	520	312.1	47.2

competitive disadvantage in relation to other potato-producing areas for fresh potatoes due to its greater distance from major markets in the East and Midwest. At the same time, it has a comparative advantage in processed potato products, which has been the growth area of the industry for the last 20 years.

Although technological innovations in food processing provided the market basis for the expansion of the Northwest potato industry, other direct innovations in farming provided the means by which it was accomplished. These included bringing new land under irrigation and the introduction of new irrigation techniques, the development of mechanical harvesting and bulk handling methods, and controlled-atmosphere potato storage.

The expansion of potato acreage in the Northwest was made possible by growth of irrigation in the region. During 1950-74, land under irrigation increased by 1.7 million acres. Most of the increase occurred in the intermountain area. During 1950-65, the increase in irrigated acreage was developed primarily through Federal irrigation projects. Since 1965, however, private development has been responsible for a larger part of the increase in irrigated land. Potatoes—commonly produced in a rotation with alfalfa, sugar beets, and wheat—were a major cash crop on much of this newly irrigated land. In the Columbia Basin project in Washington, where considerable potato

Table 20—Fresh and processed potato utilization, United States, 1957-75

Year	Fresh	Processed (fresh weight)
	Thousand cwt.	
1957	148,408	41,256
1960	149,199	59,150
1965	139,542	100,179
1970	129,809	136,574
1975	112,512	153,812

Source: (*6*).

Table 21—Columbia Basin Project, value and irrigated acreage of major crops, 1974

Crop	Value	Irrigated acres
	Percent	
Late potatoes	18.7	5.9
Early potatoes	5.2	1.8
Sugar beets	18.7	7.2
Alfalfa hay	16.0	28.2
Alfalfa seed	2.8	3.0
Wheat	17.9	27.8
	79.3	73.9

Source: (*11*).

acreage expansion occurred, these four crops accounted for four-fifths of the 1974 crop value and three-fourths of the irrigated acreage (table 21).

New technology, specifically the center-pivot sprinkler system, has brought sizeable acreages under irrigation that could not be irrigated using previous technologies such as rill irrigation or hand-move and wheel-move sprinkler systems. New technology also is a factor in the increasing size of Northwest irrigated farms. Much of the new land that has been brought under irrigation is not well suited to older irrigation technologies because of soil texture or topography. Much of the new land is of a very sandy nature, and the center-pivot technology is the only practical means of applying sufficient water for crop production. The light, sandy soil is very productive potato land—if it can be kept wet; potato yields approaching 30 tons per acre can be obtained using center-pivot sprinkler irrigation. Consequently, large acreages of potatoes are produced on land that could not be profitably farmed with other irrigation technologies.

The center-pivot system is not competitive with other irrigation technologies on farms of less than 640 acres (*3*). However, substantial economies of size apparently can be achieved on larger farms with center-pivot irrigation, and the more intensive crops such as potatoes tend to be grown on the larger farms.

The Northwest was one of the first major potato-producing areas to adopt bulk harvesting and handling methods in the early fifties. The old harvesting system required large amounts of manual labor for hand-picking potatoes off the ground into sacks and loading the sacks onto flat-bed trucks for hauling to storage. In the bulk system, potatoes are dug and mechanically loaded into trucks in one operation and stored in bulk. This eliminated a large amount of labor both in the field and the storage facility.

Large-capacity, controlled-atmosphere potato storage has extended the growers' marketing season and decreased their vulnerability to seasonal price variations. Because potato quality can be maintained over a longer storage season in controlled-atmosphere storage than in common storage, high-quality potatoes can be delivered to fresh market or processing plants throughout the year. This has resulted in expanding producer marketing options, lengthening the processing season, and generally increasing the overall stability of the Northwest potato industry. Most larger growers in the region operate their own controlled-atmosphere storages.

