PN-AAS-586

IAN 39576

Agribusiness Management for Developing Countries-Southeast Asian Corn System and American and Japanese Trends Affecting It

A Study Prepared under the Terms of Contract AID/csd 3153 Between Harvard University and the U.S. Department of State

Ray A. Goldberg, *Project Director*
Richard C. McGinity, *Project Manager*

Ballinger Publishing Company • Cambridge, Massachusetts
A Subsidiary of Harper & Row, Publishers, Inc.

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International Standard Book Number: 0-88410-286-6

Library of Congress Catalog Card Number: 78-31564

Printed in the United States of America

Library of Congress Cataloging in Publication Data

Main entry under title:

Agribusiness management for developing countries—Southeast Asian Corn System and American and Japanese trends affecting it.

(Concepts in agribusiness management)
"A study prepared under the terms of contract AID/csd 3153 between Harvard University and the U.S. Department of State."
1. Agricultural industries—Asia, Southeastern—Management. 2. Corn industry—Asia, Southeastern. 3. Underdeveloped areas—Agriculture. 4. Corn industry—U.S. 5. Corn industry—Japan. I. Goldberg, Ray Allan, 1926- II. McGinity, Richard C. III. Harvard University. IV. Southeast Asian Regional Centre for Graduate Study and Research in Agriculture. V. Series.
HD2075.8.A65 338.1'7'315095 78-31564
ISBN 0-88410-286-6

Harvard Contributors
Leonard M. Wilson
James E. Austin
Gail L. Cramer
Gordon C. Rausser
Theresa C. Sparks
Richard Gartrell
Kristin Zimmermann
Kenneth C. McCorkle
Robert Dew
Laura Hall
Wayne Broehl
Kenneth Hoadley
Eric Thor
Ernette Au

SEARCA Contributors
José D. Drilon, Director
Gil F. Saguiguit, Sr., Deputy Director
Geronimo M. Collado, Coordinator

Philippines
Manuel Arreola
Luis C. Ranit
Donato Antiporta
Gil F. Saguiguit, Jr.
Domingo E. Cigaral
Myrna S. Corpus
Corazon M. Felisimo

Thailand
Sopin Tongpan (Coordinator)
Phaitoon Hathamart
Somsak Priebprom
Winich Werayangkool
Sutat Sriwatanapongse

Indonesia
Rusli Hakim (Coordinator)
Hidajat Nataatmadja
A. Soeharjo
Sjariffudin Baharsjah

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Acknowledgments

The purpose of this study was to indicate the usefulness of an agribusiness commodity systems approach for improving the effective operation of the corn system in the developing countries of Southeast Asia with special reference to the Indonesian, Philippine, and Thailand corn economies. Because the U.S. is the major supplier of corn to the world and to Southeast Asia and because Japan is the major market for corn in Southeast Asia, an analysis of their commodity trends was also an important element in this overall study. A long overdue awareness of the importance of the noncommercial subsistence producers in the corn system became an important consideration in evaluating both the effectiveness and equity of the corn system. We attempted to analyze, wherever possible, the system's responsiveness in aiding those who were trying to become part of the commercial system with both technical assistance and more equitable treatment, as well as giving them more opportunity to obtain, share, and use the basic resources of agribusiness and share in the products of their labor.

This led us to search out unique institutions and arrangements in the corn system that provided both efficiency and development, such as the Zen-Noh Cooperative and the Thailand-Japanese Corn Agreement. It also led us to search for other models in other commodity systems that provided even more dramatic leadership, such as the Indian Anand Dairy case in the development of a local cooperative of small farmers and landless laborers, as well as the Booker McConnell case, which indicated an exogenous multinational corporation's ability to set up an outgrower's program and help small producers set up their own cooperative and sugar system in Kenya. These examples and others called "changemakers" in Chapter 6 of this book emphasized the importance of the local people and institutions in building an effective commodity system that

is responsive to the social, political, and economic priorities of the country involved.

From Appendix A, Chapter 6, one can note the number of people who not only contributed to the study itself, but also participated in brief seminars in the United States, Japan, Thailand, Indonesia, and the Philippines at various stages in the development of the project. Specific case studies were developed for this project and numerous governmental, financial, private, and cooperative officials provided valuable information and insights for this study.

We are most indebted to Dr. Kenneth R. Farrell, Administrator, Economics, Statistics, and Cooperatives Service, U.S. Department of Agriculture, Dr. James J. Naive, Program Leader, Grains and Feeds Program, Dr. Leroy C. Quance, Agricultural Economist, and Dr. Jack S. Ross, Agricultural Economist, for their review of all of our statistical material and the updating of it with the most recent U.S. Department of Agriculture data. Data from a variety of sources sometimes differed. These differences are noted in the tables throughout the study.

We are also most grateful to Dr. José D. Drilon and the entire Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) group for their co-authorship of this book. Similarly, we are grateful to the Faculty members and to the Research and Project Assistants at Harvard University Graduate School of Business Administration who contributed to this book.

We are also grateful for the complete review by the following individuals: Professor Henry B. Arthur, Moffett Professor of Agriculture and Business, Emeritus, of Harvard Business School, Dr. Wayne G. Broehl, Jr., The Amos Tuck School of Business, Dartmouth College, Mr. Nelson H. Eddy, Director of Marketing Economics, Best Foods Division, CPC International Inc., Dr. Quentin M. West, Special Assistant for International Scientific and Technical Cooperation, U.S. Department of Agriculture, and Dr. Nicholaas Luykx of the Agency for International Development, U.S. Department of State.

We are most grateful to Dean Lawrence E. Fouraker and Associate Deans John H. McArthur and Walter J. Salmon for their excellent encouragement and support, and for arranging our other research and teaching assignments in such a way as to permit us to carry out this project. We are also most appreciative of the advice and direction provided by the research division of Harvard Business School under the leadership of Professor Richard S. Rosenbloom, Associate Dean for Research and Course Development.

We are most grateful to Mr. Jack Koteen, former Director of the Office of Development Administration, Technical Assistance Bureau, Agency for International Development, and Dr. Gerald Horne, former Deputy Director, Dr. Kenneth Kohner, Dr. Alan I. Vestrich, Mr. Paul Worthington of the same program, and Dr. William L. Rodgers, first head of the Agribusiness Division, Office of Agriculture, Bureau for Development Support, Agency for International Development, for the encouragement and leadership they have given to agribusi-

ness management education in developing countries and for bringing their technical and personal backgrounds to the study.

We are indebted to Mr. Richard A. Bertelsen and Ms. Helen Frey Rochlin for their editorial assistance and to Mrs. Theresa C. Sparks and Ms. Ann M. Pavao for their administration of the typing and the collating of material in the final draft from the various authors.

We are also grateful to Mr. Carol Franco, Editor, and Mr. Gerald M. Galvin, Production Manager, Ballinger Publishing Company, Subsidiary of Harper & Row, Publishers, Inc. for expediting the publishing of this book.

Finally, the project was researched and written at a time when the Agribusiness Program was already overcommitted, and therefore much of the time given to this project was taken away from family responsibilities. We are grateful to our families for their patience and understanding as we completed this study, especially our wives Thelma and Diane.

xx

Chapter 1

Introduction and Approach

The purpose of this book is to provide private and public decision-makers in the world's food system with a variety of methods for identifying both the problems and the opportunities facing their commodity systems. Furthermore, it suggests specific institutional, corporate, cooperative, governmental, and coordinate programs of action consistent with the policies of the countries involved in the study.

The first publication based on the findings of this project, *Agribusiness Management for Developing Countries—Latin America,*[1] demonstrated that development of and proper response to new international and local food markets require a market orientation and a transfer of technology. The Central American study had as its focus nontraditional fruit and vegetable products that could reach the off-season markets in the United States and Europe. Although many of that study's producer cases highlighted small-scale landowners, their intensive use of land discouraged application of the study's results to the smaller, subsistent, noncommercial producer segments of Central American agribusiness.[2]

Corn was selected as an appropriate commodity-system example for this subsequent study because of its importance to both developed and developing segments of the global grain economy. Some 118 million hectares[3] of farm land are devoted to the production of corn, out of a total of 760 million hectares in food- and feed-grain cultivation throughout the world. Of the 118 million hectares in corn, over 52 million are located in developing countries.[4] Mexico, Central America, Bolivia, Colombia, Paraguay, East Africa, Indonesia, the Philippines, Thailand, and other developing nations look upon corn as an important national food crop. Between 1961 and 1973, corn production in the developing countries rose 3.3 percent annually, but less than half of this increase (1.4 percent) was a result of higher yields.[5] Lack of technology is not the problem. As

Dr. Ralph Cummings, Jr., says, "Maize is the crop where it is most obvious that the development of technology may be running the farthest ahead of the ability and will to apply technology."[6]

The problems as seen in this book are manifold. The primary question to be answered was whether a commodity-system approach for private and public decisionmakers would be a practical tool for locating bottlenecks in and challenges for developing an effective food system. At the same time, efficiency and productivity are not the only criteria for evaluating the performance of private and public entities in a food system. The subsistent producer and impoverished consumer "outside" the commercial system cannot and should not be ignored. The "New Directions" mandate for the Agency of International Development (AID) of the U.S. State Department with its emphasis on the rural poor was formulated after this research study was underway. The authors' awareness of the important role that the subsistent corn producer plays in a global corn system as well as AID's emphasis on rural poverty have led us to stress, wherever possible, the opportunities for a more effective and equitable participation of the small-scale corn producer.

Agribusiness, as developed at Harvard Business School, includes *all* of the interrelated private and public policymaking enterprises, from farm supply, farming, and processing through distribution to the ultimate consumer including all the private and public coordinating mechanisms that hold the commodity systems together and enable them to adjust to technological, political, social, and economic change. Agribusiness contains large- and small-scale participants irrespective of the economic and political systems involved. Unfortunately, many writers have mistakenly used the word *agribusiness* to mean large-scale entities in the food system. Using this incorrect definition of agribusiness would then pit large-scale entities against small, subsistent entities, and farm suppliers, processors, and distributors against farmers and ultimately each other. Agribusiness is in fact a descriptive term indicating that the food system is a vertically integrated, interdependent, constantly changing system.

While it is true that consolidation of decision points is taking place in various national corn systems as well as in the global corn system, this does not necessarily mean that these larger entities make all the important decisions affecting the production and marketing of corn. It does mean that these large-scale corporate, farmer, and public managers have a major responsibility not only to be responsive to the specific operational needs of their respective institutions, but also to make these decisions within the economic, social, and political priority-system of their various national, regional, and global markets.

We selected Southeast Asia as our next study area because of a well-established and knowledgeable research partner there: SEARCA, Southeast Asian Regional Center for Graduate Study and Research in Agriculture. Its director, Dr. José Drilon, has conducted pioneering agribusiness research. After consultation with SEARCA, we selected the corn commodity system because of corn's increasing importance in Southeast Asia and because its products and by-

products are basic food ingredients for humans and feed ingredients for livestock and poultry. Furthermore, new technologies have made its oil, starch, and sugar by-products important ingredients in other food and industrial products. Moreover, corn represents a complex blend of commercial and noncommercial producers; a thorough analysis of this network might provide important information on how access to new markets and technology benefits both the well-to-do and the more numerous and difficult to reach subsistent, small-scale producers. Finally, the corn system is global. Therefore, our study would deal not only with domestic and regional markets in Indonesia, the Philippines, and Thailand, but also could observe the relation of these markets to government programs and private policies in the principal importing and exporting countries.

THE AGRIBUSINESS APPROACH

In identifying the most desirable agribusiness policy for private and public firms and institutions, we at the Harvard Business School take a commodity-system approach. That is, we analyze all the interrelated functions to be performed in a given system rather than confine our investigation to one or a few significant factors. Farm supply, farming, processing, storage, assembling, and institutional and retail distribution all affect each other; and all of them respond to the changing economic, political, and social demands of consumers. Only by understanding the entire system and every factor within it can one know enough to predict developments and suggest policies to produce desired results. We believe that each private and public entity has two vital characteristics. The first is its position and function in its commodity structure and in the global food system. The second is the manner in which it relates to, or coordinates its functions with, the commodity system of which it is a part.

We recognize that the commodity systems and the global food system are constantly changing and that many firms and governmental institutions can affect the nature and rate of change. The unique agronomic characteristics of each crop and the estrus and grow-out characteristics for livestock and poultry can also influence the structure and organization of a commodity system. At the same time, each commodity system is competing for the same limited land, water, energy, and human resources available for food. In many cases, firms and institutions are confronted with the challenges of competing against themselves; they belong to one commodity system (e.g., sugar) but they participate in technological innovations in other systems (e.g., fructose from corn) that threaten to alter their "home" system. Yet, this "creative destruction" is necessary if one is to survive in world agribusiness.

In using the dynamic systems approach, we will relate the firm or governmental institution to its commodity system and to the national and international environment. Figures 1-1 and 1-2 outline the functions performed in a commodity system and the coordinating devices that hold it together. Figure 1-1 is a Domestic Flow Chart. Figure 1-2, an International Agribusiness Flow Chart,

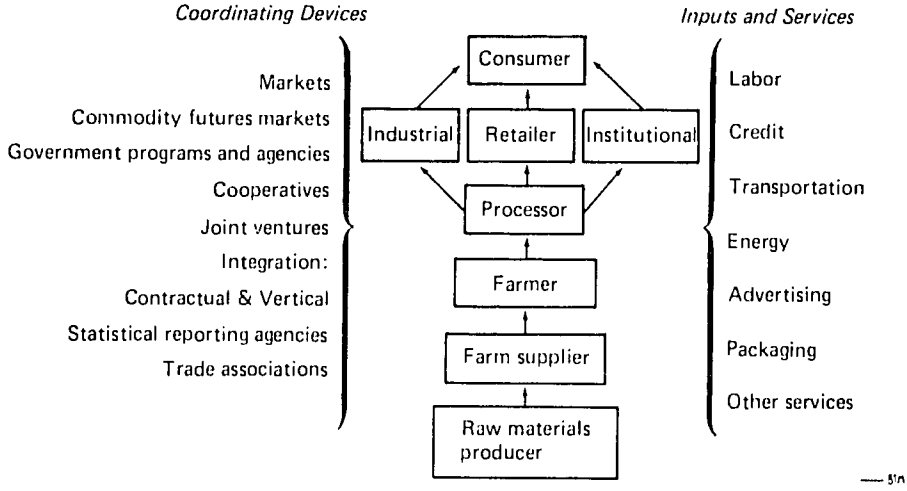

Figure 1-1. Domestic Agribusiness Flow Chart

indicates the additional international coordinating machinery as well as the absence of coordinating machinery in subsistence agriculture. It suggests that governmental institutions and private firms have to provide many more services in a developing society than in a fully developed one. These systems are dynamic. Constant change and adjustment among the participants, the system itself, and the trends affecting them all are normal. In addition, the commodity system is constantly "out of balance," with one segment developing before another and influencing it to change in turn. We should expect these imbalances. Never assume that we can impose one complex system on top of another without destroying important—perhaps critical—human, social, technological, and financial strengths. As has been ably demonstrated in Professor Theodore Schultz's life-long works,[7] the commercial and noncommercial segments of any agribusiness commodity system respond to economic and social incentives, regardless of the form of government.

The commodity-system approach provides one way of positioning private and public entities within their ever-changing environment; developing a meaningful strategy; and implementing that strategy. Table 1-1 in this chapter outlines considerations in analyzing an agribusiness investment. In an agribusiness system, every entity is "in the middle," dependent on someone else's inputs and someone else's market. In a highly volatile food system that dramatically swings from glut to shortages and back again, identifying risks and weathering unfavorable periods become extremely important. From a public decisionmaker's point of view, cost-benefit analysis of various programs and of the transfer payments

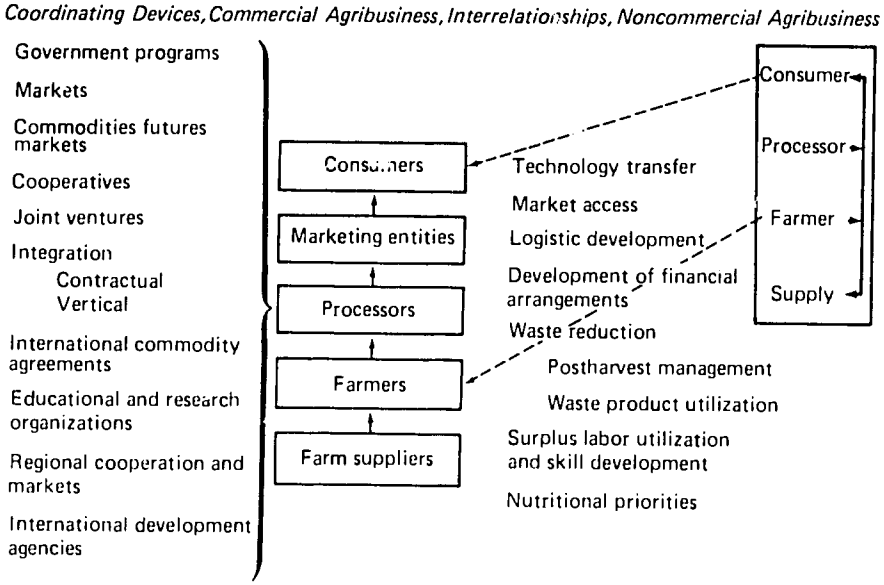

Figure 1-2. International Agribusiness Flow Chart

Table 1-1. Considerations in Analyzing an Agribusiness Investment

1. Identify spreads (existing and potential) between input costs and product prices.
2. Identify protections to spreads (futures markets, institutions, arrangements).
3. Identify government programs that affect spreads (price supports, Public Law 480 international commodity agreements, export subsidies and controls).
4. Identify means of convincing financial institutions to supply financing.
5. Identify the importance of timing in the cycle or in the change of the market structure.
6. Determine vulnerability of investment to sociopolitical pressure in agribusiness (image–politics).
7. Identify extent to which cooperation is required with system participants.
8. Identify special financial tools responsive to analyzing investments in agribusiness:
   - Commodity system model
   - Sensitivity analysis of factors affecting model
   - Special financial institutions catering to agribusiness investment needs
   - Leaseback arrangements
   - Special arrangements with cooperatives and financial institutions
   - Balance of product flows with vertical integration
   - Identification of special inducements to agribusiness
   - Government and joint ventures
9. Provide market access for production and coordinate production and marketing through contracts and formula pricing.
10. Identify unique individuals who can provide leadership and also train others.
11. Determine responsiveness of the investor to the nutritional, social, political, and economic priorities of the government or governments involved.

necessary to minimize risk, provide incentives, or cushion costs to consumers and producers requires some perspective on the trends that affect the system.

The Structure of this Book

This study applies commodity-system analysis to the world's corn system, with special emphasis on three countries in Southeast Asia. Throughout the study, cases illustrate how commodity systems operate and how their functions are coordinated at the level of the individual firm, farm, or governmental institution.

Chapter 2 focuses on major trends likely to affect this system over the next decade. It identifies the trends and sets forth the potential responses of participants in the system. A case study indicates the effects of these trends and of participants' efforts to adapt to them and change the system.

Chapter 3 analyzes trends in corn demand and consumption in Japan, the major market center for that commodity in Southeast Asia. It also describes Japan's public and private efforts to supply its growing need for corn by influencing producers.

Chapter 4 sets forth the response of participants in the U.S. corn system to major domestic and international trends, including changes in demand caused by such foreign buyers as Japan.

Chapter 5 analyzes the response of commercial and small farmers and off-farm participants in the Southeast Asian corn system to the requirements of domestic and foreign corn consumers as well as to other trends developed throughout the study.

Based on the foregoing analysis, Chapter 6 discusses the opportunities and approaches available to improve the Southeast Asian corn system and the economic development of the region. It also summarizes the potential applicability of the institutions and coordinating arrangements of the Southeast Asian corn system to other commodity systems and to other regions struggling to make their food economies respond to their national, social, political, and economic priorities.

NOTES

1. R.A. Goldberg et al., *Agribusiness Management for Developing Countries Latin America* (Cambridge, Mass.: Ballinger Publishing Co., 1974).

2. The term *agribusiness*, as used in this study, was first used in J.H. Davis and R.A. Goldberg, *A Concept of Agribusiness* (Boston Division of Research, Harvard Business School, 1957). Agribusiness comprises all farm inputs, farm production, and food and fiber processing and distribution entities involved in the production and distribution of food and fiber products to domestic and international consumers.

3. One hectare = 2.4711 acres.

4. Ralph W. Cummings, Jr., "Food Crops in the Low-Income Countries: The State of present and Expected Agricultural Research and Technology" (The Rockefeller Foundation, May 1976), p. 23.

5. Ibid., p. 25.

6. Ibid., p. 30.

7. Theodore W. Schultz, *Transforming of Traditional Agriculture* (New Haven: Yale University Press, 1964).

Chapter 2

Trends Affecting the World Corn System

This chapter identifies the major trends that may affect the private and public firms and institutions involved in the world corn system over the next decade. It provides a broad perspective within which to consider interrelations between those U.S. and Japanese segments of the system that deal with corn primarily and as an animal feed ingredient and those in Southeast Asia, where corn is an important food for humans. As the chapter progresses, it will become clear that decisionmaking in the world corn system is divided among small farmers, large commercial farms, and concentrated decisionmaking units at the farm input, processing, distribution, export, and governmental levels. This mixed system places great pressure on coordinating institutions and arrangements. Theirs is the difficult task of safeguarding the economic well-being of system participants in the face of changes in supply, demand, technology, and national priorities.

THE WORLD CORN SYSTEM

The following brief overview of the current status of the corn system will serve as a backdrop against which to analyze the effects of various trends upon the system.

The United States, with about 24 percent of the world's corn acreage, produces approximately 45 percent of the world's corn and—as Table 2-1 illustrates—over 70 percent of the world's corn exports. As Table 2-2 shows, it will probably maintain this important position at least through 1985. This dominance by the United States means that its price-support policy, corn futures market, export policy, domestic corn usage, and its development of unique insti-

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tutions (such as cooperatives) affect the corn system of other nations more than any other single factor except their own grain policies.

Only about 16 percent of the world's land in grain production is allocated to corn (see Table 2-3); but this acreage produces 23 percent of the total world grain output—primarily because of the productivity of the U.S. corn crop. The developing world, with 70 percent of the world's population has only 20 percent of the world's income, utilizes 20 percent of the world's commercial farm inputs, and produces only 40 percent of the world's agricultural output. This means that in the past the developing world had neither the resources to produce enough food nor enough income to buy additional food from others. Two new studies are most encouraging for the future of the developing world: *To Feed This World,*[1] by Wortman and Cummings, and *The Future in the World Economy,*[2] by Leontief, et al. As income and population rise, heavy demands are placed on the agricultural sector to supply more food and materials. According to one scenario by Leontief, by the year 2000 world agricultural production should increase three to four times beyond the 1970 level and per-capita output should double. The average total growth rate in agricultural output assumed for all developing regions was 5.3 percent per annum for the 1970 to 2000 period and 1.6 percent per annum for the developed world. The implication of these various past relationships and future projections between the developed and developing world as they affect the United States are demonstrated statistically in Tables 2-4 through 2-7. They indicate a growing share of the coarse grain (especially corn) export market for the United States and a tremendous potential market in the developing world—even allowing for a much needed surge of productivity in their national food production, with the developing world moving from 36 percent of total agricultural output in 1970 to a projected 62 percent of world agricultural output in 2000 (Table 2-6) and their share of agricultural imports of the world expanding from 15 percent in 1970 to a projected 40 percent in the year 2000 or from $2.3 billion to $10 billion (in 1970 dollars). Enabling these projections to become a reality means the encouragement of agricultural management skills appropriate to the technology and size units of the countries in this corn study.

Out of the 146 million farms in the world (100 million of less than 5 hectares), about 20 million produce some corn. Production is becoming more concentrated as fewer large farms produce more corn. For example, as Chapter 4 shows in more detail, in 1974 about 1 million U.S. farmers produced corn for all purposes (800,000 produced corn for grain only) on an average farm field of about 55 acres (63 acres for those farmers producing grain only). Fifteen years earlier, almost 2 million farmers raised corn on an average of 36 acres per farm. In Thailand, similarly, approximately 400,000 farmers produced corn on farms averaging 20 acres. In 1969 the average farm size was 10 acres. In 1969 only about 1400 Thai farms harvested 20 acres or more. By 1976, this figure had increased to about 40 percent of all farms.

Table 2-1. Corn Exports, Area, Yields, and Production in Selected Corn Producing Nations: 1977-1978

	Exports (million metric tons)	*Percent*	*Area Harvested (millions of hectares)*	*Percent*	*Yield (quintals per hectare)*	*Production (000,000 metric tons)*	*Percent*
World	61.4	100.0	117.7	100.0	26.4	340.2	100.0
United States	44.2	72.0	28.2	24.0	54.1	161.7	47.5
Philippines	–[a]	–	3.5	3.0	8.5	3.0	.9
Indonesia	–	–	2.0	1.7	12.3	2.3	.7
Thailand	.8	1.3	1.4	1.2	23.8	1.8	.5
Argentina	4.7	7.7	2.9	2.5	21.4	7.8	2.3
South Africa	2.8	4.6	4.1	3.5	17.6	7.7	2.3
European Community (EC)	4.8	7.8	2.8	2.4	47.1	15.0	4.4
Mexico	–	–	7.9	6.7	11.1	9.7	2.9
Brazil	1.1	1.8	11.3	9.6	15.0	18.0	5.3
People's Republic of China	–	–	14.5	12.3	22.1	31.4	9.2
India	–	–	6.0	5.0	9.2	6.0	1.8
All Other	3.0	4.8	33.1	28.1	–	–	22.2

[a] – = less than .1.

Sources: 1. World and European Community (EC) figures: U.S. Department of Agriculture (USDA), *Agricultural Statistics, 1976.*
2. Individual country figures: Foreign Agricultural Service (FAS), USDA, *Reference Tables on Wheat, Corn, and Total Coarse Grain Supply-Distribution for Individual Countries* (FG 9-76), May 1976.
3. USDA estimates, March 1978.

Table 2-2. Major World Corn Trade Flows: Average 1968-73, Crop Year 1977-78, and Estimated for 1985 (in millions of metric tons)

Total Corn Exporters				*Major Corn Importers*			
United States	Average	1968-73	17.5	Western Europe	Average	1968-73	18.6
		1978	44.2[a]			1978	23.7
	Est.	1985	48.0[b]		Est.	1985	32.0
South Africa	Average	1968-73	2.0	Japan	Average	1968-73	5.8
		1978	2.8			1978	9.3
	Est.	1985	3.5		Est.	1985	12.5
Argentina	Average	1968-73	4.3	Soviet Union and Eastern Europe	Average	1968-73	2.8
		1978	4.7			1978	16.0
	Est.	1985	6.0		Est.	1985	18.5
Brazil	Average	1968-73	.9	Selected South Asia[c]	Average	1968-73	1.2
		1978	1.1			1978	1.8
	Est.	1985	6.0		Est.	1985	3.0
France	Average	1968-73	2.9	Selected Western Hemisphere[d]	Average	1968-73	0.5
		1978	2.0			1978	1.9
	Est.	1985	4.0		Est.	1985	3.0
Thailand	Average	1968-73	1.5	Other Communist[e]	Average	1968-73	0.3
		1978	.8			1978	2.3
	Est.	1985	3.5		Est.	1985	3.0
Indonesia	Average	1968-73	.2	Selected African[f]	Average	1968-73	0.3
		1978	–			1978	1.0
	Est.	1985	1.5		Est.	1985	2.0
World Total	Average	1968-73	32.4	Selected West Asia[g]	Average	1968-73	0.3
		1978	61.4			1978	1.0
	Est.	1985	80.0		Est.	1985	2.0
				Other World	Average	1968-73	2.6
						1978	4.4
					Est.	1985	4.0

[a]As of October 1978, U.S. exports of corn have increased to 49.5 million metric tons, sold to the following countries: Western Europe, 17.2; Soviet Union and Eastern Europe, 14.8; Japan, 8.6; Mexico, 1.6; Korea, 1.9; Taiwan, 1.5; Egypt, 0.6; and others, 3.3.

[b]Please note 1978 exports now estimated to be larger than 1985 projections.

[c]Includes Bangladesh, India, Pakistan, Philippines, People's Republic of China, South Korea, South Vietnam, and Sri Lanka.

[d]Includes Mexico, Brazil, Chile, Colombia, Peru, and Venezuela.

[e]Includes Cuba, People's Republic of China, Mongolia, North Korea, and North Vietnam.

[f]Includes Algeria, Egypt, Libya, Morocco, Nigeria, South Africa, Sudan, Tunisia, and Zaire.

[g]Includes Cyprus, Iran, Iraq, Israel, Jordan, Lebanon, Saudi Arabia, Sudan, and Turkey.

Source: USDA, FAS.

Table 2-3. Corn Area and Production in Selected Countries: 1976

	Area (millions of hectares)				*Production (million metric tons)*		
Country	*Arable Land*[a]	*Land in Grain Production*[a]	*Land in Corn Production*[b]	*Corn Land as Percentage of Grain Land*	*Total Corn Production*[a]	*Corn Production*[b]	*Corn Production as Percentage of Total Grain Output*
United States	205.1	72.1	27.1	38	248.1	146.5	59
Indonesia	13.3	11.4	2.8	25	26.6	3.5	13
Philippines	7.6	6.8	3.0	44	9.2	2.6	28
Thailand	12.5	9.8	1.3	13	18.3	3.0	16
World	1,507.[illegible]	744.4	118.6	16	1,359.2	313.2	23

[a]Arable land, land in grain production, and total grain production from Food and Agricultural Organization (FAO), *Production Yearbook, 1975.* Arable land figure is for 1974. World figure includes arable land and permanent crops.

[b]Corn production and land in corn production from FAS, USDA, *Reference Tables on Wheat, Corn, and Total Coarse Grains Supply–Distribution for Individual Countries* (FG 9-76), May 1976.

Table 2-4. U.S. Share of World Grain Trade (percent of total world exports)

Year	*Total Grain*	*Coarse Grain*	*Wheat*
1960-64	.37	.40	.39
1965-69	.37	.45	.33
1970-74	.42	.48	.38
1975	.51	.59	.45
1976	.52	.54	.40
1977	.47	.57	.34

Source: Foreign Demand and Competition Division (FDCD), Economics, Statistics, and Cooperatives Service (ESCS), USDA.

Table 2-5. U.S. Coarse Grain Exports by Region (in millions of metric tons)

Year	*Developing Countries*	*Developed Countries*	*Centrally Planned Countries*
1960-64	1.6	10.7	.4
1965-69	2.2	16.3	.8
1970-74	4.8	20.9	4.8
1975	6.6	26.2	14.7
1976	7.2	36.9	9.2
1977	7.7	29.8	7.0

Source: FDCD, ESCS, USDA.

Table 2-6. Comparisons of Market Shares and Market Demand for Developed and Developing Countries: 1970 and Projected 2000 (percentage of total)

Item	*1970*	*2000*
Share of total agricultural output		
Developed[a]	64.0	37.9
Developing[b]	36.0	62.1
Grain consumption		
Developed	45.0	32.9
Developing	55.0	67.1
Consumption of Animal Products		
Developed	63.6	41.8
Developing	36.4	58.2

[a]Includes Soviet Union and Eastern Europe.

[b]Includes centrally planned Asia.

Source: FDCD, ESCS, USDA.

Table 2-7. Total U.S. Agricultural Exports by Region (in billions of dollars)

Year	*Developing Countries*		*Developed Countries*		*Centrally Planned Countries*	
		(share)		(share)		(share)
1968	2.2	(.36)	3.9	(.62)	.1	(.02)
1969	2.0	(.33)	3.9	(.65)	.1	(.02)
1970	2.3	(.32)	4.7	(.65)	.2	(.03)
1971	2.5	(.33)	4.9	(.64)	.3	(.03)
1972	2.8	(.30)	5.8	(.62)	.8	(.08)
1973	5.0	(.28)	10.6	(.60)	2.1	(.12)
1974	7.6	(.35)	12.8	(.58)	1.6	(.07)
1975	7.5	(.35)	12.5	(.57)	1.8	(.08)
1976	6.8	(.30)	13.7	(.60)	2.4	(.10)

Source: FDCD, ESCS, USDA.

Table 2-8. Growth in World Grain Production: 1976 Compared to 1961-1965 (in millions of metric tons)

	1961-1965		*1976*	
	Volume	*Percentage of Total*	*Volume*	*Percentage of Total*
Corn	216.1	21.9	334.0	22.6
Wheat	254.5	25.8	417.5	28.3
Rice (Paddy)	253.2	25.6	345.4	23.4
Other Grains	264.1	26.7	380.4	25.7
Total	987.9	100.0	1,477.3	100.0

Note: Altered figures in columns under 1976.

Source: FAO, *Production Yearbook, 1976*, (Rome, 1977). 1976 figure for corn given here may differ slightly from that in other tables because of difference in sources.

Table 2-8 shows that although all grain production has increased between 1965 and 1976, corn and wheat output has expanded at a slightly faster pace than that for rice and other grains. (Note, however, that crops such as cassava, which compete with corn in tropical areas, have had even more rapid growth rates.)

Factors and Trends Affecting the System

1. It is estimated that the grain deficit for developing countries will reach 85 to more than 100 million metric tons--or a trade value of $13 billion--by 1985. But current wheat surpluses and corn accumulations indicate that monetary demand is slow. Therefore, there will be constant shifts between

surpluses and shortages. Wheat and alternative crops such as cassava will partially replace corn as a feed grain during shortages.

2. Projections foresee some slowdown in the "population explosion," but estimates still place the world's population in 2000 between 5.5 and 6.3 billion people.
3. The rate of increase in per-capita real income is slowing down because of unemployment, inflation, declining productivity, and income transfers.
4. Some means of narrowing the gap between the developing and developed food economies is one of the major political, social, and economic problems facing agribusiness.
5. Of the 140 million farms in the world, 100 million are of fewer than 5 hectares. How to upgrade the producers and workers on these small farms is a critical problem facing agribusiness.
6. Inflation has affected costs, margins, currency values, and relations between crops and substitute waste products.
7. Government programs are major factors in determining the profitability of firms. Such programs can have an effect on:
   - the volatility and hedgeability of commodities and currencies.
   - the margins allowable under various price control programs
   - the definition of competition in antitrust laws
   - competitive pricing
   - incentives and disincentives for production
   - the relation of international commodity agreements to various domestic and regional price support programs
   - international currency changes and, in turn, contract exports
   - imports, exports, land tenure, farm size, and the national origin of owners
   - subsidies for consumers, producers, exporters, and other segments of agribusiness
   - transportation tariffs and other regulatory charges
   - standards, grades, and terms of trade and enforcement
   - government and private storage programs
   - extension and research
   - volatility of prices, favoring closer private and governmental policymaking.

   Businessmen must be wary when government is the principal buyer or seller in a market—or when they are in danger of running afoul of the love-hate relationship between developing governments and international firms. They should also be aware that nations with central economic planning are moving away from "tender offerings" in favor of direct negotiations. In general, it is fair to say that many of these factors—and especially the volatility of grain prices—recommend closer cooperation between government and industry in policymaking.
8. Twenty percent of the world's population belongs to one or more farm

supply or marketing cooperatives. The cooperatives' market share and dollar volume is increasing in Britain, the United States, and the world in general. A proposed joint cooperative international grain-trading firm will mean either a new strong competitor or a new international, regional, or domestic partner to one or more of the major multinational grain firms.

9. Multinational agribusiness firms are developing new strategies.
   - Firms are expanding into each other's commodities and geographical territories. Branded firms are moving back to commodity procurement devices, and commodity firms are moving into branded products. U.S. firms are expanding into Europe, Brazil, the Middle East, and Asia; Japanese firms are developing procurement offices and food operations in North America. European firms are establishing new footholds in U.S. and Canadian agribusiness. Cooperatives are developing their operations in farm inputs and processing, signing long-term contracts with proprietary corporations, and beginning to form new international relationships.
   - These changes force the development of new market structures involving different pricing and margin strategies that are usually more competitive than previous ones.
   - All parties now pay more attention to the low and high technology aspects of agribusiness. Chemical and drug firms are deeply committed to new seed and animal technologies and place new emphasis on upgrading waste and by-product ingredients.
   - A movement for more concentration in agribusiness decisionmaking is taking place in both developed and developing countries at the local and regional levels. If joint ventures and acquisitions are to take place according to the antitrust laws of most countries, such arrangements can be executed in only one or two major investments as each firm, once an acquisition has occurred, will be most limited in making further acquisitions by various national monopoly commissions.
   - One area in which *less* concentration is occurring is in international commodity trading. Although dollar volume and physical volume are increasing, the market share of most participants is constantly shifting, as noted by Table 2-9.
   - Worldwide concentration of most other decision points in agribusiness makes agribusiness firms more vulnerable to the loss of a major supplier or customer.
   - The inevitability of interaction among the developed, developing, and centrally planned economies has made coordination necessary and placed a major emphasis on communications.
   - Climate and water source and usage play an ever more important role in multinational decisionmaking. Many firms now find climatologists invaluable to their operations.
   - In 1977, private and public multinational firms and entities began to

Table 2-9. U.S. Export Statistics: Fiscal Years 1971, 1975, and 1976

	1971		*1975*		*1976*	
	Volume (in 000,000 of bushels)	*Percentage of Total*	*Volume (in 000,000 of bushels)*	*Percentage of Total*	*Volume (in 000,000 of bushels)*	*Percentage of Total*
Cargill, Inc.	454	29	720	19	760	17
Continental Grain Co.	342	21	623	17	768	17
Cook Industries, Inc.	257	16	614	17	793	18
Louis Dreyfus Corp.	108	7	477	13	657	15
Bunge Corporation	134	8	300	8	350	8
Garnac Grain	92	6	286	8	317	7
Toepler	0	0	196	5	215	5
Archer Daniels Midland	29	2	65	2	80	2
Peavy Company	0	0	61	2	68	2
The Andersons	15	1	54	1	63	1
Early and Daniels Ind.	0	0	54	1	62	1
Central Soya	0	0	49	1	72	2
Other	168	10	189	6	201	5
Total	1,598	100	3,698	100	4,406	100

Source: North American Export Grain Association Inc. (does *not* represent total volume of U.S. grain exports, only the volume of N.A.E.G.A. membership).

develop global food strategies to respond to a new world food economy. They came to realize that "unplanned" historical accidents will no longer necessarily place them in the most favorable competitive position.

10. Because of the assumption that commodity volatilities are greater now than before 1971-72, coordinating devices are crucial to the profitability of firms and to the stability of the countries in which they operate. Coordinating devices include:
    - new commodity futures markets–currently over $1600 billion in volume per year–in such items as molasses and, in the United States, new white sugar
    - cooperatives, ranging from domestic farm cooperatives to foreign cooperative joint ventures
    - domestic and international cooperative-corporate joint ventures
    - long-term agreements between producers in one country and multinational firms in another for procurement, marketing opportunities, and investments in each other's operations
    - emphasis on commodity-systems analysis and market analysis by the World Bank and commercial banks
    - government and private joint ventures
    - new global policy information systems such as the International Food Policy Research Institute

- new financial subdivisions with respect to financial and futures markets services set up by such firms as Continental Grain Co.
- climate associations and satellite climate information services offered by multinational firms
- joint ventures between producer cooperatives, private firms, and government in one country or region with their counterparts in other countries or regions
- the World Bank's Consultative Group for Food Production and Investment in Developing Countries
- the International Food Development Advisory Service for manpower development and technical aid
- the inclusion of centrally planned, governmental, and cooperative entities in the Food and Agriculture Organization's Industry Cooperative Program
- the emergence of private development banks as subdivisions of commercial banks, for use in agribusiness projects in developing countries.

11. For economic development, technological transfer will continue to be important. But increased productivity must be related to six other equally important but still neglected areas, namely:
    - market access
    - development of a coordinating and logistical system of storage, transportation, and risk management
    - development of a system that reduces waste, makes use of by-products, and improves the general level of nutrition
    - development of new financing arrangements
    - a program that makes use of surplus labor and upgrades the skills and participation of the population, so that subsistence producers and consumers become part of a domestic and global foodsystem.
    - effective monetary incentive programs: the proper financing of these projects must ultimately rely on the market access skills of private, cooperative, and governmental trading firms.
12. Firms and institutions are increasingly vulnerable to new social priorities. Issues that must be taken into consideration include:
    - ecology and pollution
    - water and its use
    - energy
    - unemployment versus costs of social programs
    - cooperative versus proprietary corporations
    - upgrading of by-products for animal and human consumption
    - managerial and training skills to upgrade human talent.
13. Assuming that one's assumptions and projections can be wrong, one must prepare acceptable alternatives. Most of the above assumptions for potential agribusiness growth have been conservative; therefore, agribusiness

opportunities may be greater than we have stated. At the same time, if there is a worldwide economic collapse, agribusiness for economic development will be even more needed. World agribusiness, therefore, may be the most survival-proof operation of the world's economy.

14. People are the key to all agribusiness operations. Therefore, identifying and encouraging private and public entrepreneurs is a key factor in agribusiness economic development.
15. The heart of the world's food problem is in developing market economies. If the birth rate performance since 1960 is repeated in the next decade, the developing countries' population may, by 1985, exceed 2.5 billion people, of whom 2.2 billion may be living in food-deficit countries. The per-capita income of these countries is less than $200 per year, so increased local production is essential. To do this will require raising production growth rates from 2 percent to over 4 percent a year. This increase can come about both by increased yield potential and by increased land use.
16. Additional farm inputs will be required, as implied by Table 2-10. When one compares the inputs in this table to meat and cereal production, the importance of major farm inputs becomes evident.
17. Carryover stocks, a residual factor, are also important. At a minimum, they equal the quantity of food that must be in the marketing pipeline to enable commodities to move steadily into consumption from one harvest to the next. Stocks that are too small result in high, volatile prices disruptive to consumers. Stocks that are too large remove the incentive to expand output. In 1961, U.S. and Canadian grain stocks of 137 million metric tons equaled nearly four-fifths of total world stocks. Release of stocks owned by the U.S. Commodity Credit Corporation was authorized whenever grain prices reached or exceeded 115 percent of the loan level (plus carrying charges) at which they were acquired. As a result, annual grain price fluctuations in the

Table 2-10. Selected Comparative Agribusiness Statistics as Percentages of Total Non-Communist World: 1973

Region	*Agricultural Population*	*Tractors*	*Fertilizers*	*Beef*	*Cereals*
North America	1	39	34	35	33
European Community (EC)	2	35	28	17	13
Latin America	10	5	7	23	8
Africa	19	1	2	8	6
Asia	63	7	7	6	33[a]

[a]Mainly rice.

Source: USDA Economic Research Service

United States never exceeded 20 percent in the 1960s. This regulation set the tone for the world grain markets as well. A new U.S. program developed by the Carter Administration features long-term storage agreements at the farm level; a wide gulf between support levels and release prices, with the market price affecting most of the allocation of supplies; and the requirement that farmers participating in the program withhold specified percentages of their grain lands from production. The resultant "planned volatility" is critical to the development of any U.S. and global commodity policy for individual firms. In addition, the U.S. commodity programs will be directly related to potential international commodity agreements in order to share the responsibility of keeping world price levels less burdensome to the U.S. and Common Agriculture Policy Treasuries.

18. Exports represent the surplus supply above local demand for grain at prevailing prices. In fact, all nations have an implicit or explicit minimum amount of production reserves for themselves. Imports represent a residual demand for grain or other products above what is met by local production. Total food exports represent from 12 percent to 20 percent of world crop production (as noted in Table2-11). The export values are usually the most volatile because they represent "residuals" in the world food system and match one domestic program against another. The Chicago corn futures market plays an important role in the pricing of future corn trading arrangements as these "residuals" utilize the market to hedge this volatility.

Table 2-11. Production and Exports of Selected Commodities, 1970 and 1975

	Production in Millions of Tons		*Export Volume as a Percentage of Production*		*Export Value in Billions of Dollars*	
Food	*1970*	*1975*	*1970*	*1975*	*1970*	*1975*
Wheat	320	350	18	20	3.5	10.8
Coarse Grains	580	860	8	12	2.8	10.7
Sugar	70	80	30	27	2.6	10.4
Nondairy Fats and Oils	35	40	35	32	3.5	7.7
Fish and Fish Products	80	70	14	12	3.0	6.0
Coffee	4	4.5	76	77	2.9	4.0
Beef and Veal	35	45	5	5	1.8	3.7
Rice	310	340	2	2	0.9	2.1
Cocoa	1.4	1.5	78	79	1.0	1.8
Pork	25	40	2	2	0.5	1.7
Oil Cakes	50	25	48	42	2.6	1.6
Tea	1.0	1.3	59	38	0.5	0.8

Source: USDA Economic Research Service

These, then, are the factors and trends that currently influence the world corn system. Our description of this commodity system would not be complete, however, if we did not mention the technological revolution now occurring within it. That is the purpose of the next section of this chapter. After that discussion, we will be able to describe precisely the structural results of these various forces for change on the corn system.

Technical and Nutritional Aspects of Corn

The agronomic characteristics of corn and its many uses decisively influence the decisionmaking of participants in the world corn system. Corn is produced in temperate and tropical regions throughout the world and on both highly capital-intensive operations and purely subsistent farms. The grain itself is classified into seven groups: dent, flint, flour, pop, sweet, waxy, and pod, the most important of which are dent and flint. Within all groups are white and yellow varieties. The dent group has the highest yields and accounts for over 90 percent of U.S. production. Flint varieties have a higher nutritional value than dent and are preferred in Spain, Argentina, and Italy. Their popularity in some other markets is high because their high xanthophyll content imparts a yellow color to poultry and egg yolks. Furthermore, flint corn can be stored and shipped with less spoilage than dent varieties. Many of the less important varieties of dent and flint are gradually disappearing from use as hybrid seed technology spreads throughout the world, bringing increasing uniformity to the varieties of corn in use.[3]

In its end uses corn is a highly versatile crop. It is a dietary staple in the cereal-based economies of many developing countries, particularly in Latin America and Africa, but also in parts of Asia. It is the most important feed grain in the livestock economies of the more developed nations. Although processing of corn absorbs only a small portion of total world production, a wide range of food, feed, and industrial products are produced from it. The wet-milling process, for example, produces industrial starch plus various by-products used in the manufacturing of animal feeds (steepwater, bran, and gluten) and of corn oil (germ). Prices for these by-products can be as important to the wet miller's economic fortunes as the price he receives for his primary product. Much of the world's cornstarch production is converted into corn syrups and sweeteners that compete with cane and beet sugars. In addition to wet milling, other corn processing industries produce breakfast cereals, corn meal, and alcohol.

Nutritionally, corn is the least important of the three major grains. It provides about 6.2 percent of world per-capita direct caloric consumption and 5.5 percent of protein. Wheat supplies 19 percent and 20 percent of these categories, respectively; and the figures for rice are 19 percent and 13 percent.[4] Corn is of relatively low nutritional value for humans because of its low protein content and poor balance of essential amino acids. Protein is 8 percent to 10 percent of corn by weight, and most varieties are deficient in two important amino acids:

lysine and tryptophan. All cereals are relatively low in protein content, so protein *quality*[5] is a major determinant of the amount of usable protein available from grain. Of the major grains, rice has the highest quality protein. It is followed by oats, wehat, sorghum, and corn.

Efforts to improve the nutritional value of corn have been in progress for many years. These efforts concentrate on genetic breeding, but protein fortification and improvements in storage systems are also being studied. In the 1960s, researchers at Purdue University in the United States discovered a recessive gene in corn called Opaque-2 that can cause an important change in the amino acid balance. The amino acid pattern it sponsors has higher levels and a better balance of lysine and tryptophan, therefore more usable protein. Unfortunately, Opaque-2 corns have a floury or powdery kernel that has visibly lower weight, volume, and density than more common corn types. As a result, corn consumers in poor countries resist introduction of the more nutritious varieties.

For many years, experimenters have also worked to improve the productivity of the corn plant. Of potentially revolutionary impact on the corn system is the recent discovery by genetics researchers at the University of Canada of a mutant strain of double-eared corn. With this variety, two ears of corn grow for every one a normal plant produces, and the plant's yield is doubled. Both cobs are reported to be of normal size and to mature at the same time. The researchers believe it will take between five and ten years to produce reliable, marketable varieties of this corn, which seed companies could offer to farmers with a guarantee of good results.[6] The long-range effect of this development could be very important, given increasing pressure on the world's food-producing resources and efforts by governments of poorer countries to upgrade the diets of their populations with protein from corn-fed animals.

This brief overview only begins to cover the corn commodity. An awareness of the growing nutritional and productivity efforts being developed by various international and domestic research institutions is essential in understanding the new impact the world corn system will have in the total world food system. National planners will take these new uses into consideration when determining incentive programs for corn versus other crops.

Structure and Coordination in the World Corn System

The world has between 140 and 150 million farms,[7] 40 million of which are estimated to produce most of the commercially marketed food. In other words, a minority of commercial farmers produces most of the world's food and supports a large nonagricultural population. More than half the world's farmers produce barely enough—and at times less than enouth—food for themselves and their families. Similarly, a minority of commercial consumers buys most of the traded food supplies, while the majority of consumers at or near a subsistence level finds it difficult to purchase an adequate amount and variety of food.

These conditions become apparent when U.S. agribusiness is contrasted with

the food economy in much of the rest of the world. Commercial farmers who are integral participants in U.S. agribusiness through their participation in cooperatives and contractual arrangements and through their use of futures markets are responsible for over 90 percent of U.S. food production. At the opposite end of the American system are retail consumers who are generally able to purchase food for a wide range of dietary and nutritional patterns. Government Food Stamps provide assistance to consumers whose incomes are too low to permit them to purchase adequate food on their own.

With the exception of Europe, Japan, and the highest income groups in other regions, the food economy of the rest of the world is the reverse of this structure. Over half the producers are subsistence farmers. Most consumers cannot afford to buy food for a sound diet and, except in the oil-producing nations, their governments lack the resources to assure them one.

The existence of large numbers of people who are barely able to produce an adequate diet for themselves, or to purchase one from others, is an important obstacle to economic growth in many parts of the world. The various commodity systems with which these people are associated offer a means to overcome this obstacle. But developing systemic links to these peoples is a complex task that requires a thorough understanding of the systems' organization and coordinating mechanisms. In this report, we must identify how less organized or coordinated parts of the world corn system operate and then work to relate them to its more efficient parts.

Table 2-12 shows how key components of the world corn system have changed over time. Although it is currently impossible to determine the number of livestock producers and industrial enterprises that require corn as a feed, it can be presumed that their numbers have increased as world population has grown, livestock output expanded, and corn production increased. It is also impossible to identify the farmers who are primarily corn producers among the world's approximately 146 million farmers. Nonetheless, Table 2-12 does begin to place some dimensions on the world corn system. This skeletal outline could be fleshed out if a country-by-country effort were made to identify the number of participants at each level of the system; the volumes of corn they handle; the value they add at each level; and the quality of competition they face. Ultimately, any significant business or policy decision affecting a national commodity system should be based on such information. Similarly, policy decisions affecting the international corn system must eventually be based on such data.

The structure of the world corn system has fully formed and still-developing components, just as the world economy has industrialized and developing segments. The developing countries are modernizing their economies and agricultural sectors, however, and as they do, their ways of producing and consuming corn will probably approximate patterns in developed countries. Furthermore, those countries endowed with the proper soil and climate for corn production will be able to modernize their corn systems to meet both their internal requirements and foreign demand. As these two processes occur, the corn systems of the de-

Table 2-12. Growth in the World Corn System from 1960 to 1970, with Projections for 1985

	1960	*1970*	*1985*
Consumers[a] (billions)	3.0	3.61	4.81
Meat Production[b]			
(million metric tons)	67.3	102.2	151.7
Beef	28.0	39.9	57.3
Mutton	5.6	7.2	10.3
Pork	27.6	37.5	53.9
Poultry	6.1	17.5	30.2
Livestock Population[c] (millions)	4,327.8	8,895.1	14,836.6
Cattle and buffalo	135.3	1,250.7	1,936.8
Sheep and goats	1,343.2	1,457.3	2,155.7
Swine	524.1	626.9	1,075.4
Poultry	2,225.2	5,560.2	9,668.7
Corn Price			
(in U.S.$/ton for #2 yellow, f.o.b. U.S. Gulf)			
Current dollars[d]	48.31[h]	61.29[d]	200.00[e]
1974 constant dollars[e]	86.00	98.00	95.00
Production[f]			
Corn			
Hectarage (million hectares)	102.2	107.2	130.0
Output (million metric tons)	208.5	261.3	364.0
Yield (tons/hectare)	2.04	2.44	2.80
All grains			
Hectarage (million hectares)	657.4	699.7	
Output (million metric tons)	935.9	1,212.9	
Yield (tons/hectare)	1.42	1.73	
Farms[g] (millions)			
Corn farms	n.a.	20.0	
All farms	n.a.	146.8	

[a]1960: FAO, *Production Yearbook, 1961;* 1970: FAO, *Production Yearbook, 1975;* 1985: World Bank.

[b]1960: FAO, *Production Yearbook, 1962;* 1970: 1969-71 average, from FAO, *Commodity Review and Outlook, 1975;* 1985: University of California, *A Hungry World,* July 1974, p. 133.

[c]FAO Production Yearbooks and FAO Predictions.

[d]FAO, *Production Yearbook, 1972;* and FAS, USDA.

[e]World Bank unpublished estimates.

[f]1960: FAO, *Production Yearbook, 1962;* 1970: FAO, *Production Yearbook, 1972.*

[g]Corn Farms: Study estimate based on assumed world average corn farm size. All Farms: FAO, *Production Yearbook, 1975.*

[h]The 1960 figure is for crop year 1961-62.

veloping countries will become more interrelated with those of the industrial nations. Various coordinating devices, such as futures markets, commodity agreements, contractual and vertical integration, and joint ventures, will blur the current distinctions between the developed and developing corn systems. This convergence is already occurring, as subsequent chapters will demonstrate.

The developed segment of the world corn system has an interest in enabling

developing-system participants to enter the developed sector. Developing agribusiness represents a vast market and a huge pool of underused human and natural resources.

For the most part, it is a highly concentrated industry with sophisticated coordinating arrangements. For most developed countries, the top ten firms in each functional area represent more than one-third of the commercial dollar volumes involved. In developing countries, the number of primary entities is even smaller.

Mention should be made of the particularly critical role played by grain wholesalers. Despite the relatively large number of grain corporate and cooperative wholesalers, international trade in corn and othr grains is handled by a small number of publicly, privately, or farmer-cooperatively owned companies. Their trading activities are based on an understanding of world commodity systems and their ability to store and move large volumes quickly and efficiently. They are readily able to cope with volatile markets and widely fluctuating prices, and they are sophisticated users of such coordinating devices as futures markets and worldwide intelligence.

In contrast to the operations of these firms are the activities of government-managed grain marketing entities in the major exporting nations. In Argentina, for example, the government controls grain marketing through the "Junta Nacional de Granos," or National Grain Board (NGB). The NGB assumed sole responsibility for purchasing and marketing corn and sorghum in January 1974. This arrangement has significantly reduced the role of the private grain trade in Argentina. Large shippers and traders, who previously purchased corn from farmers and moved it to export position or into the domestic market via their own elevators, now are limited to receiving for the account of NGB. The NGB takes title at the elevator and moves corn into export itself. Government-to government contract sales are increasing in importance, with particular emphasis on sales to Cuba, the People's Republic of China, and other socialist countries.

The Maize Board tightly controls corn marketing in South Africa through cooperatives that own virtually all storage elevator capacity and act as buying agents for the account of the board. Private traders are limited to buying from the board and reselling in the domestic market or bidding on board tenders for export. The board does not control the final destination of exports, except in the case of government-to-government contracts, which are currently in effect with Taiwan and Venezuela.

With the exception of these countries and the United States, the only consistent exporter of corn to world markets is Thailand, which expanded acreage, production, and inputs almost steadily throughout the 1960s and early 1970s. Government corn production goals generally have been achieved, and under normal conditions about 90 percent of the corn crop is exported. Virtually all of the exports go to markets in Southeast Asia. The most important market is Japan, which is supplied under contracts negotiated annually between the Japan Feed Trade Association and the Thai Board of Trade.

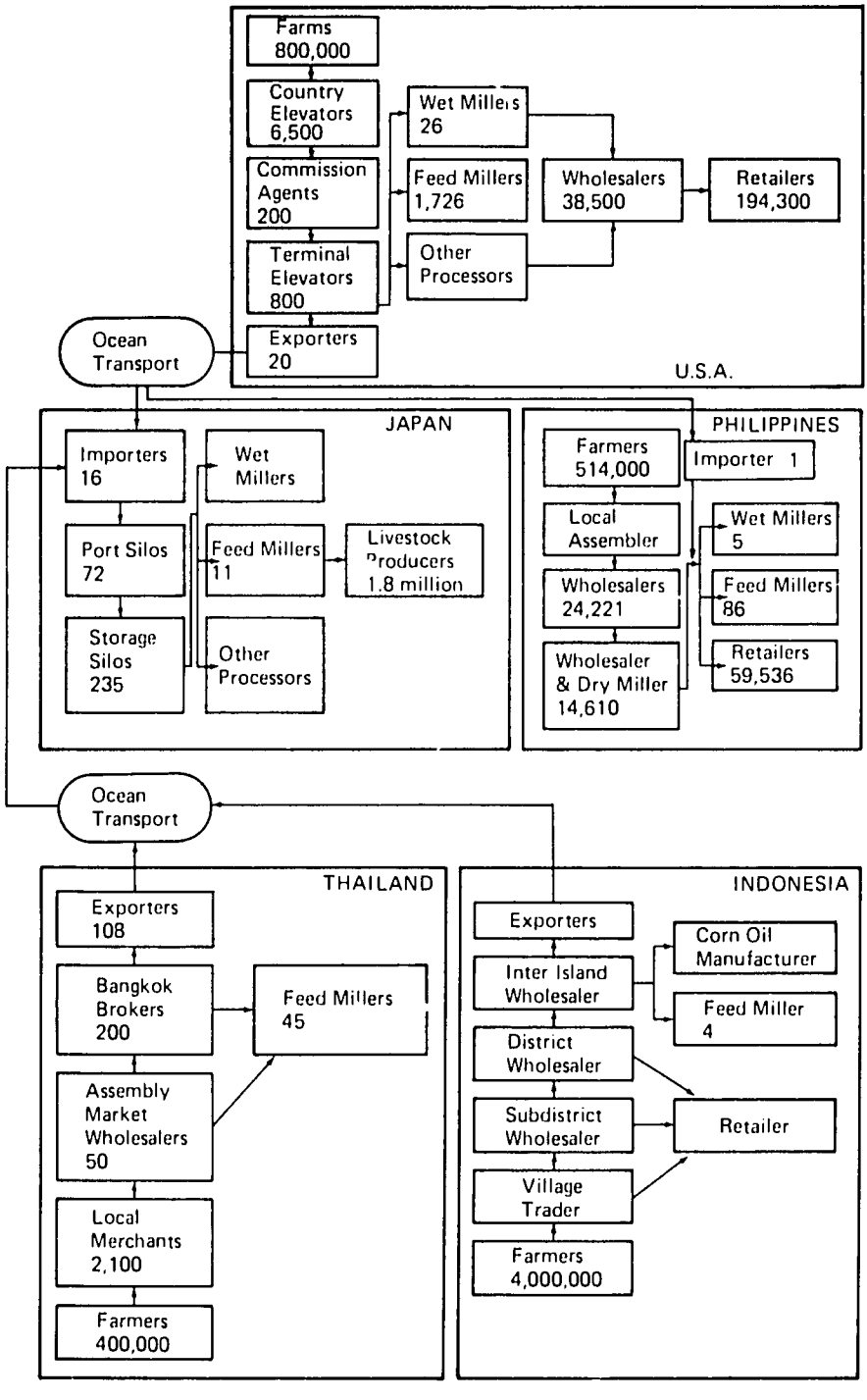
The result of this mix of government-controlled and private wholesalers is that a small number of participants play a major coordinating role in the international corn market. Coordinating arrangements strive to manage or transfer risk while improving information flow among system participants. In the developed sector of the world corn system these devices are well developed and widely used. The result is high productivity and efficiency.

Farmers, traders, and processors make major use of one coordinating device: the futures market. It serves farmers and other traders in corn by providing liquidity to the market. Traders who want to hedge and farmers who want to sell at a given moment do not have to worry about finding an actual cash buyer. Farmers can use the futures contract to hedge their harvest and fix the price they will receive for their crop in advance. Traders, who are concerned with their exposure to the market risks of thin margins and volatile prices, use the futures market to hedge their inventory and commitments. Livestock feeders can also use the commodity exchange to lock in profits afforded by existing relations between feed and livestock prices. Thus, the futures market allows participants to conduct their operations with less uncertainty by distributing their risk among speculators who will accept it. This risk-reducing function allows participants in the commodity system to concentrate on those segments of their operations they control directly.

Vertical integration is another means of managing risk exposure in the corn system. The activities of major grain companies illustrate how this technique can restrict risk exposure to preferred points. These companies have integrated backward to the storage and transport of grains or forward into processing and even into proprietary activities. In so doing, they have tried to coordinate nonessential segments of their operations to support the primary business centers. Vertical integration may raise the level of efficiency between segments of a commodity system. But it can also lead businesses to concentrate their efforts in segments of the commodity system where they were not previously involved. As companies have integrated forward, their traditional commodity nature has sometimes declined in importance as their new activities became larger and steadier profit earners.

Trade associations serve as coordinators by providing their members with intelligence about a commodity system. Producer trade associations disseminate information, foster improved corn market conditions, and represent their membership to government. Corn refiner, miller, and feed associations represent the interests of their respective groups as well.