The net impact of the technological innovations adopted by the Northwest potato industry has been to transform potato production from a labor-intensive to a capital-intensive operation. This has resulted in increasing the size of potato enterprises in the region. The large capital investment required for potato production and the necessity for operating fixed machinery and facilities at capacity to keep per unit production costs as low as possible have led growers to increase acreage. In Grant County, Wash., a leading potato-producing area, the average potato enterprise nearly doubled in size during 1969-74—from 111 to over 200 acres. Similar size increases have occurred throughout the region.

The growth of potato processing in the region has led to a high proportion of the potatoes being produced under contract to processors. In addition, several processors grow potatoes to supply their plants.

This food processing industry is a leading growth industry in the irrigated area of the Northwest and a major factor in its overall economic development. An additional impact of the expansion of the potato industry has been the development of a commercial cattle feeding and processing industry that utilizes byproducts of potato processing plants and alfalfa grown in rotation with potatoes as feed ingredients. Individuals and firms in the potato industry were heavily involved in the development of cattle feeding in the region.

Technological developments have had important impacts on the structure of other commodity subsectors in the Northwest. In the region's fruit industry, the most important innovations have been controlled-atmosphere storage of apples and the planting of dwarf apple trees. These two innovations have greatly increased the competitive position of the Northwest apple industry relative to other regions, nearly tripling apple production in the region since 1970 and increasing the size of fruit farms.

Controlled-atmosphere storage extends the storage life of apples and consequently the apple marketing season. Dwarf trees, which are planted at much higher densities than standard apple trees, improve yields per acre; reduce the amount of labor required for cultural and harvest operations; and bear at an earlier age than large trees.

The introduction of mechanical pickers for harvesting raspberries, blackberries, and other cane berries may alter the structure and composition of the Northwest berry industry. This restructuring could involve increasing the size of berry enterprises and a relative shift away from strawberries, which still are hand-harvested. Cane berries usually are grown in small plots, generally less than 10 acres. Present mechanical harvesters have a capacity of 30 to 40 acres per season, which should become the minimum size berry enterprise as the adjustment to this innovation proceeds.

The mechanical grape harvester, a recent innovation, has facilitated the rapid growth of production in the Northwest over the last decade. Grape production in the region, primarily in Washington, has about doubled since 1970.

The four-wheel-drive tractor is a key technological factor that may lead to the enlargement of Northwest dryland wheat farms. Significant economies can be attained with this tractor on farms considerably larger than the typical current Northwest wheat farm (*5*).

Market Location

The distance of the Northwest from major population centers of the Midwest and Northeast has been a major determinant of the types of farm commodities grown in the region. Transportation costs to move Northwest products to markets in the Midwest and East are greater than for products produced closer to these markets. Consequently, the Northwest is a major supplier to national markets of only those commodities in which it has a sufficient advantage over competing regions in production to overcome this transportation differential. Apples and potatoes are the most important commodities to the agricultural economy of the Northwest that are in this category. Other commodities include pears, cherries, field seeds, and several specialty commodities. This commodity mix, in turn, has been an important factor in the structural development of Northwest agriculture, influencing farm size and the development of regional marketing institutions and strategies.

Comparison of the highway mileage from the Northwest with the mileage from competing producing areas to major markets for Northwest apples and potatoes illustrates the Northwest's locational problems (table 22).

Of the major production regions for apples and potatoes, the Northwest is the only one that has developed nationwide markets. The competing areas are oriented toward regional marketing. Maine potatoes, for example, are distributed almost exclusively along the eastern seaboard; Red River Valley potatoes are distributed in Midwest markets. A similar situation exists for apples, with few

Table 22—Approximate mileage from Northwest and competing shipping points to selected markets for apples and potatoes

Commodity and shipping point	Market				
	Chicago	New York	Houston	Los Angeles	Seattle
	Miles				
Apples:					
Wenatchee, Wash.	1,890	2,690	2,180	1,130	130
Grand Rapids, Mich.	190	930	1,250	2,260	2,200
Kingston, N.Y.	890	90	1,700	2,850	2,910
Potatoes:					
Boise, Idaho	1,680	2,470	1,790	850	500
Fargo, N.D.	630	1,440	1,310	1,820	1,380
Presque Isle, Maine	1,410	660	2,270	3,420	3,400

eastern apples moving west of the Mississippi River. Consequently, in areas other than Pacific coast markets, Northwest apples and potatoes must compete with nearby production for market outlets. This competition for markets and the distance of the Northwest from large population centers have been major factors in shaping the institutional arrangements and marketing strategies of the Northwest agricultural sector.