The major grain-trading firms and Japanese trading companies are also important coordinating mechanisms. These companies have linked segments of the world corn system in both developed and developing nations from the level of the grower to processing operations that range from feed production to corn wet milling. More will be said of them in subsequent chapters. One such firm is Zen-Noh, a $16 billion Japanese cooperative that is discussed more fully in a case study in Appendix A to this chapter.


Farms 800,000
Country Elevators 6,500
Commission Agents 200
Terminal Elevators 800
Exporters 20
Wet Millers 26
Feed Millers 1,726
Other Processors
Wholesalers 38,500
Retailers 194,300
Ocean Transport
U.S.A.
JAPAN
Importers 16
Port Silos 72
Storage Silos 235
Wet Millers
Feed Millers 11
Other Processors
Livestock Producers 1.8 million
PHILIPPINES
Farmers 514,000
Importer 1
Local Assembler
Wholesalers 24,221
Wholesaler & Dry Miller 14,610
Wet Millers 5
Feed Millers 86
Retailers 59,536
Ocean Transport
THAILAND
Exporters 108
Bangkok Brokers 200
Assembly Market Wholesalers 50
Local Merchants 2,100
Farmers 400,000
Feed Millers 45
INDONESIA
Exporters
Inter Island Wholesaler
District Wholesaler
Subdistrict Wholesaler
Village Trader
Farmers 4,000,000
Corn Oil Manufacturer
Feed Miller 4
Retailer

The devices so far alluded to primarily involve the developed segment of the world corn system. They can be adapted, however, to serve the needs of participants in the developing sector as well. For the Southeast Asian corn system, for example, the Chicago futures market is the major influence on the price of internationally traded corn. The leading regional producer of corn, Thailand, and its leading buyer, Japan, formally base the price of the corn they trade on Chicago futures market quotations. Bangkok prices generally reflect changes in the Chicago quotation, adjusted for transportation costs to Japan. Participants in the Thai-Japanese system thus have a common reference point for trading in corn and considering future commodity-related investments.

One way to visualize the interrelated nature of the corn system is presented in Figure 2-1, which emphasizes these structures in the selected study countries of the United States, Japan, Philippines, Thailand, and Indonesia.

This brief summary of coordination devices and the prospect for linking the developed and developing corn systems is intended to raise this study's basic issue: unification of a fragmented world commodity system to make it more responsive to the priorities of the nations involved. This introduction will be of use in our subsequent analyses of the Japanese, U.S., and Southeast Asian commodity systems. But first, we will complete our analysis of the major trends affecting the world corn system.

Additional Trends Affecting the Structure of the World Corn System

Consumption and Trade. Corn, wheat, and rice—the world's three most important cereal grains—together account for over 75 percent of the world's total grain supply. Although rice is used almost exclusively for human consumption, wheat, corn, and other feed grains[8] are used both for human consumption and as livestock feed. The developed world uses about 80 percent to 90 percent of all its feed grains as animal feed, while the developing nations consume over 70 percent of theirs directly as human food.

Consumption of grains, including corn, is increasing worldwide because of population growth and growth in per-capita income. The world's annual population growth of between 1.6 percent and 1.9 percent adds significantly to the total demand for grain.[9] A 1.9 percent growth rate adds about eighty million new consumers every year; a 1.64 percent growth rate adds about sixty-five million. Most of these new consumers live in developing areas, where populations are larger and growth rates higher than in developed countries.

Sources: USDA and (SEARCA) Southeast Asian Regional Center for Graduate Study and Research in Agriculture.

Figure 2-1. Major Participants in the Southeast Asian Corn System: 1974-75

Consumption of corn, either directly as human food or indirectly as livestock feed and processed products is related to economic development and consumers' real disposable income. Throughout the world, people have tended to switch from consumption of cereals to animal protein as their incomes rise above minimum subsistence levels. Available evidence suggests that increasing demand for animal protein begins to develop when income reaches $100 to $150 per capita per year in current prices (1978). Increased demand for animal protein products stimulates demand for livestock feed. These relations among per-capita income, consumption of animal protein, and demand for corn as a feed ingredient lead to the large differences in use of corn between developed and developing countries. Feed use thus accounts for more than 80 percent of corn consumption in North America, Japan, and Europe, compared with less than 20 percent in Asia and about 10 percent in Africa. Among the developing countries in these latter continents, corn will continue to be used mainly for human consumption at least through 1985. In the event of supply shortages, food use will have priority over livestock feed in these countries. This situation is especially evident in the Phillippines, where food and feed use of corn compete and where chronic undersupply of yellow corn forces the feed-manufacturing industry to import yellow corn and operate its mills below capacity.

Changes in per-capita income levels in various parts of the world are causing changes in the volume and direction of international trading in corn. The trade expanded very rapidly in the 1970s, as shown in Table 2-13. Import demand increased in all major markets, but especially sharp gains occurred in the Soviet Union and the People's Republic of China. Imports into Western Europe increased about 15 percent and imports to Japan doubled. Most developing countries in Latin America and Asia also increased corn import substantially.

Changes in volume during the early 1970s were accompanied by significant changes in the pattern of world corn trade. A large jump in net corn imports by developing countries increased their share of world imports from under 5 percent in 1961 to almost 14 percent in 1975. Even as Eastern Europe and the Soviet Union became net importers instead of net exporters, the industrial nations' share of corn imports declined. Western Europe continues to be the largest corn importing region, but its share declined from 60 percent to 30 percent between 1958 and 1978. Even with their governments' determination to increase per-capita consumption of animal protein, the Soviet Union and Eastern Europe accounted for only about 15 percent of world imports. Dramatically demonstrating the shift in direction of trade flows during this period is Mexico, whose increased domestic requirements converted an annual surplus of several hundred thousand tons during the 1960s and early 1970s to an import requirement of 1.6 million tons in 1978.

Human Consumption. About 25 percent of the world's corn supply is consumed by humans as grain or as products like meal, grits, tamales, and tortillas

Table 2-13. World Corn Trade, Selected Fiscal Years: 1958-1978 (in millions of metric tons)

Historic Exporters	*1958*	*1963*	*1968*	*1974*	*1978*
United States	4.6	10.2	14.5	34.9	44.2
France	(a)	.1	1.3	4.4	1.3
Argentina	1.0	2.7	3.2	5.1	4.7
South Africa	1.3	2.7	3.1	.4	2.8
Thailand	(a)	.7	1.2	2.1	.8
Indonesia	–	(a)	.1	.2	(a)
Brazil	(a)	(a)	.7	.4	1.1
Mexico	(a)	(a)	.8	(1.5)	(1.6)
Subtotal	6.9	16.4	24.9	46.0	53.3
Total World Exports	9.0	19.7	28.2	52.2	61.4
Central Plan Exporters					
East Europe	.5	.1	.4	(.3)	(2.2)
Soviet Union	–	.8	(.2)	(4.4)	(10.5)
People's Republic of China	(a)	(a)	(.3)	(2.0)	(.2)
Subtotal	.5	.9	(.1)	(6.7)	(12.9)
Developed Importers					
Western Europe	(5.4)	(12.7)	(17.2)	(18.9)	(19.0)
Japan	(.6)	(2.4)	(4.6)	(8.2)	(9.4)
Canada	(.2)	(.8)	(.8)	(1.3)	(.7)
Subtotal	(6.2)	(15.9)	(22.6)	(28.4)	(29.1)
Other Regional Trade Patterns					
South America	1.0	2.7	3.7	4.4	5.1
Africa	1.6	2.6	3.3	.4	1.9
Asia	(.5)	(2.6)	(4.4)	(11.0)	(14.6)

Note: (a) = less than 50,000 metric tons.
( ) = imports.
– = none or balanced.

Source: FAS, USDA, *World Grain Statistics* (FAS M-258).

made in the home. Within corn-growing regions in lower income countries, a very high percentage of the corn supply is consumed directly by humans. Over half of the corn produced in these regions may not leave the farms on which it is produced. Even in such regions, however, corn is usually less important nutritionally than wheat or rice, especially in Asia and Africa. This secondary role of corn reflects, at least in part, recognition of its relatively low-quality protein and poor balance of essential amino acids.

In many parts of the world, substantial increases are probable in the volume of direct human corn consumption merely to maintain existing low levels of nutrition. Population increases will be primarily responsible for this phenomenon. Additionally, per-capita income ranges in most developing countries still

have not risen to levels where high direct consumption of cereals for food disappears, although some switching from corn and other coarse grains to wheat or rice is noticeable.[10] Despite the increase in quantity of corn consumed directly by humans, however, it appears that direct human consumption as a percentage of total consumption will not increase.

In the mid-1970s many political, educational, and business leaders attacked the practice of feeding large amounts of grain to livestock. They maintained that then-scarce grain supplies should not be fed to livestock when millions of the world's poor were starving. The argument was particularly relevant to corn, the most important feed grain in the world's higher income countries and an important dietary staple in many poorer countries. There is no simple response to these criticisms. Higher income consumers have chosen to consume grain in the form of animal products, and governments have directly and indirectly encouraged them to upgrade their diets this way with controls, industry tax incentives, and other methods. Lower income consumers would upgrade their diets similarly if a change in their income permitted. In some countries, including the United States, an extensive livestock-feeding industry has developed as a result of a local surplus of feed grains. Nevertheless, for those who must depend on grain as the mainstay of their diet, the conflict between consumption of grain by livestock and direct human consumption can become a matter of survival. Their inability to bid effectively for available grain supplies and uncertainty about who should pay the cost of moving grain from surplus areas to deficit areas make hardship among poor consumers inevitable when grain supplies are short.

This issue has not yet been resolved. Now, as world grain reserves are gradually building again, the urgency of the problem is likely to wane in the minds of many. It should not. A year or two of crop shortages in several parts of the world could again threaten the survival of millions. If such a situation should develop, governments would probably rely on the same methods they use to cope with pressures on domestic food systems. But these would be ineffective in a severe international food crisis. For this reason, it is desirable to address formally the issue of human versus animal grain consumption at the international level before another food crisis breaks out.

Feed. Future developments in world corn consumption and trade will probably be most strongly influenced by feed uses. Commercially produced livestock products require several pounds of corn or other feedgrain per pound of products: for example, three pounds of corn yield one of poultry, five pounds of corn yield one of pork, and nine pounds of feed yield one of beef.[11] Cattle are primarily foragers and do not in fact consume nine pounds of corn for each pound of beef they produce. In fact, most of the world's beef production is not grain fed but subsists on grass. To the extent that beef cattle are fed, however, they receive a ration of grain and roughage, with roughage being the larger share of the ration's weight.

Future prospects for corn use as feed depend on the demand for various livestock products and on feeding methods and ingredients. The composition of livestock demand affects demand for corn. Pork and poultry must be fed considerable quantities of corn or other feedgrains, while cattle can be raised without any grain at all. Because per-capita real income is the primary determinant of animal protein consumption, even the moderate increases in income expected through 1985 should expand meat consumption substantially. Table 2-14 shows the growth in per-capita meat and poultry consumption for selected countries and regions between 1962 and 1975. Note the growth in developing countries, especially in Latin America. In some lower income countries significant increases in livestock consumption are occurring particularly in those countries with oil revenues, which are developing livestock industries based on imported grain. The absolute increase will probably be considerably smaller than that in higher income countries, however. Much of the meat increasingly consumed in the developing countries is pork and poultry rather than beef. Preference for these products results in greater use of corn and feed grains than would a preference for roughage-fed beef. Table 2-6 also suggests that slower economic growth in high income nations will slow the rate of growth in demand for livestock products and thus for corn and other feed grains.

Demand for corn as a feed ingredient may decline somewhat as a result of changes in feeding technology and the availability of competing ingredients. Developmental efforts currently in progress may improve the use of grasslands in many parts of the world. Single-cell proteins, urea, recycled waste by-products, and upgraded roughage materials offer the potential of replacing corn and other feed grains for some applications.

Corn use in livestock feeding will also depend on corn's efficiency and cost relative to other possible feed ingredients. Livestock feed contains energy, protein or amino acids, vitamins, minerals, and water. Cheap and easily available

Table 2-14. Growth in Per-Capita Meat and Poultry Consumption, Selected Countries and Regions: 1960 and 1975 (in kilograms per capita)

	1962	*1975*
Developed		
United States	90	105
Japan	58	71
European Community (EC)	38	52
Soviet Union	6	13
Developing		
South America[a]	33	40
Africa	13	18
Southeast Asia	6	8

[a]Excludes Argentina.

Source: Various publications of FAS, USDA.

corn is now commonly used as the energy source, but other ingredients may take its place. In swine feeding, for example, finely ground whole oats have a corn replacement value of 77 percent and can replace 25 percent of the corn fed to hogs without seriously reducing their rate of weight gain. Hulled or rolled oats have a feeding value 7 percent greater than corn's. Ground wheat has a replacement value of about 100 percent, ground grain sorghum 98 percent, and ground barley 86 percent.[12] Other substitutes are also available. The substitutability of wheat for corn is especially important because currently wheat is in oversupply in many parts of the world, and the surplus is expected to persist through 1985.[13] Thus, although the world's corn and livestock economies are closely interrelated, corn use in livestock feeding need not be directly related to the anticipated growth in livestock output.

Obstacles to world trade in meat may also exert a dampening effect on the use of corn. Meat production in developing countries will be influenced by export demand and domestic consumption, but future demand and trade of meat may depend more on the policies of the importing countries than on the rate of income growth. Present policies designed to encourage domestic industries restrict meat consumption and imports, especially in the European Community and Japan. If harmonization of agricultural policies in the European Community (EC) is achieved by 1980, the United Kingdom will cease to be a major market for meat from Australia, Argentina, and new suppliers. The United States might become the most important long-run market for the meat-exporting countries, but Argentina and other South American exporters are presently unable to ship to the United States because of foot-and-mouth disease restrictions. Furthermore, U.S. livestock producers will continue to support or advocate tightening the present voluntary quota system for exports of meat to the United States. If trade restrictions cause a slowdown in world livestock consumption, demand for feed corn will certainly be affected.

Processed Products. Corn is used for manufacturing purposes by wet and dry millers, distillers, and breakfast-food manufacturers. Less than 5 percent of the world's corn crop is used for these purposes, and the proportion is stable. Wet processing, or refining, is the most important industrial use of corn. Starch is the primary product of this process. It is used in the manufacture of laminated and corrugated paper products, confectionary and other food products, textile manufacture, and in building materials. Starch can also be upgraded in the wet-milling process to produce sweeteners such as corn syrup, corn sugar, and dextrins. In general, the demand for starch depends on general economic conditions. An important new starch product is high fructose corn syrup (HFCS), or levulose, which has a wide variety of uses in industrial food preparation. Even with this important new source of demand, however, starch manufacture will not require an increasing share of world corn production. HFCS is of greater moment to sugarcane and sugar beet growers than to corn farmers.

Annual world starch production is about twelve million tons, and industrial nations are the leading producers and consumers of the products. The United States is the largest producer (over one-third of world production) followed by Japan, the Netherlands, and the United Kingdom. The U.S., Latin American, Japanese, and European starch industries are corn-based. Netherlands, France, and Poland produce mainly potato-based starch. Wheat is the major source in New Zealand and Australia, and Thailand's production is derived from cassava.

In developed countries, the most important determinant of demand for starch is the level of gross national product. Previous increases in the demand for starch and starch-derived products have been the result of growth in industries already using the products and technical developments that have generated new demands or increased use in existing applications. The trend in developed countries toward increased use of prepared foods containing cornstarch has also led to increased industrial production. New products have enabled the starch industry to continue its growth. Experimental modification methods and derivatives are constantly under study, and innovations should stimulate a growing demand for corn from this industry.

Seed. Prior to the development of hybrid corn seed, farmers brought seed, grew their crop, saved some, then used what they saved as seed the following year. Hybridization has allowed seed companies to develop their own higher margin products, which provide farmers with superior crop characteristics, especially in terms of yield. Developed countries have aggressively pursued hybridization because their commercially oriented farmers have understood its advantages, fertilizer and pesticides have been available and priced within reach, and seed varieties have been specifically bred for their geographic areas.

In developing countries, on the other hand, very limited markets have slowed development of hybrid corn seed. Most corn producers are small, semicommercial or subsistence farmers who use a minimum of purchased inputs in their operations. These farmers are often unfamiliar with the potential of hybrids, and many times there are no seeds adapted for use in their area anyway. Even where seeds are available, small farmers may be unable to pay for them and for the additional inputs required for their use. Those able to pay often fear the risks involved in changing their production practices. These problems have resulted in a larger percentage of the developing countries' corn crops being consumed as seed than in developed countries, where most farmers are commercial and make use of significant amounts of purchased inputs.

Waste. The world's food needs will not be met without improved post-harvest operations to reduce losses and make use of wastes. No one really knows the magnitude of annual loss and waste, yet there is no question that a significant percentage of what is produced never becomes food for humans or livestock. Coursey and Haynes estimate, for example,[14] that losses in root-crop[15]

production in the tropics reach between 25 percent and 50 percent. Similar losses in the corn system, particularly in tropical areas, may exist. Their true magnitude and the possibility of their reduction deserve investigation. Pending that effort, we must assume that a significant percentage of the world's corn crop is lost each year, and we must classify it as a component of consumption.

Projected Consumption. Calculations of the current demand and the 1985 projected demand for grains on a worldwide and regional basis have been made by the Food and Agriculture Organization of the United Nations (FAO), the Economic Research Service of the Department of Agriculture, the University of California, Iowa State University, and other organizations. Although the methodology and specific results of these projections differ significantly, they do agree generally in one critical respect: there will be a large shortage of all grains in developing market economies by 1985. All studies, other than FAO's (which did not project world grain balances) and Iowa State's (which projected a large surplus), indicate that grain demand and supply will be approximately in worldwide balance in 1985, but worldwide balance is deceptive. With regard to feed grains, USDA projections foresee large surpluses in North America and major export opportunities in Asia and Europe (Table 2-2). Although one may find fault with particulars in each study, as a group they have two convincing implications regarding the world corn system. First, its most pressing challenge is to develop the capability to distribute the large North American surpluses to deficit areas. Second, to guard against the possible failure of the surpluses to materialize and to reduce foreign exchange outflow, developing regions should take steps to reduce the size of their probable shortages.

Supply Response. Corn is produced throughout the world all year long, but the bulk of the harvest is taken in between July and December in North America, China, France, and parts of Mexico and Brazil. Except for rice, most of which is produced in Asia, world grain production including corn is dominated by the industrialized market and planned economies. Developing countries, with about half the world's population, produce only about one-fifth of the world's annual wheat and corn output.

As Table 2-15 shows, total world grain production increased at a compounded rate of 2.7 percent per year between the early 1960s and mid-1970s. On a global basis, the expansion in grain production was sufficient to provide for an improvement in per-capita intake of 1.9 percent per year during that decade. This overall average masks important differences among countries and regions, however, and especially between the developed and developing nations.

Table 2-16 shows that a small number of producing countries account for a substantial portion of the total production of each of the principal grains. The United States produces almost half the world's corn and sorghums; the Soviet Union variously produces between one- and two-fifths of all wheat, barley, oats,

Table 2-15. Growth in World Grain Production: 1975 versus 1961-1965

	Production in Millions of Metric Tons		*Percentage of Average Annual Growth Rate*
	1961-1965	*1975*	
Corn	216.1	322.5	3.4
Wheat	254.5	355.2	2.8
Rice	253.2	343.9	2.6
Other Grains[a]	269.1	337.6	2.1
World Total	987.9	1,359.2	2 7

[a]Barley, oats, rye, millet, and sorghum.

Source: USDA Economic Research Service.

Table 2-16. Percentage of World Grain Production by Largest Producers: Crop Year 1975

		Percentage of World Production			
Grain	*Largest Producer*	*Largest Producer*	*Three Largest*	*Five Largest*	*Ten Largest*
Wheat	Soviet Union	19.2	45.6	57.8	73.0
Corn	United States	46.8	62.3	68.1	80.3
Rice	China	34.8	61.1	71.0	84.3
Barley	Soviet Union	25.6	38.7	51.0	73.1
Oats	Soviet Union	26.5	55.1	70 2	85.2
Sorghum	United States	35.9	64.8	77.4	90.3
Rye	Soviet Union	37.6	73.4	83.2	92.6

Source: For sorghum, FAO, *Production Yearbook, 1975*. For all other grains, USDA, *Agricultural Statistics, 1976*.

and rye; and the People's Republic of China accounts for about one-third of the rice crop.

Corn yields vary considerably from region to region. Yields in most developing countries are very low compared with those for the developed nations. Table 2-17 reveals that in 1975, for example, yields in developing countries were only about 1,300 kilograms per hectare compared with about 4,800 in the developed countries. Only in Argentina and Thailand, the principal developing exporters, do yields begin to approach those in Eastern Europe and the Soviet Union, which are still far below the United States and Western Europe. Yields in the corn-producing countries of Asia, Africa, and Latin America are increasing, but much less rapidly than in the developed and centrally planned areas.

The increase in corn production in developed countries during the 1960s was primarily the result of higher yields. Total harvested acreage increased 17 percent in this period while yields increased 38 percent. Acreage planted in corn and in other basic grains was limited by price-support and supply-control pro-

Table 2-17. Corn Area, Yield, and Production by Geographic Region: 1975 versus 1961-1965

	Area Harvested (millions of hectares)		*Average Yield (kilograms per hectare)*		*Production (millions of metric tons)*	
	1961-1965	*1975*	*1961-1965*	*1975*	*1961-1965*	*1975*
Developed Nations[a]	33.2	38.8	3,507	4,834	116.4	187.4
Less Developed Nations[b]	44.8	55.4	1,132	1,325	50.7	73.4
Centrally Planned Economies[c]	21.6	20.4	2,272	3,033	49.0	61.8
World	99.7	114.5	2,170	2,816	216.1	322.5

[a]North America, West Europe, Oceania, South Africa, and Japan.

[b]Africa (except South Africa), Latin America, and Asia (except Japan and Asian centrally planned countries).

[c]Asian and European centrally planned nations including the Soviet Union.

Note: Figures have been rounded, so totals may appear inaccurate.

Source: FAO, *Production Yearbook, 1975.*

grams. In developing countries, on the other hand, increased acreage accounted for about one-half of the gain in production. In an effort to achieve self-sufficiency, their governments increased the land available for production through irrigation and other development projects.

Even the division of countries into developed and developing categories hides important similarities and distinctions among countries. For example, Table 2-18 shows absolute and percentage changes in maize yields for 1975 in selected nations. The yields in some developing nations are close to those in the more developed countries. For example, the United States yield is 5,410 kilograms per hectare and Japan's is 2,800. Chile's yield (3,360) is higher than Japan's, and Thailand (2,380) and Zambia (2,250) do not trail it by very much. There is a wide yield spectrum among the developing nations. In Latin America, Mexico's yield is 1,110 and Chile's is 3,360; in Asia, India's yield is 920, compared to 2,810 for Taiwan. In Africa, Zambia's yield is 2,250 and Nigeria's is only 840. The table also demonstrates the absence of a correlation between the relative rate of yield improvement and the relative ranking according to yield levels. For example, the Philippines has one of the lowest yields of any of the selected countries in Asia, but it experienced the eighth greatest percentage increase among the countries shown.

It is not possible, due to the lack of relevant data, to identify the causes for these different yield levels and rates of increases. Increased productivity probably reflects the adoption of improved technology, but in some cases it might simply be the result of using better land for corn or a more favorable climate that particular year. The incentive for such a change could come from shifts in

Table 2-18. Maize Yields in Selected Countries: Average 1960-1964 and 1975 (100 kilograms per hectare)

	1960-1964[a]	*1975*	*Percentage Change*	*Ranking of Yield Changes*
Southeast Asia				
Malaysia	20.5	25.0	22	11
Thailand	19.9	23.8	20	12
South Vietnam	10.6	11.7	10	16
North Vietnam	N.A.	N.A.	N.A.	N.A.
Cambodia	14.1	12.0	(17)	22
Indonesia	9.7	12.3	27	10
Philippines	6.5	8.5	31	8
Burma	5.7	4.5	(21)	23
Laos	N.A.	N.A.	N.A.	N.A.
Other Asia				
Japan	25.5	28.0	10	16
Taiwan	18.1	28.1	55	4
Pakistan	10.3	12.1	17	13
India	9.8	9.2	(6)	21
North and South America				
United States	39.2	54.1	38	7
Chile	23.8	33.6	41	6
Argentina	17.6	21.4	22	11
Brazil	12.9	15.0	16	14
Colombia	11.5	13.1	14	15
Mexico	9.5	11.1	17	13
Africa				
Zambia	17.3	22.5	30	9
Kenya	11.7	12.8	9	17
Uganda	11.6	11.0	(5)	20
Mali	10.0	6.7	(33)	24
Malawi	9.4	10.0	6	18
Ghana	9.3	11.2	20	12
Nigeria	8.4	8.4	0	19
Europe				
France	29.0	41.6	43	5
West Germany	32.9	55.3	68	2
Romania	17.2	28.6	66	3
Soviet Union	21.7	27.6	27	10
Yugoslavia	22.9	39.7	73	1

[a]Five-year average.

Source: FAS, *Reference Tables on Wheat, Corn, and Total Coarse Grain Supply-Distribution for Individual Countries*, USDA, May 1976.

world prices, differential government policies such as price supports, and demand from new domestic buyers such as cornstarch manufacturers. (See the *Rafhan Maize Products* example in Chapter 6). Such stimuli often also provoke the adoption of improved production techniques.

Regardless of their cause, the potential effect of increased corn yields on the

global corn system is great. The corn system, like other grain systems, operates at the margin: a small percentage shift in production can have a major influence on supply and demand equilibrium. If, for example, corn yields in the United States were increased 10 percent, an additional 14 million tons of corn—about 23 percent of today's trade volume—would enter the world's supply. It is possible that the developed nations are approaching a limit to their yields, but there is still considerable room for improvement among the developing nations. If developing-country yields were improved 10 percent, an additional 7 million metric tons would be produced—the equivalent of 11 percent of the corn currently in world trade. If the productivity gap between the rich and poor countries were reduced from 3.5 to 2.4 metric tons per hectare, the additional 62 million metric tons of corn produced would represent a 20 percent increase over 1975 world production levels. Such gains will depend to a great extent on technology, government programs, and entrepreneurship.

During the late 1960s, rice and wheat production in developing nations improved dramatically with the introduction of the high-yielding seed varieties (HYV), the result of a long process of genetic breeding. Adoption of the seeds along with ancillary inputs of agrochemicals, water management, and new husbandry techniques brought considerably better yields of these grains in some parts of the world. Corn, however, was largely bypassed by the "Green Revolution." This is due to the unique soil, climate, and technology combinations required in the growing of corn.

But genetic research and technology development is a continuous process. Just because corn has not shared in the initial gains of the Green Revolution to the extent of the other cereals does not mean that technology has bypassed it. There are merely certain tenacious difficulties in applying technology to corn crops.

The experience of HYV corn and wheat development in Mexico helps one to understand the major factors involved in yield improvement. Research on corn and wheat began in Mexico in the early 1940s as a collaborative effort between the Mexican government and the Rockefeller Foundation, an effort that continues today at the International Center for Maize and Wheat Improvement (CIMMYT)[16] in Mexico. Both crops have received roughly equal investments of funds and personnel, but the results in terms of yield improvement present a striking contrast (see Table 2-19). Between 1940 and 1960, wheat yields jumped 76 percent while corn rose less than half that. During the second decade the yield gap widened even more. By 1975 wheat yields were 300 percent greater than corn yields. The reasons for the discrepancy appear to be both the biological differences between wheat and maize and also institutional considerations. Delbert Myren has presented a perceptive examination of these factors.[17] A basic biological difference is that because maize is an open-pollinated plant, the full effect of hybrids can only be attained if farmers buy hybrid seeds every year.[18] In contrast, with self-pollinating wheat, farmers only have to buy a small amount of HYV to become self-sufficient.

Table 2-19. Maize and Wheat Yields in Mexico (kilograms per hectare)

	1940	*1960*	*Percentage Change*	*1961-65 Average*	*1975*	*Percentage Change*
Wheat	763	1,341	76	2,085	3,377	62.0
Maize	626	839	34	1,059	1,111	4.9

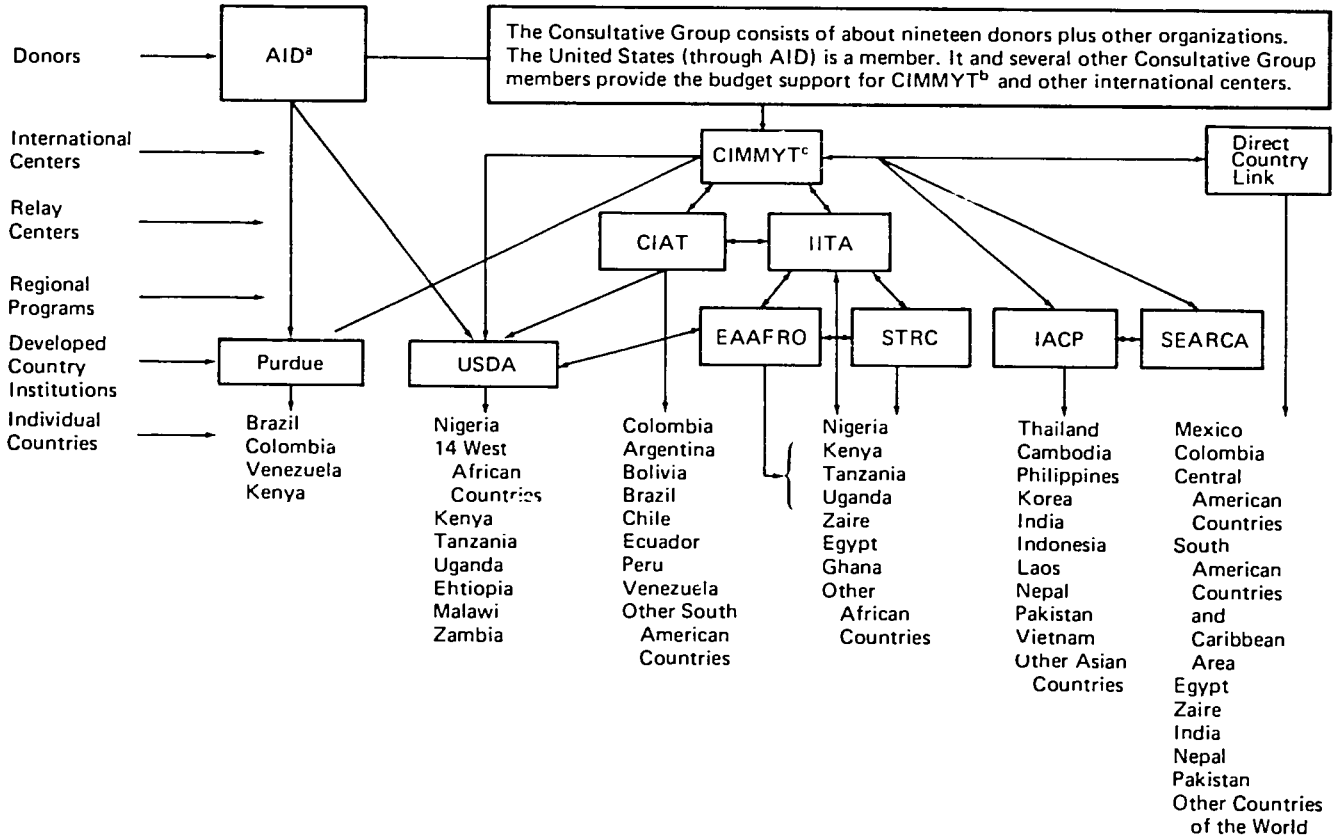
Source: FAO, *Production Yearbook, 1975.*

In respect to institutional considerations, Dr. Sterling Wortman makes the following observation:

> I think that there was one additional difference between the wheat and corn programs in Mexico, at least as I recall the situation when I was in charge of corn from 1951-1954. As I look back I realize that in the corn program we primarily had a plant breeding effort under way, not a comprehensive production program of which plant breeding was a necessary part. We were concerned very much with the problem of developing the many varieties of hybrids needed for the greater number of ecological situations in Mexico and we carried this program to the point of producing foundation seed for the National Corn Commission. We did not, unfortunately, measure our own progress by what happened to the national average yields of corn in Mexico. Rather we worried about getting enough foundation seed to the Corn Commission to allow it to plant the projected acreage of single crosses for the production of doubles. The wheat program on the other hand was concerned not only with development of rust resistant, high-yielding varieties but with seed production, the use of higher amounts of fertilizer, and adoption by farmers.[19]

Myren pointed to other differences:

1. *Quantity of Land*: the maize area is eleven times greater than wheat plantings (7,050,000 hectares versus 663,800 hectares); this increases the magnitude and difficulty of the technology dissemination task.
2. *Quality of the Land*: wheat is being produced almost exclusively (85 percent) on irrigated land whereas only about 10 percent of the maize land is irrigated. Yields do not differ greatly in natural rainfed areas.
3. *Nature of the Producers*: Here the contrast is great--with wheat being grown almost entirely on larger commercial farms while semisubsistence farms dominate maize production.[20] It seems reasonable to assume that the smaller maize farmers, who depend on their crop for their own food, would be more risk averse and hesitant to adopt new technology with its implicit risks than the larger wheat farmers.[21]
4. *External Stimuli for Change*: The wheat farmers faced the threat of disastrous losses due to rust disease, thus the urgency to adopt a disease-resistant variety


Donors
International Centers
Relay Centers
Regional Programs
Developed Country Institutions
Individual Countries
AID[a]
The Consultative Group consists of about nineteen donors plus other organizations. The United States (through AID) is a member. It and several other Consultative Group members provide the budget support for CIMMYT[b] and other international centers.
CIMMYT[c]
Direct Country Link
CIAT
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Nigeria
Kenya
Tanzania
Uganda
Zaire
Egypt
Ghana
Other African Countries
Thailand
Cambodia
Philippines
Korea
India
Indonesia
Laos
Nepal
Pakistan
Vietnam
Other Asian Countries
Mexico
Colombia
Central American Countries
South American Countries and Caribbean Area
Egypt
Zaire
India
Nepal
Pakistan
Other Countries of the World

[a]AID is shown apart in order to indicate funding linkages to U.S. research institutions. AID also contributes through bilateral arrangements to individual country programs and to the secondary centers shown. Other donor members of Consultative Group have corresponding additional funding linkages.

[b]For 1973, these are Canada, the Ford Foundation, Germany, Rockefeller Foundation, United Nations Development Program, and the World Bank. Other Consultative Group donors include Belgium, Denmark, France, Japan, the Kellogg Foundation, Netherlands, Norway, Sweden, Switzerland, and the United Kingdom. Any Consultative Group members are potential financers of operating linkages within the network.

[c]The links between CIMMYT and the individual countries take the form of: information and materials (e.g., seed) exchange (including seminars and workshops); joint research; advisory services; and training. There are links of a corresponding nature—in most instances, less comprehensive than for CIMMYT in the case of corn—among the relay centers, regional programs, developed country institutions noted, and the individual countries.

Source: *International Agricultural Research Network for Maize,* Network Series—Agriculture 1, Office of Agriculture, Washington, D.C., October 1973, p. 5.

Figure 2-2. International Corn Research Network

of wheat was great. The maize farmers did not face such an imminent environmental threat to their crop. A second type of external motivating factor is government policy. The Mexican government originally gave a higher support price to wheat than corn; however, this situation has now reversed. The government's program to develop irrigation system infrastructure in wheat-producing areas also was a significant stimulant to HYV adoption and yield differences.

5. *Ecological Adaptability*: Hybrid corn is less able to adapt to geographic and ecological variations than HYV wheat. The Mexican wheat varieties have been successfully used at sites ranging from 0 to 50 degrees latitude a wide longitudinal spread, with varying rainfall levels. This adaptability is to a great extent due to the relative photoperiod insensitivity of wheat. Corn hybrids, in contrast, require considerable on-site genetic breeding in order to adapt to local climatic conditions.

The difficulties facing corn development in Mexico may point to unrealized potential rather than to insurmountable barriers for the biological potential of corn may even be greater than that of wheat. In Mexico, reports Myren, "the highest-recorded corn yields are well above those of wheat."[22]

The existence of an international corn research network brightens the outlook for continued and accelerated technological progress. This network pools the knowledge and resources of agricultural research and training organizations, other government institutions, and donor agencies from all nations in a cooperative attempt to improve the technology of corn production. Figure 2-2 diagrams the institutional linkages in the network.

CIMMYT, the network's center, designs research for the improvement of nutritional quality and yield.[23] Its specific objectives are two:

1. breeding for adaptation resistance to disease and insect pests, for achievement of genetic yield potential, for high protein quality, and for response to the favorable conditions of the environment.
2. development of commercial varieties and new production techniques for farmers.[24]

Pursuit of these objectives is carried out in two programs: one devoted to core research, and the other to the development of new varieties and production techniques for Mexico and other cooperating countries. Core research stresses the evaluation and population improvement of germ plasm.[25] Development of new varieties and production techniques involves testing experimental varieties in many countries, selecting varieties for commercial production, and trying various production packages in the field. National research institutions release the new varieties in their own countries. Of particular importance is adapting the research to the appropriate local production technologies for farmers in differ-

ent regions and varied economic circumstances.[26] Future research at CIMMYT will stress cooperation with other institutions, manpower development for national programs, and development of production packages.

The Interaction of National Agricultural Policies

The world corn system exists within a welter of national agricultural, food, and trade policies. These policies are generally based on national priorities determined by perceived national interest, national welfare, and national need. They all deal directly or indirectly with six key issues:

1. adequacy of domestic food supply
2. foreign trade and exchange
3. maintenance or improvement of rural income
4. employment
5. nutritional level
6. the soundness of agriculturally based industries.

It is inevitable that policies addressing these issues should influence domestic and international commodity markets, including those for corn and other grains.

As the world's major corn exporter, the United States has been the most influential force shaping the world corn system. Until the early 1970s, it employed high price supports to maintain producer incomes and encourage efficiency in agriculture. This policy resulted in surpluses stored in subsidized facilities. U.S. exporters needed export subsidies to be price competitive internationally. In addition, concessional sales to developing countries under Public Law 480 reduced costly surpluses. These government programs enabled producers to improve the productivity of their land, processors to have assured supply, and livestock producers to enjoy plentiful feed at relatively low prices.

Internationally, the U.S. price-support and surplus-storage programs created a high price ceiling under which other exporting nations developed their pricing policies. U.S. programs also provided stocks of grain to make up for production difficulties elsewhere in the world, and they insulated all American participants from the risks of international price fluctuations. As Chapter 4 will show, the result was to keep U.S. domestic corn prices relatively low and stable. The existence of these stocks had a similar effect on world prices. Table 2-20 shows the rather remarkable stability in corn price that existed between crop years 1963 and 1972 at Chicago, the major world pricing point for that grain. Corn prices averaged $1.25 per bushel, and on an annual average basis never fluctuated by more than 20 percent. On a monthly average basis, prices never fluctuated more than 30 percent, and fluctuations of this magnitude occurred only when grain production dropped in 1965-66, and when corn blight threatened the U.S. crop in 1970-71.

Some deficit nations, however, chose not to rely completely on U.S. reserves.

Table 2-20. Cash Corn Prices at Chicago: 1964-1977 (U.S. cents per bushel)

Year	*October*	*November*	*December*	*January*	*February*	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*Average*[a]
1964-65	120.7	117.2	124.1	126.0	129.0	181.0	133.0	136.0	134.0	133.0	128.0	128.0	127.8
1965-66	119.0	114.0	121.0	129.0	129.0	125.0	128.0	128.0	132.0	139.0	148.0	144.0	127.0
1966-67	137.0	131.0	142.0	140.0	138.0	138.0	136.0	137.0	135.0	128.0	122.0	119.0	136.0
1967-68	115.0	106.0	111.0	110.0	112.0	114.0	113.0	117.0	113.0	110.0	106.0	106.0	112.0
1968-69	106	113	114	118	116	115	120	130	130	127	128	119	117
1969-70	116	115	115	122	123	122	126	130	134	138	147	150	125
1970-71	140	141	152	159	157	155	151	151	159	149	129	115	144
1971-72	110	107	121	122	121	123	126	129	127	129	130	136	118
1972-73	132	133	157	158	159	159	165	201	242	252	291	247	191
1973-74	237	250	268	290	313	299	269	270	293	335	363	355	295
1974-75	374	348	347	319	296	290	296	282	289	295	312	299	312
1975-76[b]	274	259	259	262	270	268	268	284	296	296	287	277	275
1976-77[b]	249	233	244	253	254	252	250						

[a]Weighted average by carlot sales.

[b]Preliminary.

Note: Prices are for #2 yellow corn, f.o.b. Chicago after 1972-73 and for #3 yellow corn before that date.

Source: Economic Research Service, USDA.

The European Community (EC) Common Agricultural Policy set up a system of price supports, production quotas, and variable import levies to protect EC corn from foreign competition. The Community's intervention prices established prices for corn and other grains in major consumption and production regions. Its variable import levies protected corn producers from non-EC competition by allowing imports to meet only demands that internal production fell short of. These programs enabled France to become the region's major corn producer, and they have deflected imports of corn from cheaper exporters like the United States. A shift in these programs could change the EC's position in the world corn system, but for social and political reason, the Common Agricultural Policy price supports for corn will probably remain intact.

Programs for other grains also tended to reduce EC dependence on U.S. corn stocks. For instance, higher price supports for soft wheat than for coarse grains created a surplus of wheat. To dispose of this surplus, the EC developed the denaturing premium, which reduced the price of wheat to the competitive price of feed grains. Apparently a program designed to regulate one commodity can strongly influence another commodity system. In this instance, the support program for wheat indirectly provided more grain for feed and thus cut down on the need for imported corn. Despite the EC price support programs, however, it remained a major importer of U.S. corn and feed grains throughout the 1960s.

The agricultural policies in several industrial nations that led to the accumulation of large surplus grain stocks influenced policy in many grain-deficit countries, especially developing ones. The surpluses allowed these nations to rely on relatively low-priced imports to make up for what they could not produce themselves. And if they found paying for the grain difficult, they could obtain it under concessional terms. In this environment, many nations felt no worry about their internal food production capability, believing that it would always be possible to go into the world market to obtain however much grain they desired.

This reliance on U.S. grain inventories meshed neatly with the attitudes prevailing in the 1950s and early 1960s regarding the proper role of agriculture in developing countries. The burdening of the agricultural production sectors with surplus labor led to the belief that industrialization could—and in fact, had to—provide the dynamic element in economic growth. Economists looked down on agriculture, and political leaders in newly independent and developing nations came to view industrialization and economic growth as synonymous. Industrial growth required capital investment, however, and many of these leaders looked to their agricultural sectors for the capital needed for industrialization.

There are essentially three ways in which the farm sector can contribute to industrial capital formation in the early stages of economic growth. First, increased productivity can benefit the nonagricultural sector through lower food prices. This way, a society's real income can be enlarged, increasing savings and capital accumulation in the nonfarm sector. Second, greater physical output

can generate higher levels of farm income, part of which can be saved and used to finance growth in the nonagricultural sectors.[27] The third way—employed by many currently developing countries—involves compulsory transfer of capital from the farm sector to other sectors. For example, a government may take more in tax revenues from farming than it spends on services for the sector and then transfer the difference to the industrial sector.[28] The danger of this approach lies in the difficulty of using agriculture as a source of capital for industrial investment without simultaneously hindering agricultural development. During the 1950s and 1960s, many developing countries emphasized industrialization and neglected to commit sufficient resources to the development of their farm sectors. They were lulled into this approach at least partly by the assumption that the agricultural policies of developed grain-producing countries would continue to result in excess production and large, available surpluses.

Policymakers failed to notice the fairly steady decline in the size of grain stocks relative to steadily rising consumption. Table 2-21 shows that world grain stocks declined from 27 percent of annual world consumption in 1960-61 to about 16 percent in 1972-73. During this same period, world grain production and consumption increased about 40 percent and exports of grain from major producing nations doubled. The margin of security was narrowing.

Three events in the early 1970s clarified the risks to importing countries inherent in this situation:

1. the U.S. decision in the late 1960s to discontinue accumulation and storage of excess grain production and to eliminate those programs that contributed to surplus creation (This decision was prompted by public dissatisfaction with the costs of government grain programs and by the widespread belief that U.S. grain farmers should compete in a relatively free market.)
2. decreased grain production worldwide in 1972-73, immediately following successive devaluations of the American dollar
3. consequent heavy demand on grain-exporting nations, which liquidated stock and caused dramatic increases in grain prices. (As attempts to meet this demand were in progress, the United States suffered a drought that reduced the 1974 corn crop.)

Although the U.S. intention to reduce its price-support and surplus-storage activities was well published, few policymakers anticipated the implications of this change in the event of lower worldwide production. A major falling-off did occur, however, and the United States was able to liquidate its grain stocks, surprising policymakers and managers throughout the world. The shocks of subsequent price fluctuations and American embargoes convinced many importers that their dependence on exporters was unwise.

The result of these events, as Table 2-21 shows, was that world grain stocks fell by about one-third between 1972 and 1975. All over the world grain buyers

Table 2-21. World Supply and Demand for Wheat and Coarse Grains: Marketing Years 1960-61—1976-77 (in millions of metric tons)

	Area Harvested (millions of hectares)	*Yield (per hectare)*	*Beginning Stocks*[a]	*Production*	*Total Exports*[b]	*Total Consumption*[c]
1960-61	539.7	1.29	167.1	695.8	70.1	683.1
1961-62	531.9	1.25	180.0	662.9	81.0	689.6
1962-63	535.8	1.34	153.2	715.9	78.5	712.6
1963-64	541.5	1.30	156.5	706.3	94.5	711.7
1964-65	548.8	1.36	151.1	747.9	92.4	744.8
1965-66	545.0	1.38	154.3	753.2	108.2	788.3
1966-67	544.8	1.52	119.4	826.7	101.1	798.9
1967-68	554.6	1.51	147.2	838.8	98.1	822.6
1968-69	559.3	1.56	163.5	874.5	89.6	846.5
1969-70	556.3	1.58	191.6	880.9	102.3	877.4
1970-71	546.5	1.62	175.1	884.8	109.7	924.2
1971-72	553.6	1.75	135.8	970.1	111.1	949.8
1972-73	548.5	1.72	156.1	945.8	139.8	984.4
1973-74	566.5	1.82	117.3	1,031.2	153.5	1,029.4
1974-75	569.1	1.72	119.4	976.8	137.3	986.0
1975-76[d]	583.2	1.68	110.2	982.5	159.9	981.6
1976-77[e]	593.8	1.84	111.1	1,093.7	147.4	1,036.9
1977-78[e]			167.8			

[a]Stocks data are based on an aggregate of differing local marketing years and should not be construed as representing world stock levels at a fixed point in time. Stocks data are not available for all countries and exclude those such as the People's Republic of China and parts of Eastern Europe. The world stock levels have been adjusted for estimated year-to-year changes in USSR grain stocks but do not purport to include the entire absolute level of USSR stocks.

[b]Trade data are based on an aggregate of differing local marketing years.

[c]For countries for which stocks data are not available (excluding the Soviet Union), consumption estimates represent "apparent" consumption, i.e., they are inclusive of annual stock level adjustments.

[d]Preliminary.

[e]Projection.

Source: FAS, USDA, *World Grain: Review of 1976/77 Situation and Preliminary Look at 1977/78 Crop Prospects* (FG 1-77), 1 February 1977, p. 28.

became apprehensive about their ability to obtain the supplies they needed, and the reduced American corn crop of 1974 added to this apprehension. Buyers made efforts to ensure their own supplies, and in the process, bid corn prices up to the unprecedented levels Table 2-22 catalogs. Between 1972 and 1975, corn prices increased by 220 percent.

Table 2-22. Selected World Grain Prices, Cost, Insurance, Freight—Rotterdam, 1970-1977 (U.S. dollars per ton)

	Wheat			*Corn*	*Sorghum*
	U.S. #2 Dark Northern Spring 14%	*U.S. #2 Hard Winter 13½%*	*Canadian Western Red Spring 13½%*	*U.S. #3 Yellow Corn*	*U.S. #2 Yellow Sorghum*
1970-71 (July-June)	73.71	71.19	74.13[a]	69.07	68.20
1971-72 (July-June)	69.74	66.69	72.42[a]	57.01	60.80
1972-73 (July-June)	100.14	92.50	101.97	77.12	78.64
1973-74 (July -June)	202.95	200.35	214.40	132.90	127.20
1974-75 (July-June)	204.26	189.05	209.65	143.18	135.53
1975-76 (July-June)	187.15	177.70	195.12	128.80	122.50
1974					
January	239.65	229.65	239.20	136.20	133.00
February	240.50	231.85	243.90	142.90	136.80
March	227.85	224.50	240.15	146.45	137.00
April	182.30	183.35	214.30	131.90	124.90
May	180.50	170.50	185.45	129.50	116.10
June	209.15	177.10	204.10	133.05	117.00
July	213.85	190.70	216.25	139.75	123.60
August	217.40	194.00	215.80	139.05	138.00
September	214.25	203.55	213.05	152.75	142.20
October	232.60	229.65	233.95	163.40	161.00
November	233.20	228.90	236.80	164.55	163.00
December	227.80	219.35	231.85	159.60	159.70
1975					
January	205.90	194.75	208.75	143.30	135.50
February	192.04	180.20	198.16	137.13	127.30
March	178.70	175.85	181.90	135.25	124.50
April	181.77	159.25	192.10	130.34	127.11
May	180.83	145.85	192.58	123.49	116.39
June	174.76	146.50	195.00	129.60	108.08
July	185.35	174.35	205.05	140.90	118.20
August	195.95	187.65	210.20	147.45	134.90
September	203.90	195.10	228.20	138.20	132.30
October	193.20	185.00	219.35	132.35	128.75
November	182.50	172.65	NA	121.68	122.05
December	187.45	166.50	NA	118.65	119.55
1976					
January	183.45	168.30	NA	118.45	118.50
February	194.90	183.10	NA	121.30	119.90
March	194.35	182.85	174.50[b]	122.05	120.25

Table 2-22 continued

	Wheat			*Corn*	*Sorghum*
	U.S. #2 Dark Northern Spring 14%	*U.S. #2 Hard Winter 13½%*	*Canadian Western Red Spring 13½%*	*U.S. #3 Yellow Corn*	*U.S. #2 Yellow Sorghum*
1976 (cont.)					
April	174.35	175.55	166.32[b]	122.24	115.18
May	177.80	169.05	168.85[b]	129.35	119.60
June	181.30	172.20	188.50[b]	133.00	120.90
July	176.46	175.70	174.55[b]	133.80	121.05
August	158.15	159.45	158.10[b]	128.10	117.30
September	148.40	149.50	155.00	132.25	119.55
October	138.25	138.90	145.00	119.95	113.45
November	137.30	130.84	140.70	108.80	105.90
December	139.00	131.80	136.77	111.10	107.70
1977					
January	145.50	134.85	143.60	123.00	111.20
February	147.75	133.30	146.00	123.90	112.35
March	134.30	131.80	135.40	117.15	104.80
April	130.15	127.65	133.10	115.45	100.10
May	124.30	118.30	131.85	110.20	97.15
June[c]	114.45	112.20	124.50	103.05	91.70
July	111.15	109.50	120.50	95.00	87.75
July 5	113.00	110.00	123.00	97.00	88.00
12	112.00	109.75	122.50	95.25	87.50
19	109.50	109.00	119.00	94.00	87.00
26	110.00	109.25	117.50	93.75	88.50
August 2	108.25	108.00	116.00	90.50	88.00
10	108.00	107.50	116.50	88.00	87.75
16	109.75	103.50	116.50	88.00	87.75

[a]Prior to September 1971, prices are for #2 Manitoba Northern.

[b]Canadian #2 Canadian Western Red Spring, 12.5% protein.

[c]Based on June–July Agricultural Attache, The Hague prices.

Note: This table lists Hamburg Mercantile Exchange prices for Rotterdam. Averages based on daily market quotes; thirty days for delivery.

Source: FAS, USDA, *World Grain Situation*, (FG-13-77), 18 August 1977, p. 21.

The complex issue of national agricultural policy relates simultaneously to food consumption, food production, trade, employment, market structure, and pricing. The interaction of rational agricultural policies—each of which addresses each of these issues—is even more complex. Nevertheless, the preceding discussion should prove that the interaction of national agricultural policies is and will continue to be a critical variable in the analysis of the world corn system.

The 1977 Farm Act provides a low price-support program to make the United States competitive in international corn markets; a high target-price to provide some relief to domestic corn producers during cost-price squeezes; and a manda-

tory sales price if the market price rises and takes corn out of storage, which will protect American and other consumers from any market shortages. In addition, the U.S. Secretary of Agriculture is undertaking to reduce the nation's wheat acreage by 20 percent and feed-grain acreage by 10 percent. The production and pricing effects of these policy developments will be closely watched by private and public corn-system participants throughout the world.

SUMMARY

This overview of the global corn economy should provide participants in the world corn system with an understanding of the evolving trends affecting their operations. More specifically, it provides the setting for detailed analyses of the relations between the developed segment of the system (represented by the United States and Japan) and the developing segment (represented by Southeast Asia). Consumption patterns in the developed and developing worlds are nearly the opposite of each other, the farmer using corn for livestock feed, primarily, and the developing world depending on the grain for food. The two halves of the corn commodity system differ enormously in their ability to meet demand; and, so far, the separate halves of the system have been unable to coordinate their policies for their mutual benefit.

NOTES

1. Sterling Wortman and Ralph W. Cummings, Jr., *To Feed the World*, (Baltimore: Johns Hopkins University Press, 1978).

2. Wassily W. Leontief, *Future of the World Economy* (New York: Oxford University Press, 1977).

3. The possible strategic implications of this uniformity became apparent with the Southern corn leaf blight in the United States in 1970. The previously unfamiliar blight struck about 15 to 20% of the U.S. corn crop. Because none of the crop was immune to the disease, many feared that much of that year's corn crop would be lost. It seemed entirely possible, for a time, that the blight might strike elsewhere and seriously threaten total world production. In the end, the blight did not spread. The U.S. crop was reduced by about 10% from the previous year, and seed breeders quickly developed blight-resistant varieties. But increasing uniformity does bring increasing vulnerability.

4. FAO, *Agricultural Commodity Projections*, 1970–1980, p. 40.

5. The quality of protein in a food source is determined primarily by the pattern of amino acids in the protein. If one or more of the amino acids are deficient, then these acids use higher amounts of the other, more plentiful amino acids. The amount of usable protein is thus reduced, and nutritional value falls.

6. *Journal of Flour and Animal Feed Milling*, August 1975, p. 32.

7. The FAO *Production Yearbook* for 1975 reports 147.8 million agricultural holdings in the world. Figures are based on the 1960 and 1970 world censuses of agriculture.

8. Feed grains include, corn, barley, oats, rye, and sorghum.

9. World Watch, Inc. reports that in 1975 world population growth was about 1.64% rather than the 1.9% estimates by other agencies. By the year 2000, therefore, the world's population may reach only 5.4 billion, substantially less than the recent estimate of 6.3 billion.

10. Organization for Economic Cooperation and Development, *Study of Trends in World Supply and Demand of Major Agricultural Commodities*, September, 1976, p. 288.

11. Conversion ratios are to dressed weight in all cases.

12. Phil Hi-Bred, Inc., *Bulletin*, Vol. 1, No. 4, 1 April, 1977, p. 2.

13. See, for example, University of California, Food Task Force, *A Hungry World: The Challenge to Agriculture*, 1974, p. 198.

14. Donald G Coursey, *World Food Crops*, Vol. 22, No. 4, 1970, pp. 261–265.

15. Cassava, yams, sweet potatoes, plantains, taro, dasheen, and breadfruit. These commodities are staple food sources for about 10% of the world's population.

16. Centro Internacional para el Mejoramiento de Maize y Trigo.

17. Delbert T. Myren, "The Rockefeller Foundation Program in Corn and Wheat in Mexico," in *Subsistence Agriculture and Economic Development*, C. Wharton (ed.), (Chicago: Aldine Publishing Co., 1969).

18. Because the yield potential of the hybrids resides in the vigor of specific crosses of selected genotypes, replanting crop seed would probably result in a 15%–20% drop in yield, thus eroding the yield advantage of the hybrids over the traditional varieties.

19. Myren estimates average wheat farm size at 17 hectares compared to 3 hectares for maize.

20. Managerial capacity would probably also differ and the HYVs require good farm management as an essential input.

21. Myren, op. cit., p. 411.

22. Myren, op. cit., p. 411.

23. N'Guetta Bosso, *CIMMYT and the International Maize Research/Production Programs*, College of Agriculture and Life Sciences, Cornell University, 1975, p. 5 (Cornell International Agriculture Mimeograph 47).

24. Bosso, *Ibid.*, p. 10.

25. *Ibid.*, p. 11.

26. *Ibid.*, p. 16.

27. Assuming, of course, the existence of:

1. an infrastructure of financial intermediary institutions able to effect the intersectoral transfer
2. entrepreneurs sensitive to investment opportunity who have adequate incentives to put capital (either owned or borrowed) at risk in new enterprises.

28. Japan and the Soviet Union used variations of this approach. During the late 1800s, the Japanese Government employed a heavy land tax which produced over three-quarters of government revenue. Likewise, confiscation and taxation in the farm sector during the 1920s and 1930s provided significant portions of the capital invested in the Soviet Union's industrial sector.

APPENDIX A
ZEN-NOH COOPERATIVE*

One company that both represents a significant type of participant in the world corn system and also represents the commercial and subsistent corn producers' attempts to reach out to world markets is the Zen-Noh Cooperative of Japan. The following case study is presented to indicate how Zen-Noh's specific perspective relates to the general trends predicted in Chapter 2.

The Corn Procurement Program

Early in 1977 the manager of Zen-Noh's Feedstuff Importing Section, Mr. Shoshichi Ohnuma, was evaluating his firm's corn procurement activities in light of the major trends in the world and Japanese corn systems. Zen-Noh, Japan's National Federation of Agricultural Cooperative Associations with over $16 billion of sales volume, was a major feedgrain importer and the nation's dominant livestock feed manufacturer. Japan was heavily dependent on the United States for its corn requirements, but Zen-Noh and other Japanese grain importers were striving to develop alternative overseas sources of supply. At the same time, Zen-Noh was attempting to procure a growing percentage of its corn and other grain needs directly from cooperatives in exporting countries. In pursuit of this objective it negotiated contracts each year with corn-exporting cooperatives in the United States and Thailand, and it was eager to do so elsewhere. Mr. Ohnuma had just received projections that indicated large increases in compound-feed demand in Japan for 1985, so he was eager to devise a plan to ensure availability of the large amounts of corn and other feed ingredients his firm would need.

Zen-Noh's Position in the Cooperative Movement in Japan

The cooperative movement in Japan[1] began in 1900 with the enactment of the Cooperative Society Law. Four types of cooperatives were then authorized: credit, marketing, purchasing, and processing. As a result of the law, the Central Cooperative Union was established, which sought to develop cooperatives throughout the country. In 1906, when credit societies were permitted to take on the additional function of marketing, the concept of multipurpose cooperatives began to spread. With the outbreak of World War II, the government significantly changed the nature of the cooperative movement for a time by making farmer membership in cooperatives obligatory. The government transformed the

*This case was prepared as the basis for class discussion rather than to illustrate either effective of ineffective handling of an administrative situation.

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cooperatives themselves into highly regimented organizations designed to meet the needs of a wartime controlled economy.

In 1947, the Agricultural Cooperative Law was promulgated to improve the management and livelihood of owner-farmers who received their lands in the post-war land reform. The law reoriented the cooperative movement to its original principles; soon after its enactment, agricultural cooperatives and federations were established at the local, prefectural,[2] and national levels. Many of these new cooperatives experienced financial problems as a result of Japan's post-war economic difficulties and the government's changing programs for coping with them. To help cooperatives overcome their financial problems, the Law for Rehabilitation and Consolidation of the Agricultural, Forestry, and Fishery Cooperatives was enacted in 1951. A subsequent law for promoting consolidation of the agricultural, forestry, and fishery cooperative federations sought to cope with similar problems among cooperative federations. In 1954, the Central Union of Agricultural Cooperatives was established to permit effective integration of the activities of Japan's various cooperative groups.

Between 1948 and 1972, separate national organizations coordinated the marketing and purchasing activities of prefectural and local cooperatives. These organizations were Zenkoren (National Purchasing Federation of Agricultural Cooperative Associations) and Zenhanren (National Marketing Federation of Agricultural Cooperative Associations). In 1972, these organizations merged to form Zen-Noh, the National Federation of Agricultural Cooperative Associations.

The cooperative structure in Japan is hierarchical. At the local level, primary agricultural cooperative societies are organized with farmers as regular members and with many nonagricultural households as associate members. In 1977, almost all of Japan's approximately five million farm households were members of primary cooperatives.

Primary agricultural cooperatives are of two types: single purpose and multipurpose. Multipurpose cooperatives engage in marketing, procurement of farm inputs, credit activities, insurance, processing, and other functions and serve all of the production and nonproduction needs of the farm business. They are the foundation of the Japanese cooperative movement. Single-purpose cooperatives concentrate on the marketing of specific commodities like fruit and vegetables, silk, and milk. Most members of single-purpose cooperatives are also members of multipurpose cooperatives.

Primary agricultural cooperatives participate in federations organized according to function at the prefectural level. These federations perform marketing and purchasing, credit, and insurance activities for multipurpose cooperatives, and they provide service at the prefectural level for single-purpose cooperatives. Additionally, each of the forty-seven prefectures in Japan have a prefectural union of agricultural cooperatives whose members are primary cooperatives and prefectural federations. Rather than engage in economic business, prefectural

unions function in the areas of guidance, coordination, research and survey, education, information, and auditing for the primary cooperatives and prefectural federations. They also represent the economic and political interests of the farm sector in each prefecture.