To achieve market penetration, Northwest agriculture, and especially its potato and fruit subsectors, have relied heavily on market promotion and advertising. Several commodity-oriented institutions have been established under legislative authority to coordinate and carry out this promotional activity. The more well-known agencies include the Idaho Potato Commission, Washington State Apple Commission, and Oregon, Washington, California Pear Bureau. Through the activities of such organizations, Northwest farmers have been able to achieve a degree of product differentiation for some of their major commodities. Advertising and promotional budgets run into the hundreds of thousands of dollars annually and include broadcast, print, and point-of-sales media. Promotional activities normally are funded through a checkoff procedure under which shippers are charged a predetermined fee on each unit of product shipped.

For such promotional efforts to be successful, however, a high level of product quality must be maintained. To this end, States in the region have developed comprehensive programs to regulate the grade and quality of produce shipped out. The institutions that have been established to administer these programs are an integral part of the structure of Northwest agriculture.

Marketing strategies for Northwest apples and fresh potatoes have been developed to lengthen the season over which shipments occur,

Table 23—Seasonal distribution of fresh apple shipments, 1976-77 marketing season

Months	Shipments	
	Northwest	Other regions
	Percent	
September-November	23.1	39.8
December-February	31.7	32.6
March-May	29.2	22.8
June-August	16.0	4.8

Source: (7).

and to equalize product flows over the marketing season. As a result, Northwest marketings of both apples and potatoes extend over a longer season and have less seasonal fluctuation than marketings from competitive regions (tables 23 and 24). The stability of supplies from the Northwest is a major reason behind the region's emergence as the dominant national supplier of apples and potatoes.

For most other fresh fruits and vegetables produced in the region, the Northwest is largely a regional supplier with a rather short shipping season. Its location and the coincidence of its growing season with other areas that are nearer population centers have prevented the region from being a strong national competitor.

The Northwest is favorably located with respect to export markets in the Far East. The shortest ocean routes between the United States and major Far East markets for U.S. agricultural commodities are from Northwest ports, which also are close to the Northwest production areas.

Wheat is the primary export commodity produced in the region. About 90 percent of the wheat produced in the region is exported, with the bulk of it destined for Japan and other Far East markets.

Northwest wheat is not competitive with wheat produced in the

Table 24—Seasonal distribution of fresh potato shipments, 1976-77 marketing season

Months	Shipments		
	Northwest	N. Dakota, Minnesota	Maine
	Percent		
August-October	25.6	20.7	9.1
November-January	27.1	35.9	37.4
February-April	30.2	40.9	41.5
May-July	17.1	2.5	12.0

Source: (7).

Great Plains. The major domestic use of Northwest wheat is in the production of cake flour, rather than bread flour. However, it is well suited to the manufacture of wheat products consumed in Japan and other Asian countries. Because of this export demand and the financial strength of producers, which enables them to establish higher reservation prices, Pacific Northwest wheat generally sells at a premium above wheat from other major production areas.

Export markets are being developed for other Northwest farm products. Alfalfa pellets are being exported to Japan for use in poultry feed. Japan also is a promising market for Northwest fresh fruit. Limited quantities of cherries exported to Japan in the last few years have been well received by consumers, and several shippers have organized the Northwest Fruit Exporters to develop this market (*13*).

Population Growth and Urbanization

Population growth affects agriculture in two ways. First, it increases the demand for nonfarm uses of agricultural resources, particularly land. Second it increases the total demand for farm food and fiber products. Both of these effects are apparent in the Northwest.

Since 1950, the rate of population growth in the Northwest has been slightly above that of the entire United States. During 1950-70, the population of the three Northwest States increased by about 39 percent, compared with 35 percent for the United States. During 1950-60, the population of the Northwest increased at about the national average, but has exceeded the national rate since 1960 (table 25).

Nearly all population growth in the Northwest has been in urban areas. The region's urban population increased by two-thirds during 1950-70, compared with about a 2 percent growth in rural areas. As a

Table 25—Population change, Northwest and United States, 1950-78

Year	Pacific Northwest		United States		Pacific Northwest
	Population	Change from 1950	Population	Change from 1950	Percent of United States
	Thousand	*Percent*	*Thousand*	*Percent*	
1950	4,477		151,000		3.0
1960	5,276	+17.8	180,007	+19.1	2.9
1970	6,213	+38.8	203,305	+34.6	3.0
1978 (est.)	7,096	+58.5	218,059	+44.3	3.3

Source: (*10*).

result, the population mix changed from less than 60 percent urban in 1950 to over two-thirds urban in 1970. Although current data on the urban-rural mix are not available, trend projections of the urban and rural growth rates indicate that the current population is nearly three-fourths urban (table 26).

Urban expansion has been greatest in the western parts of Washington and Oregon, although it also has occurred in other parts of the region. It is a major factor behind the decrease in the agricultural land base in the western Washington-Oregon area. The agricultural land base decreased by a third in this area during 1964-74, and its share of the region's total agricultural land decreased from 11 percent to 8 percent.

The rapid population growth west of the Cascade Mountains has created problems related to the transition from agricultural to nonagricultural uses of land and to conflicts between farm and nonfarm interests arising from certain cultural practices used by farmers. Problems resulting from urban expansion into agricultural areas have been most apparent in Oregon's Willamette Valley, the principal farming area in the subregion. Several counties in the Valley with high population growth rates have instituted restrictions and zoning regulations on the subdivision of agricultural land. In some instances, minimum lot sizes have been established that are too large for residences but too small for farms. Much of this former farmland is now idle. Agricultural extension agents in these counties indicate that much of their efforts now are devoted to working with residents who are trying to develop agricultural enterprises suitable to small acreages. In many cases, the enterprises recommended require more time and effort than the residents are willing or able to devote on a part-time farming basis. This type of development is taking land out of farming, despite statewide land-use planning and agricultural zoning.

A major and continuing urban-farm conflict in the Valley has come about as a result of farmers burning grass fields for weed, disease, and rodent control. Grass seed production is a major agricultural industry in the Valley, and burning-off of straw and stubble after harvest is the only practicable technology for controlling diseases and pests. However, the practice creates considerable air pollution which, at times, has bothered residents of some of the cities in the Valley. This has resulted in several court suits being brought against grass farmers by the cities. Restrictions placed on burning limit the total number of acres that can be burned each season and regulate the timing of burning so that it can take place only when wind and air conditions are such that excessive pollution will not occur.

Until now, the burning restrictions have had only a negligible

Table 26—Northwest urban and rural population distribution by subregion, 1950-78

Subregion	Year											
	1950			1960			1970			1978[1]		
	Population	Urban	Rural	Population	Urban	Rural	Population	Urban	Rural	Population	Urban	Rural
	Thousand	*Percent*		*Tousand*	*Percent*		*Thousand*	*Percent*		*Thousand*	*Percent*	
Western Washington and Oregon	2,954	62.0	38.0	3,432	68.9	31.1	4,389	73.9	26.1	NA	NA	NA
Irrigated farming area	1,010	45.9	54.1	1,151	50.0	50.0	1,206	53.7	46.3	NA	NA	NA
Dryland farming area	513	54.3	45.7	582	58.6	41.4	617	61.2	38.8	NA	NA	NA
Northwest	4,477	57.5	42.5	5,276	63.6	36.4	6,213	68.7	31.3	7,096	72.2	27.8

NA = not available.
[1] Estimate.
Source: (*10*).

impact on grass seed production, primarily because the industry has been able to obtain waivers on the acreage limitations. Field burning continues to be a major point of contention between urban and farm interests, however. Given the current farm-urban political balance, burning will continue at about its present level. Continued growth of urban political influence, however, could result in significant reductions in the number of acres that may be burned. Much of the land currently producing grass seed has very limited alternative agricultural uses. Consequently, the field burning conflict holds the potential for taking a sizeable acreage out of agricultural production in the Willamette Valley.