Each prefectural federation has its counterpart at the national level. Consequently, the national federations are also of two types: those related to multipurpose cooperatives and those related to single-purpose cooperatives. Examples of the former are the National Federation of Agricultural Cooperative Associations (Zen-Noh) and the National Insurance Federation of Agricultural Cooperatives. Examples of the latter are the National Federation of Livestock Cooperatives and the National Federation of Dairy Cooperatives. Likewise, the prefectural unions of agricultural cooperatives have their counterpart at the national level in the Central Union of Agricultural Cooperatives. Figure 2A-1 depicts the organization of the Japanese cooperative movement.

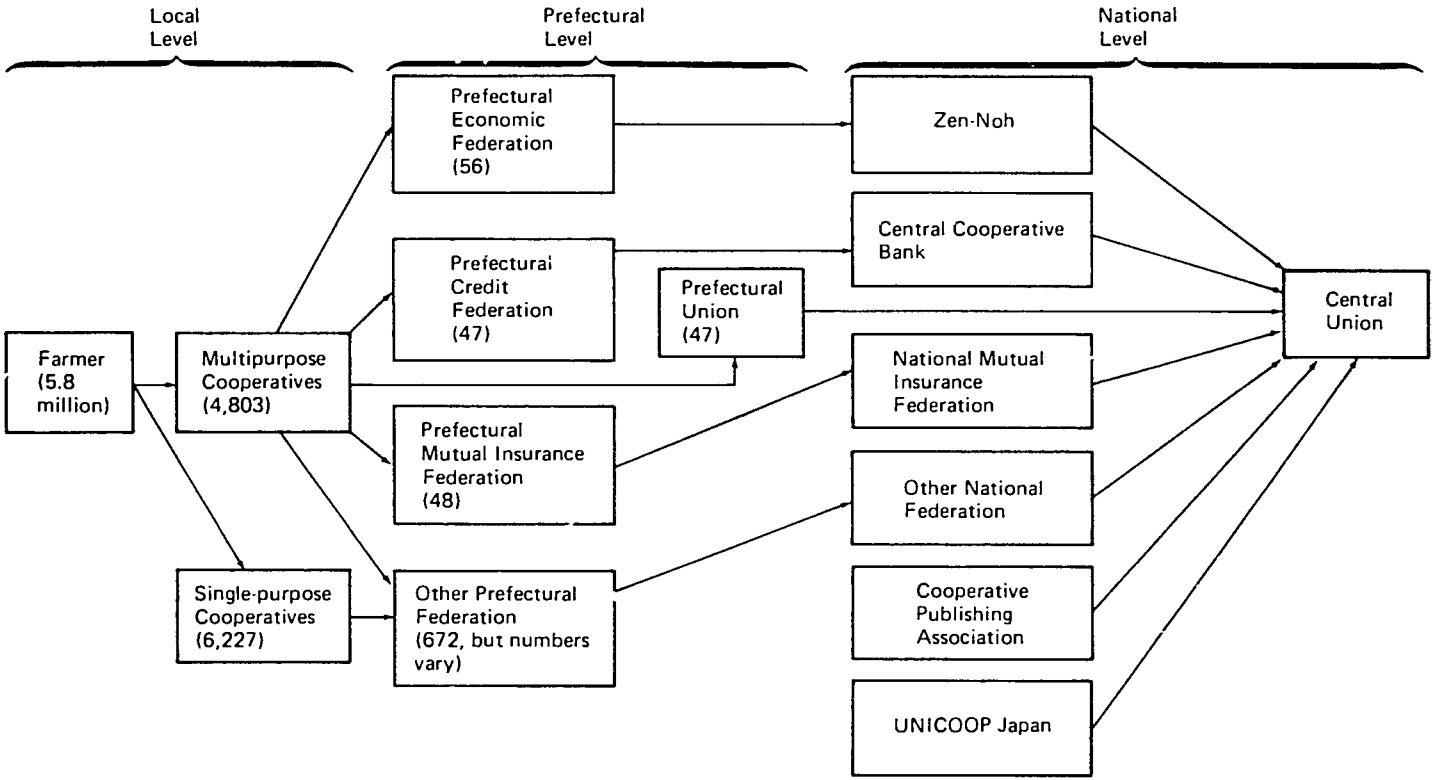
Reflecting its varied agricultural base, Zen-Noh itself is organized into divisions responsible for specific commodities. Seven divisions report to a senior management group composed of a president, several vice presidents, an executive managing director, and several managing directors. The divisions are Rice and Wheat, Horticulture and Farm Produce, Feedstuffs and Livestock, Production Materials, General Planning and Management, Administration, and Consumer Goods.

Compound-Feed Operations

In the years between 1960 and 1973, the diet of Japanese consumers changed significantly. Their intake of starchy foods (especially rice) decreased as per-capita real income increased. Consumers switched to more Western-style diets, demanding more sugar, oils, fats, and livestock products in their diets. Table 2A-1 provides data on these shifts and offers projections for their continuance through 1985. Most significant for Japan's feed-milling and grain-importing industries was the fact that consumption of animal protein in the daily diet had more than doubled.

Japanese farmers responded to these shifts in consumer demand by consolidating their holdings and expanding their livestock herds and poultry flocks. Table 2A-2 shows the dramatic concentration in livestock holdings and the rapid increase in livestock population through the early 1970s. The slight decline in livestock numbers between 1970 and 1975 reflects the sharp slowing in the shift to Western-style diets between 1973 and 1975. During those years, inflation and recession reduced consumer purchasing power and consequently lowered demand for meats.

As livestock production grew in Japan, so too did compound-feed production. From practically nothing in the 1950s, commercial-feed production rose to over eighteen million metric tons in 1976. In 1960, consumption of commercial-formula feeds exceeded consumption of roughage and domestically produced



Source: Shiro Futagami, *Multi-Purpose Agricultural Cooperatives in Japan*, and information provided by Zen-Noh management.

Figure 2A-1. The Structure of Cooperative Organizations in Japan

Table 2A-1. The Structure of Food Consumption in Japan

	Calories (per person per day)														
	Starch Food						Animal Protein								
Fiscal Year	Rice	Others	Sub-Total	Beans	Vege-tables	Fruits	Meat	Egg	Milk[b]	Sub-Total	Fish	Sugar	Oils and Fat	Others	Total
1960	1,105.5	474.5	1,580.0	104.4	84.1	28.9	27.5	26.9	35.9	90.3	86.6	157.2	105.0	53.2	2,289.7
1965	1,075.7	451.8	1,527.5	97.5	89.4	38.8	50.4	49.4	60.7	160.5	89.8	196.3	161.0	46.9	2,407.7
1970	914.3	461	1,375.3	104.4	93.4	53.4	76.9	63.5	81.0	221.4	91.3	282.7	228.9	45.1	2,471.9
1971	892.7	439.1	1,331.8	105.4	95.5	52.4	86.1	63.3	81.8	231.2	81.8	280.2	237.8	44.2	2,473.8
1972	879.9	436.9	1,316.8	103.7	94.1	61.8	92.9	62.1	83.6	238.6	83.6	294.0	258.[illegible]	44.2	2,506.6
1973	872.8	435.2	1,308.0	103.0	87.9	60.3	99.7	61.5	85.1	246.3	85.1	294.9	269.7	44.7	2,513.1
1974	862.8	430.9	1,293.7	99.7	89.4	56.4	100.3	59.9	83.7	243.9	83.7	283.3	277.2	42.6	2,486.5
1975	844.4	438.3	1,282.7	99.1	86.6	58.0	102.9	59.8	86.0	248.7	86.0	274.3	276.6	41.9	2,467.2
1985[a]	784.0	419.0	1,203	104.0	103.0	73.0	122.0	64.0	105.0	291.0	115.0	32.3	341.0	40.0	2,593.0
Percentage															
1960	48.3	20.7	69.0	4.5	3.7	1.2	1.2	1.2	1.6	4.0	3.8	6.9	4.6	2.3	100
1965	44.7	18.7	63.4	4.1	3.7	1.6	2.1	2.1	2.5	6.7	3.7	8.2	6.7	1.9	100
1970	37.0	18.7	54.7	4.2	3.8	2.2	3.1	2.6	3.3	9.0	3.7	11.4	9.2	1.8	100
1971	36.1	17.7	53.8	4.3	3.9	2.1	3.5	2.6	3.3	9.4	3.8	11.3	9.6	1.8	100
1972	35.1	17.4	52.5	4.1	3.8	2.5	3.7	2.5	3.3	9.5	3.8	11.7	10.3	1.8	100
1973	34.7	17.4	52.1	4.1	3.5	2.4	4.0	2.4	3.4	9.8	3.9	11.7	10.7	1.8	100
1974	34.7	17.3	52.0	4.0	3.6	2.3	4.0	2.4	3.4	9.8	4.0	11.4	11.2	1.7	100
1975	34.2	17.8	52.0	4.0	3.5	2.4	4.2	2.4	3.5	10.1	4.0	11.1	11.2	1.7	100
1985[a]	30.2	16.2	46.4	4.0	4.0	2.8	4.7	2.5	4.0	11.2	4.4	12.5	13.2	1.5	100

[a]Forecast by Ministry of Agriculture and Forestry.
[b]Includes processed milk products.
Source: Based on data of Ministry of Agriculture and Forestry.

Table 2A-2. Changes in the Structure of Japanese Livestock Farming: 1960-1977 (population in thousands of head as of February 1; producers in thousands of households)

	1960	*1965*	*1970*	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*	*1977*
Poultry										
Layers										
Population	54,627	120,197	169,200	172,226	164,034	163,512	160,501	154,501	156,534	160,550
Producers	3,839	3,243	1,703	1,373	1,058	846	661	510	386	329
Broilers										
Population		18,279	53,742	63,114	67,922	80,177	88,996	87,659	92,934	103,332
Producers		20	18	18	15	15	14	12	11	10
Dairy Cows										
Population	824	1,289	1,804	1,856	1,819	1,780	1,752	1,787	1,811	1,888
Producers	410	382	308	279	243	212	179	160	147	137
Beef Cattle										
Population	2,340	1,886	1,789	1,759	1,749	1,818	1,898	1,857	1,912	1,987
Producers	2,031	1,435	902	797	673	595	532	474	450	424
Pigs and Hogs										
Population	1,918	3,976	6,335	6,904	6,985	7,490	8,018	7,684	7,459	8,132
Producers	799	711	445	398	340	321	277	223	196	179

Source: The Central Union of Agricultural Cooperatives, *Agriculture and Agricultural Cooperative Movement in Japan*, p. 12, and Feed Import Department, National Federation of Agricultural Cooperatives.

by-product ingredients for the first time. By 1976, eleven feed manufacturing firms owned 54 percent of all feed manufacturing plants and produced 78 percent of all feed purchased. Over half of all compound feed was for poultry; about 28 percent was for pigs and hogs, and the remainder was split evenly between dairy and beef cattle.

Cooperatives were early entrants in the feed-milling industry. Zen-Noh's predecessor in farm supply activities, Zenkoren, was the third firm to enter the business. By the 1970s, Zen-Noh had acquired about 40 percent of the market for mixed feeds and operated 27 percent of the industry's 202 plants. Table 2A-3, which shows the breakdown of Zen-Noh business activities for 1975-76, indicates that feed milling was the company's second largest line of business. Table 2A-4 indicates the small margin per unit of sales achieved by the cooperative but the excellent return on the farmer's shareholder equity. Table 2A-5 shows mixed feed production in the 1970s by manufacturer, and TAble 2A-6 shows Zen-Noh's share in each major feed category. To achieve its dominant position, Zen-Noh located its feed mills adjacent to major livestock producing areas with ready access to port facilities. The strategy of employing more numerous though somewhat smaller mills than some of its competitors was based partly on the economics of transportation in Japan. Interisland transport of ingredients to feed mills close to end markets or even direct import of grain at smaller ports close to these markets is cheaper than operating a small number of large mills to distribute over a broad area. Zen-Noh's nearest competitor, which operates only seventeen plants in contrast to Zen-Noh's fifty-four, does not enjoy the geographic coverage achieved by the cooperative.

Table 2A-3. Zen-Noh Business Turnover: Business Year 1975-76 (in millions of U.S. dollars)

I. Marketing		*II. Supply*	
Government controlled rice	5,165	Feed	2,539
Free market rice	2,383	Fertilizer	915
Wheat, barley, and other grains	121	Agricultural chemical	426
Starches	237	Greenhouse materials	154
Vegetables	585	Packaging materials	239
Fruits	360	Agricultural machinery	547
Milk	121	Fuel	618
Cattle and hogs	423	Vehicles	186
Eggs	336	Households items	522
Chicks and breeders	21	Other	84
Broilers and chickens	161		
Other	138	Total Supply Turnover	6,147
Total Marketing Turnover	10,052		
	Grand Total: 16,199		

Source: Zen-Noh Feed Department.

Table 2A-4. Zen-Noh: Statements of Income and Retained Earnings (Years ended 30 June 1976 and 30 June 1975)

	(thousands of U.S. dollars)	
	1976	*1975*
Sales	16,198,635	14,188,043
Cost of sales	16,124,605	13,121,793
Gross profit	74,030	66,250
Operating revenue	88,419	53,370
Total revenue	162,449	119,620
Selling, general, and administrative expenses	144,999	111,571
Operating income	17,450	8,049
Other income (expense):		
Interest income	131,832	112,983
Miscellaneous income	29,661	29,421
Interest expense	(126,296)	(105,788)
Miscellaneous expense	(35,435)	(32,658)
	(238)	(3,958)
Income before income taxes	17,212	12,007
Income taxes	10,690	5,148
Net income	6,522	6,859
Retained earnings at beginning of year	363	301
Retained earnings at end of year	6,885	7,160

Balance Sheets
(30 June 1976 and 30 June 1975)

	(thousands of U.S. dollars)	
Assets	*1976*	*1975*
Current Assets:		
Cash	14,794	11,913
Securities	3,089	2,627
Notes receivable	180,646	178,910
Accounts receivable–trade	596,763	562,470
Accounts receivable–other	675,822	638,293
Inventory	149,369	216,987
Loan receivable–employee	6,209	5,030
Prepaid expenses	18,921	22,527
Assets against contingent liabilities	128,062	128,760
Other current assets	4,644	4,630
Total current assets	1,778,319	1,772,147
Fixed assets:		
Property, plant and equipment	65,695	62,660
Less accumulated depreciation	25,427	22,673
Net property, plant and equipment	40,268	39,987

(continued)

Table 2A-4 continued

	(thousands of U.S. dollars)	
Assets	*1976*	*1975*
Land	34,970	27,120
Intangible fixed assets	2,661	2,607
Investments	32,579	31,550
Long-term loan receivable	3,334	3,503
Total fixed assets	113,812	104,777
Deferred assets	1,034	1,256
Total assets	1,893,165	1,878,180
Liabilities and Shareholders' Equity	*1976*	*1975*
Current liabilities:		
Short-term bank loan	635,496	731,243
Notes payable	441,810	405,987
Accounts payable–trade	524,482	457,967
Accounts payable	15,296	22,077
Accounts payable–other	11,493	9,237
Contingent liabilities	128,062	128,759
Total current liabilities	1,756,639	1,755,270
Reserves:		
Retirement	19,301	17,510
Bad debts	14,323	12,254
Bonus	1,402	814
Price fluctuation	8,844	8,844
Income taxes	10,821	4,950
Self insurance reserves	756	757
Contingencies	718	737
Special depreciation	2,842	1,753
Importing goods	4,000	4,000
Anti-pollution	1,411	334
Total reserves	64,418	51,953
Long-term debt	21,355	25,140
Total fixed liabilities	1,842,412	1,832,363
Shareholders' equity:		
Capital	37,970	33,759
Capital surplus	32	33
Earned surplus:		
Legal reserves	5,533	4,800
Special accumulated surplus	333	66
Retained earnings	6,885	7,159
Total shareholders' equity	50,753	45,817
Total liabilities and shareholders' equity	1,893,165	1,878,180

Source: Zen-Noh, Annual Report, 1976.

Table 2A-5. Compound Feed Production by Companies in Japan: 1971-1976 (quantities in thousands of metric tons; unit shares in percentages)

	1971		*1972*		*1973*		*1974*		*1975*		*1976*		
Fiscal Year Company	*Quantity*	*Share*	*Quantity*	*Share*	*Quantity*	*Share*	*Quantity*	*Share*	*Quantity*	*Share*	*Quantity*	*Share*	*Factory Numbers*
Zeh-Noh	6,435	41.0	7,031	40.5	7,501	41.5	6,930	40.7	6,532	38.8	7,231	38.6	54
Nihon Nohsan	1,610	10.3	1,675	9.6	1,538	8.5	1,375	8.1	1,377	8.2	1,442	7.9	17
Nishin Seifun	881	5.6	994	5.7	966	5.3	914	5.4	926	5.5	1,034	5.6	6
Nihon Haigoh	842	5.4	898	4.2	967	5.3	901	5.3	829	4.9	903	4.9	11
Kyoda Shiryoh	660	4.2	726	4.1	795	4.4	730	4.3	717	4.3	796	4.3	5
Marubeni Shiryoh	366	2.3	434	2.5	496	2.7	542	3.2	645	3.8	702	3.8	6
Amino Shiryoh	419	2.7	472	2.7	524	2.9	515	3.0	514	3.1	558	3.0	4
Taiyoh Gyogyoh	534	3.4	551	3.2	566	3.1	485	2.8	446	2.7	491	2.7	4
Kawada Shiryoh	231	1.5	316	1.8	379	2.1	386	2.3	407	2.4	460	2.5	4
Toyohashi Shiryoh	308	2.0	354	2.0	389	2.2	399	2.4	398	2.4	431	2.3	3
Showa Sangyoh	348	2.2	353	2.0	372	2.1	364	2.1	369	2.2	440	2.2	4
Ten companies subtotal	6,199	39.5	6,773	37.8	6,992	38.6	6,611	38.9	6,628	39.4	7,256	39.2	64
Others	3,059	19.5	3,541	21.7	3,591	19.9	3,477	20.4	3,658	21.8	4,130	22.2	102
Total	15,076	100.0	17,345	100.0	18,084	100.0	17,018	100.0	16,818	100.0	18,617	100.0	220

Note: The fiscal year runs from April 1 to March 31.

Source: National Federation of Agricultural Cooperatives.

Table 2A-6. Compound Feed Production by Animals in Japan: 1976 (production in thousands of metric tons; shares in percentages)

Animal	Japan Total		Zen-Noh		Zen-Noh's Market Share
	Production	Share	Production	Share	
Hens and Chickens					
Chick	848	4.7	241	3.4	28.5
Layer	5,860	32.4	1,677	24.0	28.6
Broiler	2,530	14.0	699	10.0	27.6
Subtotal	9,238	51.1	2,617	37.4	28.3
Pigs and Hogs					
For pork	4,032	22.3	1,746	25.0	43.3
For breeding	963	5.3	541	7.7	56.2
Subtotal	4,995	27.6	2,287	32.7	45.8
Milk Cow	1,900	10.5	800	11.4	42.1
Beef Cattle	1,891	10.4	1,280	18.4	67.7
Others	71	0.4	6	0.1	8.3
Total	18,095	100.0	6,990	100.0	38.6

Source: National Federation of Agricultural Cooperatives.

Sources of Corn

With its limited land area and dense population, Japan has always had to import large quantities of food. Government policy has aimed at ensuring self-sufficiency of certain critical foodstuffs such as rice, still Japan's single most important food source. About 80 percent of the ingredients for Japan's feed-manufacturing industry must be imported, however. Over the years corn has been the single most important imported ingredient, accounting for about 38 percent by weight of the industry's raw material inputs.

Although Japan purchases corn from several countries, the United States is consistently its largest supplier with Thailand a distant second. The United States is a natural corn source because of its huge exports and because devaluations of the dollar in the early 1970s provided U.S. producers and exporters an additional competitive advantage during a period of world shortage and high prices. South Africa and Argentina occasionally supply significant quantities, but their shares have declined. South Africa has been changing from yellow to white corn production for use in its own processing industries, and its ports cannot accommodate the 50,000-ton vessels in which Japanese firms prefer to trade over long distances. Corn making the 10,000-mile voyage from South Africa to Japan had to travel in ships of about 25,000 tons. The cost per ton-mile of shipping grain was about seven cents higher for ships in the 25,000 to 30,000-ton class than for the large bulk carriers working the 9,000 miles between Japanese main ports and the U.S. Gulf Coast. Japan's imports of corn from Argentina have declined because of distance (13,000 miles) and increasing European Competition for Argentine corn.

Thailand has consistently supplied between 10 percent and 30 percent of Japan's corn needs since the late 1960s. Because corn was a focus of the Thai government's crop diversification efforts in the 1950s and 1960s, Thailand became the world's fourth leading corn exporter by the 1970s. Japanese trading companies encouraged Thailand's development as a corn exporter by annually contracting, through a trade association,[3] large purchases with the Thai Board of Trade. Based on crop forecasts for the current year and on Japanese demand, the Board of Trade assigned Bangkok exporters quotas for corn shipments to Japan.[4]

The large ships used for carrying grain from the United States to Japan are not employed on the 3,000-mile route between Bangkok and Japan because Thailand's ports and grain-loading facilities can accommodate only vessels of less than 12,000 tons, for which the operating cost per ton-mile is about six cents. Still, the Thai corn trade is important to Japan, for it provides an efficient means of directly supplying the smaller ports on Japan's west coast and eliminating the transshipment costs of landing American corn at major ports and transferring it to smaller coastal vessels for interisland delivery. The shipping arrangements established in the Thai-Japan Maize Trade Agreement are predicated on use of smaller Japanese vessels and delivery to smaller ports in Japan.

In the import of corn and other feedgrains to Japan, Zen-Noh has an important position. It is a leading importer of corn and feedgrain through its UNICOOPJAPAN commodity-trading subsidiary. Established by Zen-Noh's purchasing predecessor Zenkoren in 1961, UNCOOPJAPAN works to import all the commodities required by Zen-Noh members and to export their products worldwide. Thus, Japan's farmers directly participate in the agribusiness of many parts of the world. In pursuit of its worldwide importing and exporting activities, UNICOOPJAPAN maintains offices in the United States, Thailand, Australia, Brazil, Germany, and Czechoslovakia.

UNICOOP's share of corn and other feedgrain imports to Japan was not as great as Zen-Noh's share of the compound-feed market. Although UNICOOP's share of feedgrain imports overall is the largest of any importer, it ranks second behind Mitsubishi in corn imports. For this reason, Zen-Noh is obliged to purchase part of its corn needs from other Japanese importers. It regularly deals with the Nichimen, Marubeni, Sumitomo, C. Itoh, Mitsubishi, and Mitsui groups.

International Cooperative Relations

Zen-Noh is eager for its trading subsidiary to handle all of its grain import needs. One of the ways in which UNICOOP can achieve this end is by developing direct relations with other cooperatives in grain-exporting nations. The philosophy behind this effort was articulated by the former president of Zen-Noh, Imaichiro Masaki, as follows:

> Because of the scarcity of natural resources, the economy of our country is destined to be influenced considerably by the overseas economic

> situation, and incidentally the economic activity of our agricultural cooperatives is also facing serious problems. In view of this, the economic development of our country cannot be achieved without close collaboration with foreign countries, and likewise the cooperation with overseas cooperatives is of growing importance for Zen-Noh. We wish, therefore, to develop our business activities, thereby making mutual benefit and contributing to the further prosperity of both farmers and agricultural cooperatives in foreign countries.[5]

This philosophy is reflected in Zen-Noh's maintaining contractual supply relations with exporting cooperatives in several countries. To identify cooperatives in other countries that were likely to be attractive contract partners, Zen-Noh management applied the following criteria:

1. The cooperative had to have effective leadership and the strong support of its membership.
2. Grain-exporting cooperatives had to have assured access to sufficient amounts of grain.
3. Financial strength and fixed asset base had to be adequate.
4. Management had to show understanding of Zen-Noh needs.
5. Ideally, the cooperative should have some influence directly or indirectly over home-country agricultural policy.

Zen-Noh succeeded in establishing contractual relations with exporting cooperatives in the United States and Thailand. The American cooperative was the Farmers Export Company, which operates export terminals on the Louisiana Gulf Coast. The Thai cooperative was the Agricultural Cooperative Federation of Thailand (ACFT) in Bangkok.

The contract with the U.S. cooperative is relatively simple. Each year, beginning in the late 1960s, Zen-Noh and Farmers Export agree on an annual volume and an approximate schedule for shipments. Pricing agreements are made when details for a specific shipment are arranged, and the contract is renewed annually. Thus, Zen-Noh can set up a regular schedule for its ships to arrive at the Farmers' terminal and take on grain. The arrangement also assisted Farmers Export in obtaining financing for an expansion of its first port facility. Zen-Noh has managed to import about half a million tons of corn each year through this contract and is interested in expanding that quantity.

Like the U.S. contract, Zen-Noh's contract with ACFT is renewable annually. It is considerably more complex, however. It calls for a specific quantity and shipping schedule, and ties pricing to the Chicago futures market price for #2 yellow corn, as defined in the Thai-Japan Agreement on Maize Trade. Under the corn export quota system established by the Thai Board of Trade, no single exporter is allotted more than 4 percent of Thai corn exports in a given year.[6]

ACFT was exempted from this restriction, however, to the extent to which it had firm contracts to export. As a result of its annual contracts with Zen-Noh, ACFT has increased its share of Thai corn exports from nothing in the early 1960s to more than 6 percent in 1976-77. Its share of the Japanese trade exceeds 13 percent. Zen-Noh has further assisted the Thai cooperative by annually lending it approximately $500,000 for corn purchases from local Thai cooperatives. This sum could be increased to $1 million if the additional working capital is needed and requested by the Thai cooperative. Although the sums are not large and have to be repaid at the conclusion of each export season, Zen-Noh management believes that they enable the Thai cooperative to operate more effectively and provide liquidity to smaller local cooperatives and their small-scale farm members.

Development of the New Corn and Feedgrain Suppliers

Mr. Ohnuma recently received projections of consumer demand for livestock protein in Japan for 1985 (see again Table 2A-1). Based on these projections, his department estimated Japan's mixed feed requirement in 1985 to approximate 23 million tons. Assuming a feed-ingredient mix similar to that used in 1976, this implied an aggregate need for corn for feed manufacturing of about 8.5 million metric tons in 1985, or about 30 percent more than the 1976 level. Mr. Ohnuma was also aware that demand for corn from Japan's starch industry was increasing steadily, for the industry was increasing its dependence on corn as a starch source.[7] Furthermore, increasing demand for corn-based sweeteners in Japan would add a significant additional increment to corn demand. Altogether, Mr. Ohnuma was quite certain that Japan would require not less than 10 million metric tons of corn by 1985, and quite possibly 12 million.

Mr. Ohnuma's experience in the Feedstuff Importing Department had made him sensitive to the real vulnerability of Zen-Noh's supplies of corn and other grains. In the 1970s, shipments from its leading supplier (the United States) were curtailed on several occasions due to a diseased crop (1971), dock strikes at Gulf ports, occasional freezing of the Mississippi River, and a drought in 1974. Mr. Ohnuma did not believe Zen-Noh could safely continue to rely on the less than 800,000 corn farmers in the United States to supply 80 percent to 85 percent of its needs. Other sources were necessary, but tapping them was difficult.

To diversify its sources of agricultural exports, the Japanese government had been promoting production-for-export ventures in foreign countries. These programs were aimed at:

1. assuring ample supplies of agricultural products and industrial raw materials
2. diversifying sources to secure constant supply
3. increasing supplies in world trade to lower and stabilize prices
4. providing foreign exchange to less developed countries so they could purchase Japanese industrial products
5. obtaining the goodwill of countries receiving aid.

Zen-Noh had supplied technical assistance to one such government project in Indonesia during the early 1970s in hopes of developing new suppliers, but the effort turned out to be fruitless and Zen-Noh withdrew the advisors it had provided.

More recently, Zen-Noh had become involved in a project developed by the Agricultural Cooperative Federation of Thailand. ACFT had requested a loan of about one million dollars for an integrated corn development project in three areas of central Thailand's "corn belt." The loan would finance a fifteen-year project designed to expand the use of appropriate mechanization in Thai corn production; introduce and diffuse seeds of higher yield and quality than those currently used by Thai farmers; improve corn cultivation practices; and improve the production and marketing infrastructure (irrigation, farm-access roads, etc.). The goals of the project were improvement in corn production and quality, higher living standards for the Thai cooperative's member farmers, a strengthening of the Thai cooperative organization and increase in its share of Thai corn exports, and the promotion of corn exports through coop-to-coop trade between Japan and Thailand. Significant amounts (75 percent) of financing were available for such a project from the Japan International Cooperation Agency, a government development-assistance organization.

Although Zen-Noh had accepted the Thai proposal, Mr. Ohnuma knew that it could not provide an increment of corn production large enough to satisfy Zen-Noh's growing requirements. Thus, he felt he had to keep searching for potential new suppliers of corn. The countries he considered to have the greatest potential as future suppliers were Brazil, the People's Republic of China, and Vietnam. These countries were most attractive because of their productivity improvement potential,[8] the export orientation of their political leaderships, and—in the case of Vietnam and China—their proximity to Japan. Considerable obstacles would attend his efforts to make these nations corn exporters to Japan, however.

Brazil was of interest because it was believed to be the only southern hemisphere nation capable of expanding its corn output significantly within a few years and because it harvested its corn crop just as Japan's current suppliers undertook spring planting. Brazil had organized cooperatives that would be attractive partners to Zen-Noh and its corn was typically produced by small or subsistent farmers. Furthermore, it was relatively close to a competitive Europe, and freight rates for cargo space from Brazil to Japan were about five to six dollars per metric ton higher than from the U.S. Gulf to Japan. Vietnam appeared to be the major potential new supplier. Its climate and yield potential were very good, and its leadership felt a strong need to generate foreign exchange. Further, it appeared to be effectively reunified and thus likely to enjoy a stable government for some time. Although Zen-Noh had succeeded in importing small quantities from China in the past, it had a large and growing population and typically consumed almost all of its annual corn production.

In short, there were significant economic reasons for the dominance of the

United States as the leading supplier of corn to Japan. On a per-ton basis, the United States was not the cheapest producer of corn in the world, but its logistical system was efficient enough, and the volumes it could ship were great enough, to make it the major competitor for any nation wishing to sell corn to Japan. Mr. Ohnuma realized these facts, yet at the same time he knew that Zen-Noh and Japan had to develop new sources of supply. Doing so would be in the best interests of the cooperative and the nation, and it would be consistent with the public-policy priorities of expanding trade relations with less developed countries and helping them develop their economies and integrate small-scale producers into their corn systems.

Conclusions

The Zen-Noh case makes it evident that potential future demands for corn will induce firms like Zen-Noh to seek longer-term procurement agreements. Given the political, economic, and social priorities of Japan and developing country suppliers, a mutuality of interest exists. It is important to note that because Zen-Noh is a producer cooperative, it has a great sensitivity to the requirements of foreign producers.