Population growth in the Pacific Northwest has been important in increasing the size of local and nearby markets for its agricultural output, partially offsetting regional locational disadvantages. During 1970-78, the Northwest's population increased by 14 percent and that of the entire West by 15 percent, about double the national rate of population growth. As a result of this westward population shift, the area in which the Northwest has a locational advantage for many of its agricultural products has become a major market.

IMPLICATIONS FOR THE FUTURE

The factors outlined in the preceding section will be the major determinants of the future shape of the Northwest's agricultural sector. Water resource policies, population growth, market development, and interregional competition appear to be the critical factors that will influence the future development and structure of agriculture in the region.

Water Resource Policies

Changes in Federal water resource policy, specifically the requirement that new projects be cost effective, may result in a larger proportion of future irrigation development being undertaken by private interests. Because of the large investment required to build water delivery systems, most private irrigation developments in the Northwest involve large blocks of land. Irrigated farms in the region currently using privately developed water sources range in size from about 2,000 to over 20,000 acres. The capital investment in such farms may amount to several million dollars, which is beyond the reach of all but the wealthiest persons. Such farms normally are developed and operated as large-scale corporate ventures. Consequently, the change in direction of Federal water policy, which in the past has promoted a family farm structure in the Northwest's irrigated subregion, could foster a marked increase in large-scale corporate farming ventures.

Another aspect of Federal policy which may affect the structure of farming in the irrigated subregion is the current debate over enforcement of the Reclamation Act's acreage limitation provisions. Although the size of farm ownership and operating units in Federal projects in the Northwest generally are within the Act's limitations, the number of relatively large farms in these projects has been increasing while the number of farms of 160 acres or less has been declining. Advances in irrigation technology are a major factor behind this increase. If a policy of strict enforcement of the current acreage limitations of Federal irrigation projects is adopted, it could further impede farm enlargement and curtail the adoption of new innovations.

Alternatively, a compromise policy may be adopted that would preserve the family farm character of the projects, while allowing individual farm operating units to attain a size sufficient to capture any economies of size and efficiencies inherent in new technological innovations. If the latter type of policy is adopted, which appears most likely, the trend toward larger farms in Federal irrigation projects in the Northwest will continue.[8]

An increase in the size of farms in the irrigated subregion, whether due to the growth of large-scale farms with privately developed water sources or to an increase in the number of larger farms in the Federal irrigation projects, likely will cause a change in the crop mix produced in the subregion. This is because the more intensive, high-value crops such as potatotes, sugar beets, vegetables, and seed crops tend to be produced by the larger farm operators. The 1978 crop summary report for the Federal Columbia Basin Project, for example, shows that over 60 percent of the project's irrigated acreage was used in the production of extensive grain and forage crops (*11*). These crops accounted for just over one-third of the total value of all crops produced in the project. On the other hand, the available information, admittedly sketchy and incomplete, indicates that as much as 70 percent of the land operated by privately developed, large-scale farms is devoted to intensive crops.

The difference in crop enterprise mixes of large and smaller farms is indicated by the farm profiles for Northwest irrigated field

[8]The U.S. Senate recently passed the Reclamation Reform Act of 1979 (S12593, September 14, 1979). The key provisions of this Act increase the allowable size of farm operating units to 1,280 acres and eliminate the residency requirement for farm operators in Bureau of Reclamation projects. At the time of this writing, the House had not voted on a reclamation bill. However, the bill passed by the Senate, although not the final word on the matter, indicates the direction toward which the structure policy of Federal irrigation projects may be heading.

crop farms (table 16). If past cropping patterns on large and small farms in the subregion are indicators of the future, increasing farm size will cause an increased level of production of intensive crops and a reduction in the production of the more extensive grain and forage crops.