This case has implications for producer cooperatives in the United States that desire to play a more active role in world grain trading. To do so, firms like Farmers Export will have to recognize the social, political, and economic priorities of other cooperative producers and to take into account the economic development of corn producers in other countries. And policymakers must realize that the level of U.S. price supports can act as an incentive or disincentive to world production and as a price umbrella or a threat to world competition.

All firms and public policy entities will have to assume the twin roles of competitor and cooperator if the future development of the world's corn system is to take a beneficial direction. Naturally, a firm's survival and profitability are important. But other social, political, and economic priorities will have to be taken into consideration if markets are to remain available to all participants in the world corn system.

NOTES

1. We gratefully acknowledge our reliance, in this section, on information in the paper *Multi-Purpose Agricultural Cooperatives in Japan*, by Shiro Futagami of the Central Union of Agricultural Cooperatives (Tokyo), and presented at the *National Seminar on Integrated Approaches to Agricultural Cooperative Development in Nepal*, December 10, 1976.

2. A prefecture is a level of government organization analagous to a state or province. Japan has forty-seven prefectures.

3. The Japan Feed Trade Association, or JFTA.

4. For a fuller description of the Thai-Japan Maize Trade Agreement, see C. Itoh & Co., Ltd. (4-576-041) in chapter three.

5. Source: Foreword in pamphlet entitled *The National Federation of Agricultural Cooperative Associations*, published by Zen-Noh.

6. This limitation is regularly circumvented by Bangkok exporters who trade export quotas among themselves.

7. Domestic potatoes were the source of about 80% of the starch produced in Japan in the 1960s. Corn had become the principal source by the mid-1970s, however, supplying about two-thirds of all starch produced.

8. In 1975, Brazil's corn yield was estimated to be 1230 kilogram/hectare; China's was 2210 kilogram/hectare; and Vietnam's was about 1170. In the same year, U.S. yields were between 5 and 6 thousand kilos per hectare and Thailand's was 2380.

Chapter 3

Consumption and Supply in a Growing Regional Market: The Case of Japan

This chapter describes the structure of the corn system in Japan, the trends affecting it, and the ways in which participants in it have sought to relate their activities to those of foreign suppliers. The Japanese corn industry provides an excellent example of the influence of national market forces and government policies on the international corn system. Equally important, it offers numerous opportunities to analyze arrangements in which corn-consuming entities have sought to reach back to foreign producers in developed and developing countries to ensure the availability, the quality, and—to some degree—the price of their commodity needs. Because Japan is the dominant corn-consuming nation in Asia, it is critical to analyze its corn system in order to understand the changing market influences on other countries in Southeast Asia.

DYNAMICS OF THE JAPANESE CORN SYSTEM

As the most important feed crop for the expanding poultry, hog and livestock industry of Japan, corn plays a critical role in the future of the Japanese food economy. Consumption trends, supply responses, and the availability of corn and its potential substitutes will be analyzed in this chapter. Japan's dependence on corn imports makes it eager to reduce the risk of having too few feed grain suppliers. As its food economy expands, Japanese public policymakers recognize the dangers of increasing the country's dependence on imported corn and other feed grains. This chapter sets forth the dynamics of the corn system in Japan and the alternative strategies available to its public and private food system managers.

Consumption

Corn consumption has advanced rapidly in Japan during the last two decades as both feed and industrial uses have steadily increased. Table 3-1 shows that feed manufacturing has supplied the bulk of total demand, although industrial use accounts for a generally growing share of consumption.

As the Zen-Noh case study in Chapter 2 explains, the years between 1970 and 1973 saw the diet of Japan's increasingly higher income level consumers change significantly: daily caloric intake increased by 10 percent; consumption of starch foods (especially rice) decreased; and consumers demanded more sugar, oils and fats, and livestock products. Table 2A-1 quantifies these trends and predicts they will continue through 1985. Table 2A-2 provides data on the consolidation of holdings and expansion of livestock herds and poultry flocks with which Japanese farmers have taken advantage of these shifts in consumer demand.

As Japanese livestock production grew, so too did compound-feed production. In 1960, consumption of commercially mixed feed exceeded use of roughage and domestically produced by-product ingredients for the first time. Table 3-2 shows this rapid growth from 1963 to 1976. Note that although poultry

Table 3-1. Source and Use of Corn in Japan: 1960-75 (in thousands of metric tons; years beginning July 1)

	Supply				*Consumption*		
Year	*Beginning Stocks*	*Production*	*Imports*	*Total Supply*	*Feed Use*	*Industrial Use*	*Total Use*
1960	185	113	1,708	2,006	1,721	100	1,821
1961	185	116	2,109	2,410	2,119	101	2,220
1962	190	104	2,396	2,690	2,345	150	2,495
1963	195	104	3,076	3,375	2,842	290	3,132
1964	243	84	3,223	3,550	2,895	392	3,287
1965	263	75	2,887	3,225	2,414	542	2,956
1966	269	63	3,837	4,169	3,289	700	3,989
1967	180	61	4,582	4,823	3,502	948	4,450
1968	373	51	5,287	5,711	4,295	1,086	5,381[a]
1969	330	40	5,975	6,345	4,742	1,188	5,930[b]
1970	415	33	5,173	5,621	4,130	1,152	5,282
1971	339	33	5,416	5,788	4,157	1,303	5,460
1972	328	24	6,881	7,233	5,470	1,325	6,795
1973	438	19	8,210	8,667	6,400	1,425	7,825
1974	842	14	7,388	8,244	6,124	1,325	7,449
1975	795	14	7,600	8,409	6,300	1,375	7,675
1976	734	–	–	–	–	–	–

[a]Includes exports of 6,300 metric tons.

[b]Includes exports of 3,000 metric tons.

Source: Beginning stocks, production, imports, feed use, and total use are found in FAS, USDA, *Reference Tables on Wheat, Corn, and Total Coarse Grains Supply–Distribution for Individual Countries* (FG 9-76), p. 58. Figures for total supply and industrial use are calculated from figures in the USDA publication.

Table 3-2. Compound Feed Production in Japan, and Number of Plants Operating: 1963-76 (in thousands of metric tons; years beginning April 1)

	Type									
					Poultry					
Year	*Pigs*	*Dairy*	*Cattle*	*Other*	*Broiler*	*Layer*	*Other*	*Subtotal*	*Total*	*Number of Plants Operating*
1963	875	640	36	120	296	3,365	869	4,530	6,201	–
1964	1,157	711	55	142	383	4,095	953	5,431	7,496	–
1965	1,774	804	77	183	455	4,069	793	5,312	8,150	178-187
1966	2,552	924	125	200	705	4,443	949	6,097	9,898	196-205
1967	2,423	1,667	234	193	795	4,713	898	6,407	10,324	190-204
1968	2,433	1,301	448	183	993	4,997	1,002	6,992	11,356	208-216
1969	3,100	1,521	600	199	1,401	5,404	1,076	7,941	13,362	214-217
1970	3,932	1,741	876	77	1,506	5,880	1,064	8,450	15,076	211-216
1971	4,032	1,812	1,203	73	1,745	5,894	934	8,573	15,693	208-210
1972	4,699	1,945	1,453	85	2,045	6,815	933	9,163	17,345	208-214
1973	5,155	1,907	1,835	74	2,196	6,063	854	9,113	18,084	214-221
1974	4,860	1,792	1,665	69	2,170	5,693	769	8,632	17,019	219-221
1975	4,538	1,834	1,544	65	2,315	5,694	829	8,838	16,818	–
1976	5,197	1,956	2,008	73	2,579	5,948	856	9,383	18,618	–

Source: Livestock Survey, Commercial Feed Division, Livestock Bureau Ministry of Agriculture and Forestry, Monthly Feed Report.

feed has been the largest component of feed production, its share of all feed production has decreased as consumers have demanded increasing quantities of pork and beef in their diets. Despite the increasing share of production represented by these feed types, however, only broiler-feed production maintained strong growth through the inflation and recession years of 1974 and 1975. This phenomenon reflects, at least in part, consumer shifts toward broiler meat and away from higher priced protein sources during these years. Broiler feed has also increased from about 9 percent to over 27 percent of poultry-feed production and from about 6 percent to almost 14 percent of all feed produced. This growth in Japanese broiler-feed demand reflects a pattern observable in many other industrial nations: production units of increasing size, improving economies of scale, and real consumer prices lower than those for red meats.

Participants in the corn-refining industry have also taken advantage of changes in the Japanese diet. Production of cornstarch and its by-products consumes over half the corn that Japan uses for industrial purposes (Table 3-3). Although domestic sweet and white potatoes and imported wheat are also used in starch manufacture, Table 3-4 shows that cornstarch has grown from the smallest to the largest category of starch production over the last two decades. Underlying this development is the decline in sweet potato starch production that occurred after 1963, just as demand for sugar and other sweeteners was accelerating rapidly. Cornstarch manufacturers were quick to seize on this market opportunity. Table 3-5 records an almost ninefold increase in use of cornstarch for sweetener production between 1965 and 1967. Note that, except for its use in sweeteners, cornstarch use has been essentially unchanged since 1966.

As in other industrial nations, cornstarch demand in Japan fluctuates according to economic conditions in the industries that consume it. Thus, demand

Table 3-3. Use of Corn in Japan's Wet-Milling Industry: 1968-75 (in thousands of metric tons)

Year	*Total Industrial Use*[a]	*Wet-Milling Industry Use*[b]	*Wet-Milling Share (percentage)*
1968	1,086	742	68
1969	1,188	785	66
1970	1,152	881	76
1971	1,303	891	68
1972	1,325	907	68
1973	1,425	993	70
1974	1,325	1,144	86
1975	1,375	922	67

[a]From Table 3-1, years beginning July 1.

[b]Japan Sweetener Association, years beginning April 1.

Source: FAS, USDA.

Table 3-4. Annual Starch Production in Japan by Raw Material Source: 1953-75 (in thousands of metric tons)

Year	*Sweet Potato Starch*	*White Potato Starch*	*Wheat Starch*	*Cornstarch*	*Total*
1953	244	84	70	8	406
1954	248	90	75	9	422
1955	465	97	80	9	629
1956	406	102	87	9	604
1957	366	120	76	11	573
1958	400	136	89	12	636
1959	519	145	97	16	777
1960	474	158	110	28	770
1961	525	170	110	36	841
1962	607	130	80	85	902
1963	740	150	70	140	1,100
1964	650	180	55	220	1,105
1965	550	250	60	305	1,165
1966	540	130	84	400	1,154
1967	495	208	70	520	1,293
1968	367	320	60	510	1,257
1969	264	245	60	539	1,108
1970	230	244	60	581	1,115
1971	175	233	65	594	1,067
1972	174	261	70	615	1,120
1973	92	193	70	706	1,061
1974	91	164	70	617	942
1975	98	209	N.A.	710	N.A.

Sources: Sweet Potato and White Potato Starch: Ministry of Agriculture. Wheat Starch: Food Distribution Department, C. Itoh & Co., Ltd. Cornstarch: Japan Sweetner Association.

increased through the 1960s and early 1970s as the Japanese economy grew strongly. More recently, growth has slowed because of the worldwide recession of 1975 and its lingering effects on the Japanese economy.

A significant new source of industrial demand for cornstarch is now emerging. Large food and soft-drink producers are abandoning familiar cane and beet-based sugars for the high fructose corn syrup (levulose) introduced in Japan in the early 1970s. Japanese corn sweetener manufacturers have acquired the technology to produce the product from U.S. firms[1] to supply growing demand from Japanese food producers. In 1976 Snow Brank Milk Products, the largest private Japanese dairy processing concern, decided to use the new sweetener to replace 25 percent of its annual 30,000-ton sugar requirement in ice cream, dairy drinks, and yogurt products. Snow Brand's chief competitors—Meiji Milk Products, Inc. and Morinaga Milk Industry Company—are also increasing their use of the new sweeteners.[2] As shown in Table 3-6, soft-drink manufacturers have been important users of high fructose syrups since their introduction, but the new sweetener still accounts for only about 10 percent of the industry's needs.

Table 3-5. Use of Japanese Cornstarch Production: 1964-74 (in metric tons; years beginning October 1)

Use	*1964*	*1965*	*1966*	*1967*	*1968*	*1969*	*1970*	*1971*	*1972*	*1973*	*1974*
Sweeteners	32,000	32,000	111,000	284,000	280,000	290,000	311,000	314,000	325,000	376,000	373,000
Fish Paste	20,000	16,000	20,000	22,000	22,000	20,000	20,000	6,000	5,000	5,000	4,000
Corrugating	80,000	68,000	96,000	100,000	110,000	124,000	90,000	99,000	107,000	107,000	73,000
Modified Starch	33,000	48,000	43,000	43,000	43,000	58,000	70,000	74,000	75,000	85,000	72,000
Beer	18,000	35,000	45,000	45,000	45,000	35,000	30,000	38,000	42,000	48,000	41,000
Pharmaceutical	–	4,000	–	–	–	–	–	–	–	–	–
Monosodium Glutamate	–	5,000	10,000	5,000	–	–	–	–	–	–	–
Other	27,000	62,000	45,000	21,000	10,000	12,000	60,000	63,000	64,000	85,000	54,000
Total	220,000	270,000	370,000	520,000	510,000	539,000	581,000	594,000	615,000	706,000	617,000

Source: Japan Sweetener Association. Total use for years 1965 and 1966 does not agree with total production for same years in Table 3-4.

Table 3-6. Consumption of High Fructose Corn Syrup in Japan: 1974-76 (in metric tons)

	1974		*1975*		*1976*	
Use	*Quantity*	*Percentage of Total*	*Quantity*	*Percentage of Total*	*Quantity*	*Percentage of Total*
Soft Drinks	56,000	55.0	70,000	54.5	84,000	53.9
Fruit Juices	6,600	6.5	9,200	7.2	12,000	7.7
Frozen Desserts	14,900	14.6	19,400	15.1	25,200	16.2
Canned Fruit	4,800	4.7	5,800	4.5	6,900	4.4
Soy Sauce	4,900	4.8	5,900	4.6	6,400	4.1
Bread	7,800	7.7	8,200	6.4	7,700	4.9
Cakes	1,900	1.9	2,200	1.7	2,600	1.7
Confections	800	.8	900	.7	1,100	.7
Other	4,200	4.0	6,700	5.3	10,000	6.4
Total	101,900	100.0	128,300	100.0	155,900	100.0

Source: Japan Sweetener Association.

Table 3-7. Consumption of Sucrose in Japan: 1974 (in thousands of metric tons)

Use	*Quantity*
Bread	132,442
Candy	65,000
Cookies	151,343
Other Confectionary Uses	624,771
Jams	70,922
Milk Products	116,687
Ice Cream	48,720
Soft Drinks	547,224
Seasonings	59,839
Pickles	103,097
Home Use	699,993
Total	2,618,038

Source: Japan Sweetener Association.

The potential market opportunity for this new product is large, however, if it can be manufactured at a price competitive with those of other sweeteners. Consumption of sugar (sucrose) in Japan exceeds 2.5 million tons annually. Table 3-7 breaks down this consumption.

Industry projections based on the Ministry of Agriculture's food demand forecasts predict a need for about 23 million metric tons of compound feed in Japan in 1985.[3] This figure means consumption of 8.8 million metric tons of corn, assuming corn continues to account for about 38 percent by weight of total feed production. If the cornstarch recovery rate continues to approximate

66 percent, Japan's need for corn in 1985 is likely to fall in the range of 10 to 12 million metric tons.

There are therefore three main reasons for strong and growing demand for corn in Japan: increasing per-capita real income, rapid industrial growth, and technological developments in processing that have created new products and markets. These trends in Japanese consumption epitomize the changes occurring in higher income sectors of the world corn system. Increasing demand will create opportunities for corn producers and producing nations, but attempts to satisfy this demand will result in logistical, price, and production pressures throughout the corn system.

Supply

Because of its limited land area and dense population, Japan has always imported large quantities of food. The government has sought to ensure self-sufficiency of certain critical foodstuffs such as rice, the nation's most important human food source, so animal feed commodities have been accorded lower production priorities. Imports therefore supply most Japanese demand for corn as a feed grain.

As Chapter 2 explains, the United States has long been Japan's largest corn supplier, and Thailand is a distant second. Japanese trading companies have encouraged Thailand's development as a corn exporter, and the formerly considerable trade with Argentina and South Africa has declined and shows no sign of reviving.

Zen-Noh and other companies, along with the Japanese government, agree that they must decrease the dependence of Japanese livestock producers and industrial corn processors on the United States. American feedgrain surpluses during the 1960s and early 1970s permitted Japanese importers to ignore this dependence. But the corn blight of 1971, transportation tie-ups due to American dock strikes and severe winter weather, the soybean embargo in 1973, and export controls in 1974 underlined the vital need for alternative corn suppliers. The efforts of the importers and the government to develop new sources of corn are explored in detail later in this chapter.

THE STRUCTURE OF JAPAN'S CORN SYSTEM

As in other countries, decisionmaking in the major off-farm segments of the corn industry is concentrated. Despite the limited number of decision centers, firms operating in Japan's corn industry do not freely exercise monopoly or oligopoly power, for uncertainties regarding corn supply and general political and economic trends have encouraged greater cooperation among the major participants. The government, through its antimonopoly law and fair trade commission, closely monitors business decisionmaking, especially as it affects any part of the food system. Private firms and government agencies tend to discuss decisions

involving pricing and capital investment. Thus, the Japanese avoid the unfair business practices that sometimes occur when power is concentrated.

Among the feed millers, eleven firms accounted for almost 80 percent of all annual production and owned 118 of the industry's 220 plants operating in 1976. The Nihon Haigoh and Nihon Nohsan firms are the oldest and have always been in feed activities of some kind. Although they were the earliest entries in the compound-feed business, their shares of the market are by no means the largest, as Table 2A-5 shows. Zen-Noh, the National Federation of Agricultural Cooperatives, enjoys almost 40 percent of the Japanese market for compound feeds. In 1976, Zen-Noh alone operated 54 of the industry's 220 plants. As Chapter 2 details, they are strategically located throughout the nation. In achieving its dominant industry position, Zen-Noh has been exempt from antimonopoly laws.

In the smaller, wet-milling segment of the corn system, twenty firms operate twenty-two plants with an aggregate production capacity of 1.62 million tons of starch. Table 3-8 shows that eight firms—those of the Japan Cornstarch Association—own 64 percent of industry capacity. Except for Ibaragi Cornstarch, these firms are the oldest in the industry, all having entered during the early 1960s. Nisshoku (NSSK), the largest company, is partly owned by the U.S. firm, CPC International, Inc., the largest cornstarch manufacturer in the world.

Import of corn is heavily concentrated as well. Table 3-9 shows that in 1976, five firms handled two-thirds of Japan's corn imports for feed manufacturing and eleven smaller firms managed the rest. Four of the five are the largest Japanese trading companies; Mitsubishi, Marubeni, C. Itoh, and Mitsui. The fifth is UNICOOP, a subsidiary of the Zen-Noh cooperative federation. Several of the smaller firms are rather closely linked to the four large trading firms through financial or other ties. For example, Mitsubishi has ties with Nisho Iwai; Mitsui has ties with Nichiryoh, Tohshoku, and Yuasa; C. Itoh has ties with Tohmen; and Marubeni has ties with Kanematsu. Thus, the import of corn to Japan is managed by a relatively small number of firms and decisionmakers.

Figure 3-1 summarizes this brief description of the corn system in Japan. It shows the relative volume of corn flow through the major industry segments and numbers the establishments at each level. This diagram will appear again in a later chapter as part of a schematic chart of the larger Southeast Asian corn system and appeared already in Chapter 2 to provide the reader with an overview of the interrelationships of the Southeast Asia and U.S. corn systems.

BEHAVIOR WITHIN JAPAN'S CORN SYSTEM

As the Japanese feed and livestock economy has matured, the development of a national storage program has taken place to act as a buffer against supply interruptions. However, there are some limitations to the storage program's effectiveness because of the dominance of the U.S. corn system, its effect on the

Table 3-8. Manufacturing Capacity in the Japanese Cornstarch Industry, by Firm and Trade Association: March 1975 (in metric tons)

Organization	*Yearly Capacity*	*1975 Production*	*Percentage Share of Industry Production*	*Number of Factories*	*Year Founded*
Japan Cornstarch Association	1,038,000	685,080	64.1	10	
NSKK	315,000	207,900	19.5	2	1946
Japan Cornstarch	180,000	118,800	11.1	1	1957
Sanwa Denpun	120,000	79,200	7.4	1	1960
Shikishima Denpun	51,000	33,660	3.2	1	1963
Okubo Denpun	12,000	7,920	.7	1	1961
Ajinomoto	60,000	39,600	3.7	1	1964
Oji Denpun	180,000	118,800	11.1	2	1964
Monen Seiyu	120,000	79,200	7.4	1	1965
All Japan Cornstarch Industry Association	499,500	329,670	30.9	10	
Aito	99,000	65,340	6.1	1	1967
Shono Denpun	75,000	49,500	4.6	1	1967
Kawai Denpun	30,000	19,800	1.9	1	1967
Kato	150,000	99,000	9.3	1	1968
Morimoto	19,500	12,870	1.2	1	1967
Oriental	30,000	19,800	1.9	1	1967
Isomura Denpun	15,000	9,900	.9	1	1967
Kamiya Denpun	15,000	9,900	.2	1	1966
Kogo Denpun	45,000	29,700	2.8	1	1966
Ibaragi Cornstarch	21,000	13,860	1.3	1	1944
Kansai Cornstarch Association	81,000	53,460	5.0	2	
Ginboshi	21,000	13,860	1.3	1	1968
Matsubara Seifun	60,000	39,600	3.7	1	1968
Total, 20 Firms	1,618,500	1,068,210	100.0	22	

Source: Japan Sweetener Association.

Table 3-9. Japanese Import of Corn and Grain Sorghum for Feed Manufacturing by Importer: 1976 (in thousands of metric tons; shares as a percentage)

	Corn		*Grain Sorghum*		*Total*	
Importer	*Quantity*	*Share*	*Quantity*	*Share*	*Quantity*	*Share*
UNICOOP-JAPAN	987	14.1	781	18.1	1,768	15.6
Mitsubishi Shohji	1,098	15.7	607	14.1	1,705	15.1
Marubeni	868	12.4	535	12.4	1,403	12.4
Itohchu Shohji	727	10.4	632	14.6	1,359	12.0
Mitsui Busan	929	13.3	426	9.9	1,355	12.0
Nichimen Jitsugyoh	246	3.5	470	10.9	716	6.3
Tohmen	435	6.2	149	3.5	584	5.2
Kanematsu Goshoh	296	4.2	250	5.8	546	4.8
Nisho Iwai	384	5.5	60	1.4	444	3.9
Tohshoku	274	3.9	66	1.5	340	3.0
Sumitomo Shohji	201	2.9	100	2.3	301	2.7
Nichiryoh	198	2.8	39	0.9	237	2.1
Yuasa Sangyoh	138	2.0	82	1.9	220	2.0
Ataka Sangyoh	74	1.1	31	0.7	105	0.9
Ohkura Shohji	65	0.9	36	0.8	101	0.9
Meiwa Sangyoh	11	0.2	53	1.2	64	0.6
Others	55	0.9	1	0.0	56	0.5
Total	6,986	100.0	4,318	100.0	11,304	100.0

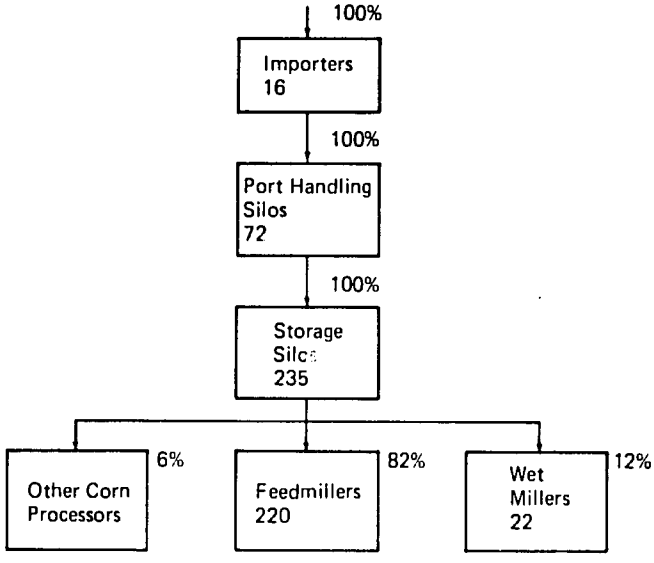
Note: The amount of 725,000 of total use of corn was for nonfeed purposes and 343,000 net of grain sorghum was also for nonfeed use.

Source: National Federation of Agricultural Cooperatives.

world corn system and especially on the cost/price structure of the Japanese feed, poultry, and livestock economy. The interaction of the Japanese storage program, U.S. corn prices, and the resulting feed cost structure in Japan is set forth below.

Storage

As Japan's corn industries grew, so did their need for storage capacity. Thus, between 1965 and 1975, the total number of port grain silos increased from none to 212 with a total capacity of 3.7 million metric tons.[4] Following the shock of the U.S. soybean embargo in 1973 and its cancellation of certain corn sales to the Soviet Union in 1974, the Japanese government sought to encourage expansion in storage capacity and in the stockpiling of food and feedgrains. For example, government and industry have established a "supply stabilization fund" to maintain an inventory of 50,000 tons of soybeans (a month's supply) for food use only. Wheat inventories have been raised from 1.7-month's supply to almost 2.5-months', and the government has expanded its stocks of feedgrain (primarily barley) by 50 percent.



Source: various trading firms and trading associations.

Figure 3-1. Facilities in the Corn Commodity System in Japan: 1976

Beginning in 1976, the government has also encouraged feed manufacturers to increase their raw materials inventories from a one-month's to a two-months' supply. These efforts have required new storage facilities, but the government has provided loans for new construction and subsidies for grain inventory carrying costs. The 1977–1978 budget provides funds for the addition of 100,000 tons of corn and 200,000 tons of feed barley.[5]

As a result of these initiatives, importers and corn-consuming firms jointly seek to maintain about a two-months' inventory of their grain needs. This level may vary somewhat in response to commodity price movements. For instance, if Japanese buyers expect corn prices to increase significantly, they may buy early and enlarge their inventories. Alternatively, they might postpone their purchases and allow their inventories to drop below the two-months' level if they anticipate lower prices. In deciding to follow one of these courses, the purchasers must weigh inventory carrying costs, the potential change in basic commodity price, and the need to maintain a reserve of corn above what is required for uninterrupted operation of processing plants and adequate stocking of the grain distribution pipeline.

Price Stability

Because practically all of Japan's corn is imported and approximately 80 percent of its imports originate in the United States, Japanese corn prices are directly influenced by U.S. corn prices. This relation is reinforced by the fact

that the price of corn for export to Japan from Thailand, Japan's second largest supplier, is tied directly to the Chicago futures market price for corn.

The relation between U.S. and Japanese prices is clear when one compares corn prices at U.S. Gulf ports[6] and cost, insurance and freight (CIF) prices for corn at major ports. Table 3-10 offers such a comparison and indicates clearly the correspondence between Japanese import prices for corn and American values. The stability of Japanese prices obviously depends on the stability of U.S. corn prices. Currently, there is less upward pressure because the U.S. system is increasing its carryover of corn. However, new legislation with relatively low price support levels will ensure that the Chicago futures market remains the major trading and hedging device for corn dealers and processors throughout the world. U.S. corn prices will continue to reflect world supply and demand conditions and so, consequently, will Japanese prices.

Cost/Price Structure

Their dependence on U.S. prices is very important to all participants in the Japanese corn system. Consider the cost structure of Japanese feed manufacturing shown in Table 3-11. Raw materials are by far the largest cost element in Japanese feed manufacture, so participants throughout this industry segment feel fluctuations in prices for corn very rapidly. Increasing ingredient costs require manufacturers to increase prices to maintain margins; livestock producers, in turn, adjust their operations to reflect higher input costs. Consumers, finally, face higher meat and poultry prices. Clearly, crop conditions in the United States, world supply/demand pressures, and national policy decisions affecting corn directly influence the cost of protein to the Japanese consumer.

COORDINATION OF CONSUMPTION AND SUPPLY

A variety of institutions and arrangements help to maintain a steady flow of corn to Japan's feed mills and corn refiners and to manage the unavoidable risks of dealing in a commodity of constantly changing value. Each of the entities discussed in this section acts as a coordinator in the system and is used as a form of risk management.

Integration

Integration is one of the more important forms of coordination linking the various parts of the Japanese corn system. Figure 3-2 summarizes the ownership of corn as it moves into and through that system.

Cooperatives. Probably the most striking example of integration is the cooperative movement represented by Zen-Noh and described in Appendix A of Chapter 2. To facilitate the expansion of livestock production among coop-

Table 3-10. Unit Values, Transport, and Handling Charges Between U.S. Producers and Japanese Importers: 1969-76 (in U.S. dollars per metric ton)

Item	*Year*						
	1969-70	*1970-71*	*1971-72*	*1972-73*	*1973-74*	*1974-75*	*1975-76*
Seasonal average price received by U.S. farmers	45.67	52.36	42.52	61.81	100.39	118.89	98.42[a]
Implicit U.S. inland storage, handling, and freight costs	8.37	9.62	11.52	18.67	23.81	17.65	20.36
U.S. export unit value to Japan	54.04	61.98	54.04	80.48	124.20	136.54	118.78[b]
Ocean freight to Japan[c]	12.17	8.43	5.12	12.99	25.77	12.00	9.97
Japanese import unit value (lagged 2 months)[d]	66.07	74.21	62.94	89.95	145.15	155.46	136.03[e]
Unexplained difference[f]	(0.14)	+3.86	+3.78	(3.52)	(4.82)	6.92	7.28

[a]Through May 1976.

[b]Through June 1976.

[c]Maritime Research Bureau Figures.

[d]Japanese Customs Bureau Figures.

[e]Through April 1976 and not lagged two months.

[f]The result of comparing averages calculated by different research organizations. From 1972 through 1974, high ocean freight rates and rising corn prices caused a price squeeze between U.S. ports and Japanese ports, as shown by the fact that the Japanese import unit value for U.S. corn did not cover the U.S. export unit value of corn destined for Japan plus ocean freight. This situation did not preclude profits, however, because Japanese buyers during this period were purchasing and pricing their corn through contracts or futures transactions several months in advance of shipment times rather than the two months indicated under "Japanese Import Unit Value."

Source: H. Christine Collins, "Price Changes and Price Spreads Between Farm and Foreign Markets for Wheat, Corn, and Soybeans—Evaluated from Unit Values," *Foreign Agricultural Trade of the United States*, U.S.D.A., October 1976.

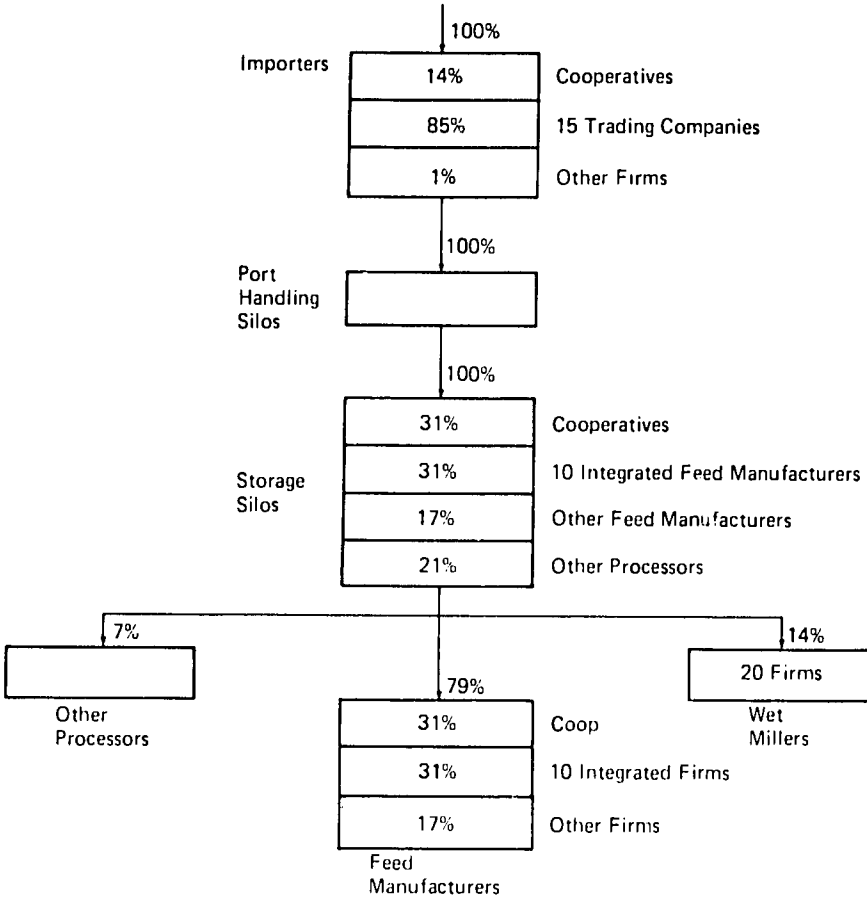
Table 3-11. Cost Structure of Feed Manufacturing and Distribution in Japan

	Percentage
Milling Cost Structure	
Raw materials	85
Production cost (includes depreciation and receiving costs)	11
Finance	2
Miscellaneous	1
Margin	1
Milling Total	100
Dealer Cost Structure	
Product delivery charge	5
Margin	5
Dealer Total	10
Grand Total	110

Note: These figures are representative percentages. The actual cost structure varies according to the age of mills, their location, the extent of integration, and other factors.
Source: C. Itoh & Co. (America), Inc. Company sources.

erative members, Zen-Noh became an early entrant in the compound feed industry. It now operates chick hatcheries, produces feeder calves and hogs, and processes and markets meat, milk, and eggs. Its large role in feed manufacturing led it to integrate backward into importing by forming a trading subsidiary, UNICOOP, in 1961. UNICOOP operates in a fashion somewhat similar to large Japanese trading companies and to international grain trading firms. It maintains several overseas offices and imports about 14 percent of Japan's total corn needs.

Zen-Noh's importance in Japanese agribusiness ranges far beyond the corn industry. It implements government price-support programs in its collection of rice from local coops and prefectural federations and in its marketing of the grain in urban areas. It has developed storage facilities, processing plants, and distribution channels throughout Japan. In the area of fruits and vegetables, Zen-Noh attempts to maintain price stability by regulating overall market supply. It seeks to expand the market by developing new sales outlets either through its own or other private supermarkets. Fertilizer raw materials are imported and supplied to domestic chemical manufacturers who then sell the fertilizer back to Zen-Noh for distribution to local cooperatives. In the import of grains and other ingredients for feed manufacture, Zen-Noh operates, under exclusive charter, bulk grain carriers, grain silos, and related facilities at Japan's main ports. It also assists local and prefectural cooperatives in obtaining farm machinery, automobiles, and fuel. Finally, it is developing cooperative-owned gas stations and the "A-Coop" supermarket chain. In short, Zen-Noh is inte-



Sources: Feed Manufacturing: based on figures for feed and nonfeed imports in Chapter 2 and on shares of the feed market shown in Table 2A-5. Wet Milling: based on figures for nonfeed imports in Chapter 2 and on shares of industrial use accounted for by wet milling in Table 3-3. Other Processors: Residual.

Figure 3-2. Ownership in the Japanese Corn System as Measured by Quantity Flows: 1975

grated throughout the entire food system in Japan from farm supply through retail food distribution. It is in a position to expand its role further.

Zen-Noh is significant not only within the cooperative movement but also within the Japanese economy as a whole. Since its formation by merger of the Zenkoren[7] and Zenhanren[8] cooperative federations in 1972, its sales volume has ranked just behind those of the five largest general trading companies (Table 3-12). It has dominant shares in the Japanese markets for rice (95 percent), wheat and barley (89 percent), fertilizer (65 percent), farm chemicals (52 per-

Table 3-12. Comparison of Zen-Noh's Sales Volume with those of the Five Largest Japanese General Trading Companies: 1972–75 (in millions of yen)

	Sales Volume			
Company	*1972*	*1973*	*1974*	*1975*
Mitsubishi	4,529,833	5,181,920	7,486,162	9,407,680
Mitsui	4,955,481	6,967,730	8,627,216	7,885,170
Marubeni	3,402,501	4,649,112	5,548,401	5,762,570
Sumitomo	2,429,688	4,019,474	5,117,789	5,509,561
C. Itoh	2,778,380	3,179,907	4,477,402	5,245,097
Zen-Noh		2,497,749	3,422,552	4,256,414

Note: One U.S. dollar is approximately equal to 280 yen. Figures are for years ending March 31, except for Zen-Noh, whose years end June 30.

Source: Mitsubishi, Mitsui, and C. Itoh, *Business Reports;* and Zen-Noh Feed Department.

cent), and compound feeds (41 percent). It commands smaller shares in the markets for farm machinery (30 percent), eggs (20 percent), and broilers (15 percent).

Trading Companies. Another important form of integration is represented by Japanese general trading companies, which are unlike trading firms in other countries in terms of the size and diversity of their operations. These trading companies account for a large share of Japan's imports and domestic distribution activity. Their worldwide communications networks give them access to large amounts of economic and business intelligence.

Broadly speaking, the goal of trading companies is market integration or coordination inside and outside Japan. They accomplish this integration by maintaining extensive financial relations with each other, acting as agents for Japanese and foreign suppliers of a great variety of products and commodities, and maintaining very extensive distribution networks throughout the world. Trading firms develop sophisticated and diverse business operations, performing as organizers, project managers, and financial coordinators. They may or may not acquire an ownership interest in these projects. But with or without such an interest, they are expected to obtain equipment, materials, and funds, wherever they are available in the world, at the lowest cost. They are also expected to use their marketing expertise and organizational networks to find markets. In a typical project, for instance, a trading firm might purchase machinery and equipment from a European country, draw up a technical agreement with a U.S. firm, develop sources of raw materials in a developing country, obtain long-term loans through its affiliated Tokyo banks, and market the project's products through its worldwide network. This form of integration is as much a qualitative or coordinating function as it is the controlling or ownership variety more familiar to Western businessmen.

Table 3-13. Indicators of Scale of Ten Leading Japanese Trading Firms: March 1975

Name of Company	Capital (in millions of U.S. Dollars)	Employees		Subsidiary and Affiliated Companies		Offices	
		Japanese	Local	Domestic	Overseas	Domestic	Overseas
Ataka	37.9	3,498	553	101	64	31	66
C. Itoh	124.7	7,717	1,735	108	179	36	92
Kanematsu-Gosho	27.6	3,901	898	125	60	24	74
Marubeni	113.7	8,040	2,275	140	179	55	117
Mitsubishi	124.7	10,064	2,581	74	183	52	118
Mitsui	121.5	10,475	2,290	92	225	57	143
Nichimen	35.8	3,956	690	68	52	34	71
Nissho-Iwai	64.8	7,071	1,302	62	68	46	91
Sumitomo Shoji	56.0	5,775	1,329	55	102	43	98
Toyo Menka	35.7	4,094	913	36	75	57	66

Note: One U.S. dollar is approximately equal to 280 yen.

Source: Tokyo Economic Information Service Co., Ltd., *SOGO-SHOSHA: Japanese General Trading Companies Yearbook*, 1976, Introduction.

There are several thousand trading companies in Japan, but the most significant are the general trading companies. Table 3-13 lists the most important of these companies with certain indicators of the scale of their operations. Each of these firms is involved in various facets of agribusiness in Japan and elsewhere in the world. Earlier in this chapter, Table 3-9 showed their roles in the import of feedgrains to Japan; Table 3-14 reveals the importance of food-related activities in their operations. Generally, food-related operations account for about 15 percent of sales. If the agricultural-chemical, food distribution, and retailing activity of these firms could be isolated, one would see that their agribusiness activities are a considerably greater portion of their sales than the 15 percent produced by foodstuffs.

An indication of the diversity of the general trading companies' involvement in agribusiness is apparent in the organization of Mitsui and Company, Ltd. Companies within the Mitsui group are major competitors in a variety of agribusiness industries. Mitsui Toatsu Chemicals is the leading Japanese producer of urea, an important nitrogenous fertilizer, with 30 percent of the market. Nippon Flour Mills is the second ranking wheat miller in Japan, with over 20 percent of the market of wheat flour. Another Mitsui subsidiary owns the largest Japanese sugar-refining operation, accounting for about 25 percent of the total domestic capacity. Mitsui also owns 28,000 hectares of forest land, and its Oji Paper, with about 16 percent of the market, is the leading paper producer in Japan.

Events in world grain markets during the early 1970s have caused the development of close ties between individual corn processors and trading company importers, even in the absence of outright subsidiary or affiliated relationships. Feed millers and corn refiners needed the expertise and assistance of the general trading firms after the U.S. corn blight and the Mississippi River freeze, the acceptance of floating currency rates in 1971, and the imposition of U.S. export controls in 1973 and 1974. The acquisition of Japan's grain needs having become so much more complicated, corn processors aligned themselves with the importers most likely to be able to supply their needs. Table 3-15, which is based on industry interviews, shows these relations as they existed in Japan's feed-milling industry in early 1977.

This discussion of the various degrees and forms of trading-companies' involvement in Japan's corn system can only begin to define the extent of their coordinating role. Tables 3-9 and 3-15, which reveal their dominance of imports and close assoications with processing firms, do suggest the significance of their role, however. The Mitsubishi case study in Appendix A to this chapter provides a specific example of the general trading companies' continuing efforts to relate market opportunity and supply source.

Trading Associations

Trade associations perform important coordinating roles throughout the Japanese corn system. Especially important is the Japan Feed Trade Association.

Table 3-14. Sales of Ten Major General Trading Firms by Commodity Group: Six Months Ending 30 September 1975 (in millions of U.S. dollars)

	Mitsubishi	*Mitsui*	*Marubeni*	*C. Itoh*	*Sumitomo Shoji*	*Nissho-Iwai*	*Toyo Menka*	*Kanematsu -Gosho*	*Ataka*	*Nichimen*
Metals	4,508	4,171	2,364	1,393	3,297	2,193	896	658	1,229	732
Machinery	2,164	2,244	2,209	1,574	1,992	1,666	983	550	399	510
Foodstuffs	2,211	2,190	1,320	1,257	703	769	668	763	506	496
Fuels	2,805									
Chemicals	1,189	1,489	1,131	2,469	1,807		344	595		291
Textiles	854	941	1,355	1,922	592	500	892	866	703	526
Other	823	1,972	769	505	681	1,313	141	303	487	203
Total	14,554	13,007	9,148	9,119	9,072	6,440	3,923	3,735	3,324	2,759

Note: One U.S. dollar is approximately equal to 280 yen.

Source: Tokyo Economic Information Service Co., Ltd., *SOGO-SHOSHA: Japanese General Trading Companies Yearbook*, 1976.

Table 3-15. Relations between Japanese Corn Importers and Leading Feed Manufacturers

Feed Manufacturer	*Major Corn Suppliers*
Zen-Noh	UNICOOPJAPAN, Nichimen, Mitsubishi, Sumitomo Shoji, C. Itoh, Marubeni, Mitsui
Nihon Nosan	Mitsubishi
Nishin Seifun	Mitsubishi, Marubeni, C. Itoh, Sumitomo
Nihon Haigoh	Mitsui
Kyodo Shiryoh	Mitsui
Marubeni Shiryo	Marubeni
Amino Shiryoh	C. Itoh
Taiyoh Gyogyoh	Mitsubishi, Mitsui
Kawada Shiryoh	C. Itoh
Toyohashi Shiryoh	Mitsubishi, C. Itoh
Showa Sangyoh	C. Itoh, Mitsui

Source: Industry Interviews.

This nonprofit group represents Japan's major feedgrain importers and performs a variety of valuable services, including:

1. representation of the interests of Japan's feedgrain importers
2. collection, analysis, and dissemination of statistics regarding the world feedgrain situation, Japanese imports, and industrial consumption
3. annual negotiation of the Thai-Japan agreement on maize trade
4. encouragement of corn production projects in developing nations.

In accomplishing these activities, the association provides its members a valuable intelligence service and gives the managements of highly diversified firms a forum for considering supply and demand problems in corn and feedgrains.

Other important trade associations in the corn system with somewhat narrower orientations are the Japan Feed Manufacturers Association, the Japan Corn Starch Association, the All-Japan Corn Starch Industry Association, the Kansai Corn Starch Association, and the Japan Sweetener Association.

Contract and Trade Agreements

Contracts are an important method of relating consumption and supply. The most striking example of the use of a contract to secure Japan's corn needs is that embodied in the Japan-Thailand agreement on maize trade.

This agreement governs the sale of Thai corn to Japanese importers and has been used as a model for similar arrangements with other commodities and countries. Negotiated annually in June and July since 1961 by the Japan Feed Trade Association and the Thai Board of Trade, it establishes the amount of corn to be purchased, the approximate timing of deliveries, and the method of

pricing. The agreement usually provides for Japan to take about 50 percent of Thailand's exportable surplus of corn, and clauses are included to cover such problems as crop failure and breach of contract. Of particular interest is the fact that the agreement directly ties Thai corn prices to U.S. futures market prices. The C. Itoh case study in Appendix B to this chapter presents the Japan-Thailand agreement in the context of the annual negotiations between the Thai Board of Trade and the Japan Feed Trade Association, and it further defines the computations involved in setting the price for Thai corn.

As Chapter 5's discussion of the Thai corn system will make clear, this agreement has encouraged the growth of the Thai corn industry, strengthened its unique trading institutions, and allowed the orderly export of its product. For the Japanese, it has meant the development of another relatively reliable supplier in addition to the United States, partly reducing its undesirable dependence on that corn giant.

Less formal than the Thai agreement but nonetheless important to participants in Japan's corn system is the unwritten "understanding" between the American and Japanese governments that the United States will not embargo exports of key food and feedgrains to Japan. Since 1974, Japanese and U.S. officials have regularly discussed the availability of corn and other grains and reaffirmed the commitment not to embargo. The understanding recognizes Japan's status as the single largest importer of U.S. agricultural products, its heavy dependence on U.S. food supplies, and its reliability as a customer. Participants in the Japanese corn system have come to rely on regular reaffirmation of this understanding in their planning.

Cooperative-to-Cooperative Agreements

The Japanese Cooperative Federation, Zen-Noh, seeks through its UNICOOP subsidiary to develop contractual relations with other cooperatives in grain-exporting nations.

The case in Appendix A of Chapter 2 described in detail Zen-Noh's corn procurement from cooperatives in the United States and Thailand. Its efforts are a part of the broad effort by Japanese government agencies and participants in the corn system to diversify Japan's corn suppliers and to reduce their dependence on the United States. The case also described Zen-Noh's investment in and technical assistance to attempts to expand corn production in Thailand. This effort, encouraged by the Japanese government's Overseas Economic Cooperation Fund, is managed on site by the Agricultural Cooperative Federation of Thailand. As this and other cooperatives continue to develop arrangements with cooperatives in other countries, the potential for an international cooperative trading firm with multinational farmer ownership will come closer and closer to realization.

Joint Ventures

Mitsui & Company and a local partner in Indonesia have attempted yet another approach to coordinating corn consumption and demand. With P.T. Kosgoro of Jakarta, Mitsui formed a joint venture named Mitsugoro to produce and export corn from South Sumatra in Indonesia. The project, of which Mitsui owns 51 percent, is situated in a densely populated province, yet one that has relatively large uninhabited areas and is not highly productive agriculturally. Four farms totaling 4,000 hectares have been established in previously undeveloped areas surrounded by jungle.

The Indonesian government requested Mitsui to participate in the venture, and the Japanese government encouraged it to do so. To date, this novel attempt to develop a new source of supply for Japan's corn industry has produced neither a profit nor large quantities of exportable corn. But it has opened land to productive agricultural purposes, contributed to the development of new population centers, and demonstrated to public policymakers that careful planning is critical in future economic development projects. It has also provided small farmers in the area with a market willing to pay them prices considerably higher than those they received for their corn in the past.

As the Mitsui & Company case in Appendix C to this chapter makes clear, the venture has given Mitsui—and, indirectly, certain Japanese government agencies—considerable experience in the problems of corn supply diversification. This experience is proving valuable in other business-government initiatives to diversify Japan's sources of corn, feedgrains, and other food items.

Government Activities

Consideration of the corn commodity system in Japan is possible only in the context of the country's evolving food needs and policies. The bases of Japanese agricultural and food policies are essentially three:

1. Maintenance of the family farm and increasing the nucleus of full-time farmers
2. Self-sufficiency in certain commodities
3. Assured and stable access to vital commodities, such as corn, that must be imported.

Like all countries, Japan requires a food system to supply dependably its food needs over an extended period. Maintaining such a system is especially critical to Japan because of its heavy dependence on imports of grains, other than rice, and of oilseeds and sugar. On a caloric basis, Japan's food self-sufficiency is only 50 percent and has been sliding downward for over a decade. In the early 1970s, the government became increasingly concerned about the country's food security as a result of deterioration in world supply-demand balances and price fluc-

tuations of several commodities, including corn. A 1975 report to the Ministry of Agriculture and Forestry by the Advisory Council on Agricultural Policy cited Japan's vulnerability to shortages in world commodity markets as reason to take steps to expand domestic production substantially.

Domestic Policy. To increase domestic production, the Japanese government has instituted a variety of farm reforms and subsidy programs. The aims of these programs, broadly, are:

1. to maintain food self-sufficiency at current levels
2. to increase domestic production of feedgrains, wheat, soybeans, fruit, and vegetables
3. to ensure that domestic rice consumption and production are in balance
4. to produce most of the country's livestock and poultry requirements
5. to increase the efficiency of agricultural production by means of increased aid to full-time farmers.

Changes in the budget of the Ministry of Agriculture and Forestry reflect efforts to accomplish these aims. Expenditures for controlling rice production have been reduced while support levels for rice, wheat, barley, and soybeans have increased. The largest item in the ministry's budget—the Food Control Account—was responsible for 40 percent of the total in 1976, or about $3.1 billion. Of this amount, the rice subsidy (the difference between the support level to the producer and the price paid by consumers) accounted for $2.25 billion. In 1974 the ministry instituted a $65 million incentive program for expanding production of grains and forage crops. Although modest in size, such a program had not been undertaken previously. The ministry's 1975 budget included price supports for beef and eggs, also for the first time, and additional funds for oilseed price stabilization. In that year it appropriated funds for use in stockpiling soybeans ($1.4 million) and feedgrain ($1.7 million) and for use in encouraging increased production in certain developing countries ($12.8 million).[9] The sums are small, but the government is developing the capability to subsidize a considerable increase in domestic production and accumulate large stockpiles, should commodity prices and carrying costs make accumulation economically feasible.

Development of New Overseas Sources. The government is well aware, however, that Japan will continue to be dependent on imports over the long term for many food items, particularly feedgrains and oilseeds. Several agencies therefore continue to implement foreign-aid programs aimed at enlarging the number of Japan's feedgrain and oilseed suppliers. The Export-Import Bank of Japan provides direct investment and export financing in both developed and developing countries; and the Overseas Economic Cooperation Fund (OECF) provides

financing for programs and projects too risky for the Export-Import Bank. The Japan International Cooperation Agency (JICA) sends experts to and receives trainees from developing countries and provides funds for development of the agriculture, forestry, mining, and manufacturing industries. Other government agencies and government-affiliated organizations are involved indirectly with agricultural projects.

The stated aim of Japan's foreign aid to agriculture is to obtain imports of feedgrains and oilseeds from developing countries. Where direct import is not possible, it still grants aid in the expectation that an increase in world supply will reduce feedgrain prices. Government agencies and private firms are currently engaged in feedgrain development projects in no fewer than eight countries. In Brazil, the government is involved in a joint government-private development investment venture whose ultimate goal is production of corn and soybeans on two areas totaling over a million hectares. In Indonesia, an integrated 15,000-hectare corn project in a minimally productive area of South Sulawese is working to increase output through irrigation, flood control, roadbuilding, development of machinery-lending centers, and construction of storage facilities. In Lampung Province, the location of the Mitsui project described above, JICA furnishes aid for developing an integrated plan for corn production. In Thailand, through the Thai Cooperative Federation, Zen-Noh and OECF jointly finance and provide technical expertise to corn producers in the 270,000-hectare project described in the Zen-Noh case (Chapter 2, Appendix A). In Mexico, the Japanese government is financing a project to develop corn and soybean production on 20,000 hectares of land in Sinaloa Province. JICA is also surveying areas in northern Mexico for possible corn and sorghum production. In Argentina, JICA is devising a plan for establishing storage facilities, increasing production, and collecting and purchasing corn and sorghum. Government agencies have conducted surveys in the Philippines for a corn production project of 20,000 hectares being undertaken on Palawan Island. Even Australia receives Japanese technical assistance and loans for construction of warehouses and port elevator facilities for feed grains.[10] Finally, in Vietnam, Zen-Noh is helping its Vietnamese counterpart (V-Coop) to develop 1,000 hectares of corn fields. The cooperative partly draws on government financial resources and technical expertise in this three-year pilot project aimed at cultivating new lands, improving soil, and increasing output. Zen-Noh hopes to import corn from V-Coop within ten years.[11]

Feed Price Stabilization Fund. Even as it seeks to develop new foreign feedgrain suppliers, the government is working to reduce the risks of large feedgrain price fluctuations. A government fund established in 1975 will provide money for subsidy payments to livestock producers in order to stabilize domestic feed price levels. From its initial $20 million, the fund will be built up to $100 million by 1980. In the past, three private funds provided such protection to live-

stock producers: those of Zen-Noh, the Japan Feed Manufacturers Association, and a group of cooperatives not included in Zen-Noh. The reserves of these funds had been built up by fees of $1.33 per ton of formula feed charged to feeders and 67 cents per ton carged to the formula-feed manufacturers. In 1973 and 1974, however, soaring commodity prices caused depletion of these funds and a $70 million government loan to them. The private funds are now rebuilding their total reserves to the point where they will equal those of the new government fund. The private funds are free to make compensating payments for relatively small changes in feed price levels. The government fund only makes payments if the price increases of formula feeds exceed 8 percent in a given year or if prices for feed ingredients increase by more than 15 percent.[12]

Other Activities. Japanese government agencies have encouraged the development of Japan's corn industry in many ways. The Ministry of Agriculture and Forestry, for example, promptly collects and disseminates a variety of statistical information regarding the livestock, feed milling, and starch manufacturing industries. It works closely with processors and producers in anticipating cost and price changes and in devising ways to soften the effect of those that are adverse.

The importing of corn is unregulated, except for those amounts earmarked for starch production and certain nonstarch uses. Cornstarch manufacturers can import a certain amount of corn under an import quota without paying any duty, but they are obliged to buy a certain amount of domestic potato starch from Zen-Noh as a protection for domestic potato growers. Otherwise, they must pay import duties totaling about fifty dollars per ton. Other processors may import a limited quantity of corn with a 0 to 10 percent duty under tariff quotas for alcohol, breakfast food, popcorn, grits, meal, and flour production. They too must pay import duties totaling about fifty dollars per ton for imports above the tariff quota.

In short, government activities have provided a foundation for an expanding livestock industry while protecting the welfare of potato farmers. The goal of satisfying increasing consumer demand for animal protein led to government policies permitting farmers and entrepreneurs relative freedom to serve the growing market. In the future, as the economy matures and growth rates tend to decrease, government policy will continue to encourage increases in the protein content of the Japanese diet. At the same time, as potato producers are encouraged to shift to other crops, need for corn as a source of starch is likely to increase. Thus, the government will probably continue to encourage both major sectors of the Japanese corn system.

SUMMARY

This chapter has used a rapidly growing part of the world's corn system—the Japanese corn industry—to highlight the consumption, production, technolog-

ical, and government-policy factors that influence world and regional markets for corn and corn products. The discussion began with an analysis of changes in the Japanese diet to emphasize the importance of a consumer and market orientation in analyzing a commodity system. We then described trends within the corn industries to show the importance of the response of firms and entrepreneurs in serving the needs of a changing, growing market. Finally, we analyzed the efforts of livestock producers, corn processors, and government agencies to cope with Japan's dependence on foreign suppliers.

The Japanese corn system is unique in that its dependence on foreign suppliers has forced its participants to be highly innovative in the ways they seek to ensure their supplies and control their costs. Their efforts have provided significant opportunities to participants in both developed and developing parts of the world corn system.

The ultimate consumer reaches back to his supplier in both developed and developing countries. His goals are to assure his supply and determine his costs. His tools are cooperatives, contracts, joint ventures, futures markets, cooperation in government agencies, and backward integration. In this "reaching back" process, new lands have been brought into production; cooperative joint ventures have been launched; long-term trading relations providing market access to small-scale and commercial producers have been instituted; and institutions such as cooperatives, boards of trade, and futures markets have been strengthened to make the regional and global corn system work more effectively for national goals.

In the three case studies that follow, we will take a more detailed look at strategies for the coordination of supply and demand. The Mitsubishi case illustrates an effort at integration; C. Itoh shows us one use of contractual agreements; and Mitsui provides an example of a joint venture.

NOTES

1. See, for example, "Isomerized Sugar Technology is Sought by Japan Maize Products," *Japan Economic Journal*, 10 February 1976, p. 13.

2. *Ibid*, and "Food, Soft Drink Makers Switch to Isomerized Sugar," *Japan Economic Journal*, 5 October 1976, p. 13.

3. Interview with the management of a major feed manufacturer.

4. Source: Interview with Assistant Manager of UNICOOPJAPAN, Ltd., New York Office.

5. *U.S. Department of Agriculture News*, 18 March 1977, p. 2.

6. The main area of departure for U.S. corn shipped to Japan and other parts of Asia.

7. National Federation of Marketing Cooperatives.

8. National Federation of Purchasing Cooperatives.

9. Bryant H. Wadsworth, "New Policies Could Spell Trouble for U.S. Farmers," *Foreign Agriculture*, 6 October 1965, p. 2.

10. Bruce L. Greenshields, "Japan's Farm Aid Ups Competition for U.S. Farmers," *Foreign Agriculture*, 16 August 1976, pp. 6–7.

11. *Japan Economic Journal*, 10 February 1976, p. 13.

12. Bruce L. Greenshields, "Japan to Subsidize Feed Costs and Encourage Rice Expansion," *Foreign Agriculture*, Vol. XIII, No. 6 (February, 1975), p. 2.

APPENDIX A
MITSUBISHI CORPORATION*

In mid-1975, management of Mitsubishi Corporations's Feed, Meat, and Livestock Department was consulting with management of Mitsubishi International Corporation (MIC), its subsidiary in the United States, on whether to acquire ownership of grain elevator facilities in the United States, at either a major ocean port or inland in an important grain-producing area. Consideration was being given to this issue because Mitsubishi Corporation was a leading Japanese importer of grains (see Table 3A-1) for feed milling and processing operations of subsidiary and affiliated companies and because MIC was a substantial exporter of grains to Japan and (to a lesser extent) other countries. Because the United States was the leading source of Japanese imports it seemed the logical place for Mitsubishi to develop a grain originating and shipping capability. Managements of Mitsubishi Corporation and MIC believed that MIC ownership of such facilities could enable it to coordinate more effectively the flow of feedgrains from the United States to Japan. Moreover, it would allow Mitsubishi a better chance to anticipate unusual events that might disrupt the flow of U.S. grains to Japanese markets.

Background of Mitsubishi Corporation

Mitsubishi, one of the large Japanese general trading companies, grew out of the Mitsubishi Zaibatsu in the late 1800s. Zaibatsu were originally industrial and financial combines. As Japan's foreign trade grew, Zaibatsu established trading arms. The trading companies became important in their respective Zaibatsu as foreign trade activities grew to have central importance in Japan's economy. Mitsubishi Corporation began as a small trading firm, aggressively diversified into mining and manufacturing, and evolved as a leader in the industrialization of Japan.

Broadly speaking, Mitsubishi Corporation's functions were threefold: trade, finance, and organization. The trading function involved a wide variety of commodities and included domestic sales, imports, exports, offshore trade, and related activities, such as warehousing, transportation, and consulting. Trading transactions conducted either for Mitsubishi Corporation's own account or for others on a commission basis constituted its most important source of corporate earnings.

The financing function comprised investing and lending. Investment opera-

*This case was prepared by Richard C. McGinity, Research Associate, under the supervision of Professor Ray A. Goldberg, as a basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Table 3A-1. Mitsubishi Corp.: Profit and Loss Statements: 1972-75 (in millions of yen; years ending March 31)

Ordinary Profit and Loss	*1972*		*1973*		*1974*		*1975*	
Operating Profit and Loss								
Sales		4,529,833		5,181,920		7,486,162		9,407,680
Operating costs and expenses		4,484,939		5,132,084		7,400,592		9,800,782
Cost of goods sold	4,434,592		5,073,659		7,330,310		9,210,463	
Operating expenses	50,347		58,425		70,282		90,319	
Profit from operations		44,894		49,836		85,570		106,898
Nonoperating Profit and Loss								
Nonoperating revenues		48,628		56,323		67,772		95,592
Interest	40,990		46,148		58,011		82,107	
Dividends	3,829		4,524		6,456		10,763	
Other	3,809		5,651		3,305		2,722	
Nonoperating charges		70,950		72,327		120,402		168,963
Interest	59,841		60,574		94,084		147,827	
Depreciation and other provisions	6,838		6,892		18,791		11,247	
Other	4,271		4,861		7,527		9,889	
Ordinary profit		22,572		33,832		32,940		33,527
Extraordinary Profit and Loss								
Extraordinary Profit				2,587		2,330		1,984
Restoration to profit of reserve for price fluctuation			63				71	
Restoration to profit of reserve for overseas market development			660		2,105		1,680	
Restoration to profit of reserve for special depreciation			279		225		233	
Net balance of profits and losses on foreign exchange			1,585					

Extraordinary Loss		11,751		12,810		12,774		5,211
Exchange loss	10,751		3,258		1,970			
Provision for overseas investment losses	–		2,807		10,547		3,609	
Provision for price fluctuation	–		456		243		1,260	
Provision for losses on investment in natural resource development	–		1,929		–			
Provision for losses on foreign exchange	1,000		4,000		–			
Provision for overseas market development	–		360		–			
Other	–	–	–	–	14	–	342	
Profit before Taxes for the Period		10,821		23,609		22,496		30,300
Provision for Income Taxes		4,000		11,220		8,800		16,160
Net Profit for the Period		6,821		12,389		13,696		14,140

Note: One U.S. dollar approximately equals 280 yen.