A shift to a more intensive crop mix as a result of increasing farm size would affect the level of economic development and activity in the nonfarm economy of the irrigated subregion. The intensive crops are the mainstay of the food processing industry which is developing in the subregion and is its leading manufacturing industry. Increased production of these crops, which would come from larger farms, would result in an expansion of this industry and an increase in nonfarm employment and economic activity.

The food processing industry has experienced rapid development and expansion in areas where the farm structure is dominated by large-scale operations. The city of Boardman, Oreg., which is located in such an area, is fast becoming a major food processing center. Boardman currently has a population of about 2,000, with growth to about 20,000 anticipated. Such growth will derive from expansion of the food processing industry and associated activities. This relationship between farm size and community development is contrary to the findings of previous studies that have shown an inverse relationship between farm size and community development (*1, 4*).

A USDA analysis of the impacts of strict enforcement of the Reclamation Act's acreage limitations in the Columbia Basin Project concluded that: "Several potential adjustments in the local economy with enforcement of the proposed rules seem to be offsetting, leading to a tenative conclusion that overall community impacts would not be significant. Some decreases in employment and economic activity could accompany the reduction of large farming operations and less production of the more intensive crops and local food processing. Conversely, more farm families would enlarge the population and increase the demand for private and public services" (*8*).

This conclusion does not support the finding of an inverse relationship between farm size and overall community development, but rather indicates a tradeoff between urban and rual growth as farm size changes. The Boardman example illustrates, however, that community impacts associated with a large farm structure can be quite large and more than offset possible negative effects of a smaller farm population. At least in the Northwest irrigated subregion, there may be a positive relationship between farm size and community development, due primarily to an enterprise mix on the larger farms that generates substantial off-farm industrial activity.

Market Development and Interregional Competition

Ability to develop and expand markets for the more intensive field, fruit, and vegetable crops produced in the region will be a key factor determining the extent and direction of future growth in Northwest agriculture, particularly in the irrigated subregion, which is the region's agricultural growth area.

The distance of the Northwest production areas from the major domestic markets in the eastern half of the country will continue to be the Northwest's major obstacle with respect to developing domestic markets for its agricultural production. Rising costs for petroleum fuels, largely through their impacts on transportation costs, will improve the competitive position of production areas near the major population centers relative to more distant producing areas such as the Northwest. This may result in production moving into the eastern areas and away from the western producing areas. Bulky commodities, such as fresh fruit and potatoes, for which transportation costs make up a large part of the retail price, will be the most affected by increasing transportation costs. These are the commodities in which the Northwest competes directly with production areas in the Midwest and East. This could limit the potential for expanding national markets for Northwest-produced fresh produce.

The Northwest may be in a somewhat stronger position with respect to national markets for processed agricultural commodities. Because of the value added through processing, processed food products have a higher value to weight ratio than fresh agricultural commodities. Consequently, transportation costs are a smaller fraction of the final market price of processed products than of fresh produce. This has the effect of lowering the transportation cost differential for processed Northwest food products relative to unprocessed commodities. The regional nature of energy markets also may affect the future competitive position of the Northwest food processing sector. The region relies heavily on hydrogenerated electricity for industrial energy in contrast to most other regions of the country which use natural gas and other fossil fuels for their primary energy source. Consequently, the cost of industrial energy is lower in the Northwest than in most other regions and should be less subject to the disrupting price increases and shortages that have affected some regions. This provides a cost advantage for Northwest processors that would substantially offset their higher transportation costs. Because of escalating prices for fossil fuels, the industrial energy cost differential between the Northwest and other regions is expected to increase over time, further improving the competitive position of the Northwest food processing industry.

There also is good potential for developing export markets for a number of Northwest farm commodities. Wheat traditionally has been the region's major export commodity. Recently, however, efforts have been made to develop export markets for other commodities, including alfalfa pellets, fresh fruit, and live cattle. Most of the market development effort is directed toward Japan and other Far East markets. Market acceptance of these commodities apparently has been favorable. However, there are problems that still need to be overcome, particularly with fresh fruit, before exports will be a major market outlet. These are related partially to developing handling and shipping techniques that will both maintain product quality and provide adequate pest control. But the use of various nontariff barriers to restrict access of U.S. farm commodities to these markets is the most pervasive problem confronting Pacific Northwest exporters.

The growth in output of several of the intensive crops produced in the irrigated subregion has exceeded the rate of market growth, resulting in periods of depressed farm prices. The impact has been greatest on the large-scale farms. Many of these farms individually produce a large enough share of the region's total production of certain commodities to affect prices. In effect, these large farms face a downward sloping demand curve, rather than the horizontal demand curve of pure competitors faced by typical farm firms. This situation may have caused a general slowing of the rate at which the large-scale farms are developing their land. A number of them hold substantial acreages of undeveloped land and have indicated that it will be developed only as the market situation warrants. The commodities for which these large-scale farms face a downward sloping demand curve include those for which the Northwest supplies a substantial share of the national output, such as potatoes, and crops that are produced primarily by large farms for local and regional markets, such as fresh vegetables.

The price situation faced by the larger farmers in the region may be partially the result of the development of processing capacity lagging behind growth in farm production capacity. To the extent this is the case, continued growth of the region's farm product marketing and processing sector will provide the additional capacity to absorb the excess farm capacity and provide a basis for further growth in farm output.

In a longer run sense, however, the rapid growth of intensive crop output may have saturated the region's current final demand markets for these commodities. In this respect, the rate of future development will be dictated largely by overall market growth resulting from population increases and shifts, the degree of success achieved in market development and expansion efforts, and the successful introduction of new crop enterprises.

Approximately 70 different crops currently are produced in the irrigated subregion. Some of these, however, are minor crops with very small total acreage. In addition, there are crops of an experimental nature, as farmers, processors, and experiment stations in the area search for new crops that can be profitably produced on Northwest irrigated farms. Grapes, and, more recently, asparagus, are prominent examples of minor or new crops that have become major crops in the area. The expansion of grape production occurred in the late 1960's and early 1970's. Grape acreage, including both juice and wine varieties, is now around 22,500 acres and currently is expanding at the rate of about 500 acres per year. Grape processors are continuing to expand their facilities. Asparagus has been produced in the Northwest for many years. A major expansion in acreage currently is taking place, largely offsetting a decrease in asparagus acreage in California. Thus, the increase in Northwest asparagus production does not constitute an increase in total U.S. volume, but rather a shift in production areas.

There have been several attempts to develop an oilseed industry in the irrigated subregion, but to date the production of oilseed crops has been largely experimental. In the mid-1970's, there was considerable interest in soybean production, but investigation of the potential for this crop determined that the area could not effectively compete with current production regions. Sunflowers and safflower now are viewed as the most promising oilseed crops that might be produced in the region.

The interest in oilseed production stems both from the large consumption of vegetable oil by the region's potato processing operations, which would provide a substantial local market for vegetable oil produced in the area, and from efforts to reduce the cost of protein feed supplements to the region's livestock and poultry producers. If an oilseed industry can be established successfully, it would provide a major alternative crop on both currently irrigated and newly developed land, as well as additional nonfarm employment in crushing and processing operations.

Population Growth

Recent population trends, principally the high growth rate of the Western States relative to that of the United States as a whole, have enhanced the competitive position of Northwest agriculture. Assuming that these trends continue, as appears likely, substantial growth will occur in the market area in which the Northwest has a locational advantage for many of its agricultural products. Based on estimated population growth rates during 1970-78, the population of the 13 western States is expected to increase by 37 percent during

1978-2000, compared with 17 percent for the entire United States. The population of the three Northwest States should increase by 35 percent during this period. Based on these assumptions, the population of the western States will be about 54 million in 2000, an increase of 15 million from 1978. The population of the three Northwest States will increase from 7 million to nearly 10 million. This growth, by increasing the size of the western regional market, will lessen the locational disadvantage that traditionally has been a major problem for Northwest agriculture.

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