Source: Mitsubishi Corporation, *Business Reports.*

tions included establishing new businesses, participating in joint ventures, and acquiring equities. Close relations were maintained with specialized manufacturers, especially through the medium of equity participation. These manufacturers produced the products traded through the Mitsubishi Corporation distribution network.

The organizing function had developed rather recently as other firms and institutions had come to rely on Mitsubishi Corporation's organizing and coordinating ability. Large projects such as nuclear power generation, urban redevelopment, construction of leisure-amusement complexes, ocean development, and establishment of industrial complexes all involved numerous participants and countless decision points. Mitsubishi had developed an important capacity for systematically organizing such projects and managing them to their completion.

In performing these functions, Mitsubishi Corporation believed it could take advantage of five major strengths. First, it had considerable experience in a variety of businesses from heavy industries to service operations. Second, it had a highly developed international communications and information network tying together its 120 overseas branches. Third, at least half of its middle- and upper-level management had experience working overseas and possessed a distinctly international perspective. Fourth, it enjoyed a strong credit rating and was able to borrow internationally with ease. Finally, although it did not itself pursue development or control of new technology, it sought to keep abreast of developments and sources of technology and their profitable uses.

Mitsubishi Corporation accounted for about 14 percent of Japan's imports in 1973 and about 10 percent of its exports. In 1975, its sales reached 9.4 trillion yen (U.S. $32.5 billion: Table 3A-1). In the year ending 31 March 1975, domestic trade accounted for about 46 percent of its turnover; exports from Japan represented 19 percent; imports totaled 28 percent; and trade outside of Japan contributed about 7 percent.

Mitsubishi was organized into nine operating divisions: project development and construction, fuels, ferrous metals, nonferrous metals, machinery, foods, textiles, chemicals, and general merchandise. These divisions were subdivided further into various profit centers. A general administrative division serviced the operating divisions, coordinated their activities, provided staff for corporate management, and was responsible for recruiting, employee relations, legal affairs, and finance. Mitsubishi operated 60 offices in Japan and 120 overseas. Exclusive of its subsidiaries and joint ventures, the company employed 13,000 persons, nearly 3,500 of them overseas. Tables 3A-1 and 3A-2 contain recent financial information.

Mitsubishi's Agribusiness Activities

Mitsubishi was involved in all phases of agribusiness from the manufacture of agricultural inputs through food retailing. Its chemical division produced a broad array of agricultural chemicals, including fertilizers (nitrogenous, phosphatic,

and potassic), insecticides, herbicides, and fungicides. The division also produced food and feed additives. Its machinery division produced and built plants for manufacturing agricultural chemicals, pulp and paper, textiles, sugar, and rubber products. It also produced fishing boats, plants and machinery for vegetable oil extraction, bottling, food packaging, canning, and farm machinery. Mitsubishi's food division imported a variety of food and feed commodities and produced such items as oil cake and meal, refined and liquid sugar, canned goods (fruit, vegetables, juice, and fish), dairy products, and livestock products (broilers, eggs, and pork). Its textile division was a leader in the Japanese textile industry, the third largest in the world following those of the United States and the Soviet Union.

The operations of the food division alone totaled 1.3 trillion yen (U.S. $4.64 billion), or about 14 percent of Mitsubishi's turnover. Exports represented about 5 percent of the food division's transactions, imports about 31 percent, offshore or "third-country" transactions about 39 percent, and domestic transactions about 30 percent. Most exports were canned goods, especially tuna. Principal imports were wheat, barley, soybeans, oilseeds, feedgrain, oil cake and meals, meat, raw sugar, frozen seafoods, dairy products, cocoa, coffee, canned foods, and liquor. Third-country transactions involved soybeans, feedgrains, raw and refined sugar, vegetable oil, frozen tuna, and coffee. Domestic transactions involved primarily cornstarch, edible oils and fats, flour, refined sugar, frozen fish, canned goods, and dry groceries. To conduct these transactions smoothly and to assist in the development of economies in the Asian region, Mitsubishi was participating in the management of domestic and overseas enterprises and promoting the establishment of joint-venture projects. These activities included flour milling, vegetable oil processing, sugar plantation and mill operation, management of shrimp and tuna fisheries, cold-storage facilities, grain elevators, cattle and poultry farms, a pineapple plantation, and fast-food chains. In terms of sales, agribusiness operations represented from one-fourth to one-third of Mitsubishi Corporation's activities.

Feedgrain Operations

Mitsubishi and its associated companies were one of the leading Japanese importers of corn and milo along with the Zen-Noh group (a federation of Japanese former cooperatives), Mitsui and Company, and Marubeni (see Table 3-9). Corn was required in the feed-milling, dry-milling, and wet-milling industries in Japan. Through 1974, output of compound feed in Japan had been growing steadily for several years (Table 3-2) in response to increasing consumer demand for poultry and livestock products. Imports of corn and feedgrain had increased steadily as well, reflecting increasing demand for raw materials by the Japanese feed-milling industry. Mitsubishi and its affiliated companies were the second largest feed millers in Japan (Table 3A-3) and owned a significant share of elevator facilities in the country (Table 3A-4).

Table 3A-2. Mitsubishi Corp.: Balance Sheets, 1972-75 (in millions of yen; years ending March 31)

Assets	*1972*	*1973*	*1974*	*1975*
Current Assets	1,730,165	2,031,492	2,881,916	2,808,204
Cash on hand and in banks	184,723	200,104	177,140	214,373
Notes receivable	588,883	745,476	1,252,902	1,022,253
Trade accounts receivable	648,616	690,276	985,986	986,298
Marketable securities	116,063	164,569	104,212	100,475
Merchandise and supplies	69,924	84,633	135,108	177,736
Advances for joint ventures	3,864	1,925	4,601	6,074
Advance to suppliers	76,598	98,147	155,646	196,526
Prepaid expenses	8,514	7,400	14,890	16,370
Payments for others	2,218	5,779	5,921	6,788
Accounts receivable–miscellaneous	25,186	25,895	34,697	47,192
Short-term loans	21,353	25,302	36,228	58,321
Guarantee deposits	2,460	588	499	1,358
Other	5,810	8,413	13,265	17,571
Reserve for doubtful receivables	(-)24,047	(-)27,015	(-)39,177	(-)43,231
Fixed Assets	191,998	238,809	319,334	365,129
Tangible fixed assets	53,095	66,780	78,447	84,216
Fixed assets leased to other	–	–	21,339	25,736
Buildings and structures	12,752	13,964	19,352	20,969
Machinery and equipment	7,065	8,440	3,723	3,582
Ships and vehicles	3,331	6,288	391	497
Furniture and fixtures	6,755	5,985	1,605	2,911
Land	19,421	24,620	26,035	25,951
Construction in progress	3,772	7,482	6,003	4,570
Intangible fixed assets	865	893	1,120	2,058
Intangibles	394	402	420	494
Long-term prepaid expenses	471	491	700	1,564
Investments	138,039	171,135	239,768	278,855
Securities investments	32,607	42,102	60,132	71,017
Capital stock of subsidiaries	20,396	30,553	48,883	49,623
Investments–other than securities	525	597	643	620
Investments in subsidiaries–other than capital stock	1,060	2,757	1,364	2,550
Long-term loans	83,451	89,334	125,308	148,146
Other	–	5,792	3,437	6,899
Total Assets	1,922,164	2,270,300	3,201,250	3,173,333

Liabilities				
Current Liabilities	1,566,326	1,876,220	2,702,704	2,618,973
Notes payable	666,723	837,620	1,363,756	1,177,763
Trade accounts payable	350,908	366,431	515,508	496,324
Short-term borrowings	392,912	511,930	609,684	668,397
Accounts payable–miscellaneous	35,063	38,892	59,434	64,148
Advances from customers	83,777	75,618	102,359	153,797
Deposit liabilities	8,918	15,635	14,621	12,040
Deferred income	11,706	10,381	12,177	11,372
Customers' guarantee deposits	2,555	2,846	3,855	6,029
Accrued income taxes	2,000	7,140	4,850	9,460
Other	11,763	9,727	16,460	19,643
Long-Term Debts	270,382	289,375	375,010	406,535
Long-term borrowings	268,945	279,050	365,264	396,863
Debentures	1,437	10,325	9,746	9,672
Reserve	22,649	32,578	41,468	46,961
Legal reserve for retirement allowances	3,316	4,695	5,110	7,668
Reserve for price fluctuation	2,428	2,82[illegible]	3,064	4,253
Reserve for overseas market development	6,265	5,965	3,860	2,180
Reserve for possible losses in investments	4,216	7,023	22,643	26,252
Reserve for losses in natural resources development investments	3,143	5,072	–	–
Reserve for extra depreciation	2,281	2,002	1,777	1,544
Reserve for losses on foreign exchange	1,000	5,000	5,000	5,000
Other	–	–	14	64
Total Liabilities	1,859,357	2,198,173	3,119,181	3,072,469
Net Worth				
Capital	31,401	31,799	33,477	34,904
Capital stock	31,401	31,799	33,477	34,904
Legal Reserve	7,146	8,281	7,611	16,589
Capital reserve	3,066	4,081	2,981	11,429
Profit reserve	3,780	4,200	4,630	5,160
Revaluation reserve	300	–	–	–
Surplus	24,259	32,047	40,981	49,370
Total Net Worth	62,806	72,127	82,069	100,863
Total Liabilities and Net Worth	1,922,163	2,270,300	3,201,250	3,173,332

Note: One U.S. dollar approximately equals 280 yen.
Source: Mitsubishi Corporation, *Business Reports.*

Table 3A-3. Compound and Mixed Feed Production by Major Feed Millers: 1971-74 (in thousands of metric tons)

	1974	*1973*	*1972*	*1971*	
Zenmoren	7,389	7,560	6,845	6,376	
Nihon Nosan	1,549	1,681	1,651	1,514	(Mitsubishi Group)
Nisshin Seifun	976	1,044	974	879	(Mitsubishi Group)
Nippai	957	989	935	915	(Mitsui Group)
Kyodo Shiryo	762	793	730	657	(Semi-Mitsui Group)
Marubeni Shiryo	544	529	417	352	(Marubeni Group)
Taiyo	567	525	539	528	(Independent)
Amino	527	510	498	405	(C. I. Group)
Toyohashi	401	385	354	309	(Semi-Mitsubishi Group)
Kawada	399	374	316	218	(C. I. Group)
Showa	380	379	353	347	(Independent)
Others					
Total	17,933	18,106	16,767	15,524	

Source: Mitsubishi Corp.

Table 3A-4. Grain Silo Capacity in Japan: 1974 (in thousands of metric tons)

By Type	*Total*	*At Ports (capable of loading and unloading large ocean vessels)*
Handling Silo	1,987	1,411
Maker's Silo, Mainly for:		
Wheat	349	252
Feedgrain	846	127
Soybean, etc.	456	297
Total	3,641	2,105

By Group[a]	*Handling Silo*	*Processor's Silo*	*Total*
Mitsubishi Group	176	146	322
Mitsui Group	148	73	221
Marubeni Group	226	13	239
C. I. Group	78	37	115
Tomen	83	5	88
Zen-Noh	209	113	322

[a]Feedgrain only.

Source: Mitsubishi Corp.

Representatives of the feed and livestock department had conversations several times daily and personal meetings a few times a week with Mitsubishi's regular feedgrain customers. When a customer decided to buy a quantity of corn, he and Mitsubishi began detailed negotiations regarding price and other terms, usually reaching agreement on the same day. To the minority of buyers who did

not care to deal with one trading company primarily, Mitsubishi provided quotations and firm offers as requested. Mitsubishi based its quotations on Chicago Board of Trade futures prices for #2 yellow corn, plus premiums for land and ocean transportation.

Mitsubishi prepared its offering price by calculating the maximum discount (if any) it could offer from the prevailing market price established on the Chicago market. The offering price was usually a few dollars less per ton than the lowest purchasable price from an exporter, but the discount might inflate to several dollars if the market was declining. Mitsubishi based the size of its discount on its "view of the market" (i.e., its opinion of the probable course of prices for the foreseeable future), on its existing grain inventories, and on its anticipated effectiveness in relating cash and futures markets in its hedging effort.

Mitsubishi bought most of its corn and feedgrain from the United States. When Mitsubishi Corporation purchased U.S. corn, it placed all of its orders with MIC. MIC made purchases from grain traders in one of the following ways, sometimes with Mitsubishi Corporation's cooperation:

1. Mitsubishi Corporation contacted Tokyo offices of major grain traders and negotiated with them on behalf of MIC.
2. MIC contacted the New York offices of grain traders.
3. MIC requested affiliated offices in U.S. grain-growing areas to accumulate daily purchases.

Except for method (3) above, MIC usually purchased its corn on a freight on board "basis" arrangement. That is, the transportation premium for delivering the grain into ocean-going vessels at the shipping port was determined first and the pricing of the commodity itself, based on the Chicago futures market, was left till later but prior to the time of shipment. Selling prices by Mitsubishi Corporation to customers were cost, insurance, freight Japan: composed of the cost of the commodity, ocean transportation, insurance premiums, interest, and the currency exchange premium (if the prices were based on yen).

Figure 3A-1 illustrates the purchase of corn in the United States and its export to Japan. Normally, corn shipments traveled from U.S. ports on the Gulf of Mexico to Japanese main ports. The voyage took about one month, so the total transportation time from grain-producing and storage areas in the United States to Japanese ports was one to two months. The period between the shipment's arrival in Japan and the grain's eventual use varied according to the customer's stock position, mill location, and manufacturing policy. But generally this period averaged about one-and-a-half months. The period between purchase of the "basis" and shipment of corn fluctuated widely, depending on market conditions. When buyers anticipated a rise in prices, they sought to purchase corn further in advance of their needs. In a declining market they bought closer to the required time for shipment. Expectation of abnormal situations like stevedore strikes or government export controls impelled buyers to secure their purchases

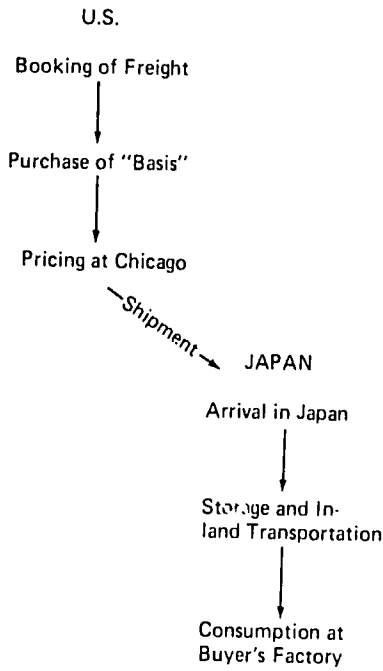

Figure 3A-1. Steps in Purchasing Corn in the United States for Mitsubishi's Export to Japan

ahead of time. Typically, however, the period from purchase to shipment was about three months.

Like other grain-trading firms in Japan, Mitsubishi Corporation could not take positions in U.S. futures markets. Its hedge operations were consequently limited to links either with corn from other countries or with other commodities, such as milo. Mitsubishi Corporation's subsidiaries, however, were allowed to take positions in futures markets and naturally did so in hedging operations.

In 1972, crop failures in various parts of the world caused large wheat and corn purchases from the United States by nontraditional buyers such as the Soviet Union and the People's Republic of China. These purchases reduced U.S. grain stocks dramatically and created apprehension over the availability of feed-grain supplies among the United States' regular buyers. This apprehension was heightened in 1974 when a drought significantly reduced the size of the U.S. corn crop. The uncertainty created by these events moved grain users to make strenuous efforts to tie up supplies for immediate and future delivery. Reflecting this effort, world grain prices rose to historically high levels. In the United States, apprehension over diminishing supplies and extremely high prices moved the government to embargo exports of soybeans in 1973, to establish a grain export monitoring system, and to cancel temporarily a sale of corn and wheat to the Soviet Union in 1974.

In view of these events, the management of Mitsubishi's Feed, Meat, and Livestock Department felt that action had to be taken to assure the company's feed-grain supply. Possible alternatives were ownership of production and shipping operations in major exporting countries, joint ventures for production and export of grains from nontraditional producing areas, (for example, Japanese firms had become involved in projects for the production and export of soybeans in Brazil and corn in Indonesia), contract procurement arrangements spanning several years, and bilateral government arrangements.

One alternative among several being considered by management of MIC was ownership of grain elevator facilities in the United States, either at a major feed grain exporting point like Chicago or New Orleans, or in an important feedgrain-producing area like Illinois, or both. Although this alternative would not lessen Mitsubishi's dependence on U.S. feedgrains, it would provide the company with somewhat more certainty about the amount and timing of feedgrain deliveries, and it would be a source of valuable market intelligence. Additionally, it would begin to enable Mitsubishi to enlarge the scope of its grain trading into offshore or "third-country" trade in the U.S. domestic market and in countries other than Japan.

Pros and Cons of Elevator Acquisition in the United States

The issues involved in Mitsubishi's consideration of acquiring elevator capacity in the United States were complex. In addition to the normal operational, financial, and organizational uncertainties there were significant strategic and political issues. Operationally, the management of Mitsubishi felt confident that it had or could employ personnel capable of managing a facility in the United States. Although the marketing and logistics setup in the United States was significantly different than in Japan, Mitsubishi personnel were aware of those differences and capable of adapting to them.

Financially, Mitsubishi management was aware that the highly competitive, high-volume, low-margin grain elevator operation offered rather low returns on invested capital. Table 3A-5 shows the estimated required investment, operating costs, and return for a new, large-scale elevator facility in eastern Illinois. Returns for a similar facility at a major port would probably be somewhat lower, since expenditures for real estate and construction would likely be greater than in the interior. Still another possibility for obtaining elevator facilities was through a leasing arrangement of some kind.

Organizationally, Mitsubishi would have to deal with issues of coordination, labor-management relations, and acceptance by the host community. Any operation in the United States would be acquired and managed by MIC. Important issues or problems would be reported to Mitsubishi Corporation for consultation and advice. Such coordination had functioned satisfactorily in the past, and Mitsubishi management did not believe it would be a source of problems. Labor-management relations and host community acceptance were believed to be much

Table 3A-5. Investment, Operating Costs, and Returns on a Typical New U.S. Terminal Elevator Facility: 1975 (in U.S. dollars)

5 Million Bushel Elevator	Total Cost:	6,000,000
Estimated Gross Income[a]		
Long-Term Basis Improvement: 4.5 million bushels @ 20 cents per bushel	900,000	
Thruput Margin—three turns 15 million bushels @ 5 cents per bushel	750,000	1,650,000
Estimated Expenses		
Employee Costs	130,000	
Depreciation	278,085	
Power	42,600	
Property Taxes	71,000	
Insurance	30,000	
Repairs and Maintenance	9,000	
Supplies	7,000	
Miscellaneous	7,500	
Total Expenses		575,185
Gross Income before Interest		1,074,815
Capital in Use		
Fixed Assets	6,000,000	
Inventory: 4.5 million bushels @ $3/bushel for seven months	7,875,000	13,875,000
Return on Average Capital in Use .0775		
Rate of Return on Fixed Assets .1791		

[a]Does not include any overall marketing opportunities of the grain division.
Source: Casewriter's estimate based on industry interviews.

more delicate issues, especially in a rural farming community unused to dealing with people from outside the United States. This area could be the source of various difficulties, from strikes to inability to buy desired quantities of grain. Other Japanese firms had established operations in rural areas of the United States, however, and they had been quite successful in achieving acceptance. Consequently, Mitsubishi felt it should be able to do likewise.

Strategic and political uncertainties were perhaps more difficult to define, but very real nonetheless. In the early postwar period, several major grain-trading firms had sought to establish storage and marketing operations in Japan. They had not been successful due to the very close relations between Japanese trading companies and their customers. Establishment of grain-gathering and exporting operations in the United States by a Japanese firm could be expected to intensify an already highly competitive situation. On the other hand, if Mitsubishi were successful, other trading companies might create apprehension within the United States over control of its own grain supply and lead to restrictions, formal or informal, on the very thing Mitsubishi was seeking: reasonably certain access to U.S. corn and feedgrain.

Summary of Relevance

In this case we have but one example of a Japanese trading firm wrestling with the problem of developing a procurement operation in one of the few remaining surplus-producing areas of the world. The long-established structures developed in the United States make its choices both more difficult and yet more compelling.

Given the importance of the United States in world corn trade, the disruptions of the global market due to unusual weather patterns and changes in the USSR's and the People's Republic of China's buying pattern, and the informal Japanese-U.S. grain agreement, it is understandable that the Mitsubishi Corporation would desire more direct contact with the farming and assembling portions of the U.S. grain industry. And Zen-Noh's direct relations with U.S. grain cooperatives placed added pressure on such trading firms as Mitsubishi to assume a similar competitive position. A USDA study indicates that in 1976 over 40 percent of U.S. exports were handled by foreign-owned grain firms, so these firms would not be making an unprecedented move by becoming more directly involved in the U.S. grain system.

This case shows the market and supply considerations that affect decision-making in the trading firms and shows how backward integration is used in an effort to cope with those pressures. It is also a specific example of the internationalization of the world corn system and the fact that other foreign firms will be playing a more active role in the U.S. corn system as its position of major world corn exporter is maintained. These non-U.S. firms have to take into account not only U.S. priorities in their operations in the United States but also the priorities of their own governments and owners. The expansion of foreign trading activity has increased in 1978 with the acquisition of a majority of Cook's export elevators by the Mitsui Group of Japan and by the acquisition of Cook's Portland elevator by the Marubeni Group of Japan.

APPENDIX B
C. ITOH & COMPANY*

In mid-1975 management of the Feed Materials Department of C. Itoh & Company's Produce Division were preparing for the annual renegotiation of the Japan-Thailand agreement on maize trade. The agreement, first concluded in 1961, had established quantities, shipping schedules, and pricing arrangements covering the export of Thai corn to Japan for the ensuing year. Each of these items was renegotiated annually in meetings between the Japan Feed Trade Association (JFTA)[1] and the Thai Board of Trade (BOT). This year's negotiations were particularly important to C. Itoh because its representative had been chosen as vice-chairmen of JFTA and lead negotiator of JFTA's approaching negotiations. Thus management had to be aware not only of C. Itoh's interests but of those of the entire feed trade. In fact, because Thailand was such an important source of Japan's food supply, Itoh management had to keep national interests in mind also.

Background of C. Itoh & Company

C. Itoh was one of the leading Japanese general trading companies. It ranked fourth in sales volume behind Mitsubishi, Mitsui, and Marubeni. It was unusual in that it began as a small wholesale linen firm in 1858, not as a commercial and financial combine like Mitsubishi and Mitsui. As the cotton-spinning industry developed in the late 1800s, the need to import raw cotton caused the development of companies specializing in that activity. When the textile industry developed to the point that it needed to export, cotton importers became textile exporters as well. Itoh and Marubeni both grew in this way, and they diversified their activities as time passed. In 1974 textile production and trade accounted for somewhat less than a third of Itoh's sales of 4.5 trillion yen (U.S. $15.6 billion).

Itoh's activities could be grouped around four functions: domestic and international distribution and marketing, financing, developme t, and business organization and integration. In its distribution activities, Itoh undertook market research and commodity-demand prediction, managen.ent of commodity and currency trading, including barter and switch transactions, hedging on behalf of customers, inventory management, and physical distribution. In finance, it arranged with domestic and international sources of funds to extend loans and credits for varying purposes and maturities. It sought to anticipate demand for new products and to organize businesses and distribution channels to satisfy that demand.

*This case was prepared by Richard C. McGinity, Research Associate, under the supervision of Professor Ray A. Goldberg, as a basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Itoh's activities with respect to steel, for instance, were indicative of the breadth of the company's efforts. To satisfy the demand of its steel mills, Japan had to import large amounts of iron ore and coking coal. It was impossible to depend on spot purchases of raw materials in the international market, so Itoh and other trading companies sought out resources throughout the world and promoted their development by encouraging investment. Itoh participated on an equity and credit basis in resource development projects, transportation of raw materials to Japan, manufacturing, and eventual export of steel products. The company provided financial assistance to buyers by advancing as much as 80 percent of the purchase price to Japanese steel mills two months before shipment and the remaining 20 percent when shipment was made. The sales contract with the ultimate customer typically set payment for sixty to ninety days following delivery.

Despite the continuing importance of textile-related activities within the company, Itoh's operations were highly diversified. Petroleum and chemicals accounted for 23 percent of sales; metals, 17 percent; machinery and construction, 17 percent; edible oil, feed, and foodstuffs, 12 percent; textile materials, 12 percent; textile manufactured goods, 11 percent; and timber, paper, and general commodities, 8 percent. Domestic operations were about half of sales. Exports were about 20 percent; imports about 24 percent, and offshore transactions (transactions not involving Japan) about 6 percent.

Because of Japanese financial management practices and the extent to which it was involved in financial projects and companies external to itself, Itoh's capital structure consisted primarily of debt (Table 3B-1). In the course of their operations, trading companies were expected to extend trade credit, take equity positions, and extend and guarantee loans. Assets representing such activities accounted for almost half of all Itoh assets. To finance them Itoh relied heavily on debt sources, primarily commercial banks. Although Japanese manufacturing firms typically had about 80 percent of their capital structure in the form of debt, trading companies carried even higher debt ratios. Long-term bank loans represented about 16 percent of capital, short-term borrowings about 48 percent, and commerical bills about 10 percent. Other forms of debt represented most of the balance of Itoh's capital structure. This situation is common in Japan, where commercial banks are essentially providers of permanent credit to their borrowers and exert significant influence in company policymaking.

Table 3B-2 gives an indication of the size and complexity of Itoh's operations. Its sales in 1974 were 4.5 trillion yen (U.S. $15.6 billion), almost double the level of two years earlier. Although much of this increase was attributable to inflation, Itoh was growing steadily.

Significance of Thai Corn Imports to Japan

In the early 1950s, Japan produced slightly more than half its food needs. Its food self-sufficiency declined in the 1960s and 1970s as increasing per-capita consumption of meat and livestock products forced the country to import the

Table 3B-1. C. Itoh: Balance Sheets: 1972-75 (in millions of yen; years ending March 31)

	1972	*1973*	*1974*	*1975*
Assets				
Current Assets				
Cash	143,823	167,109	156,618	171,775
Notes receivable	251,353	320,449	536,731	441,129
Accounts receivable	322,092	349,098	508,970	486,121
Marketable securities	55,781	72,949	9,027	5,767
Merchandise	69,934	105,762	122,321	169,629
Merchandise in transit	6,049	8,108	13,826	7,278
Advances to vendors	47,129	70,686	150,973	132,534
Other receivables	9,021	11,859	12,208	17,850
Miscellaneous deposits	5,004	5,384	6,425	11,771
Short-term loans	24,226	30,036	32,722	68,186
Prepaid expense	7,777	6,976	11,582	15,040
Other current assets	8,278	12,034	4,244	5,455
Less allowance for doubtful accounts	-10,800	-13,200	-17,200	-18,800
Total Current Assets	939,667	1,147,250	1,548,449	1,513,735
Fixed Assets				
Tangible Fixed Assets				
Buildings	9,543	10,302	9,935	9,633
Structures	2,703	2,764	3,296	3,928
Vehicles	522	499	603	560
Furniture and fixtures	2,545	2,772	2,697	2,565
Land	9,610	15,701	20,142	20,648
Construction in progress	3,918	2,000	4,459	6,238
Total Tangible Fixed Assets	28,842	34,038	41,133	43,572
Intangible Fixed Assets				
Land lease rights	1,489	1,485	1,494	1,494
Other intangibles	294	293	309	423
Long-term prepaid expenses	1,644	754	1,631	2,284
Total Intangible Fixed Assets	3,427	2,532	3,434	4,201
Investment				
Investment-subsidiaries	25,402	30,205	43,222	47,090
Investment-others	82,432	144,199	176,941	181,847
Long-term loans	51,674	57,668	70,214	94,897
Total Investment	159,508	232,072	290,377	323,834
Total Fixed Assets	191,777	268,641	334,944	371,607
Total Assets	1,131,443	1,415,891	1,883,393	1,885,342
Liabilities				
Current Liabilities				
Notes payable	282,100	323,417	496,012	436,672
Import notes payable	87,470	131,240	189,299	192,592
Accounts payable	173,927	207,091	250,451	226,098
Short-term borrowings	208,491	327,359	361,887	392,879
Accrued expenses	8,838	11,376	20,052	23,104
Advances from customers	75,735	55,995	95,407	73,757

Table 3B-1 continued

	1972	*1973*	*1974*	*1975*
Deposits received	28,532	21,611	29,362	57,049
Deferred income	11,853	9,419	13,070	21,287
Taxes payable	3,300	8,648	4,650	1,450
Other current liabilities	4,022	4,461	7,757	8,754
Total Current Liabilities	884,268	1,100,618	1,467,947	1,433,642
Fixed Liabilities				
Convertible debentures	342	–	–	–
Long-term borrowings	189,039	225,912	295,627	324,962
Other fixed liabilities	693	1,298	1,181	31
Total Fixed Liabilities	190,074	227,210	296,808	324,993
Reserves				
Employees' retirement allowance	2,730	7,480	9,654	12,621
Price fluctuation	2,500	2,940	3,020	4,250
Replacement of fixed assets	1,030	1,824	2,389	2,389
Special depreciation	923	869	801	723
Overseas investment	4,432	9,569	18,177	23,147
Overseas marketing research	4,410	4,121	2,658	1,461
Reserve for future losses on foreign exchange	4,000	3,455	–	–
Other	43	571	6	100
Total Reserves	20,068	30,829	36,705	44,691
Total Liabilities	1,094,410	1,358,657	1,801,459	1,803,320
Capital and Surplus				
Capital Stock	21,137	25,336	26,856	34,913
Legal Reserves				
Capital surplus	4,994	12,679	27,272	19,216
Earned surplus	3,125	3,400	3,800	4,210
Total Legal Reserves	8,119	16,079	31,073	23,426
Surplus				
Reserve for contingencies	3,000	6,800	13,800	17,000
Reserve for retirement fund	1,000	1,000	1,000	1,000
Reserve for dividends	1,300	1,800	3,000	4,200
Reserve for scholarship fund for employees' children	100	100	100	100
Unappropriated retained earnings	204	283	451	658
Net profit for the period	2,173	5,835	5,653	719
Total Surplus	7,777	15,819	24,004	28,677
Total Capital and Surplus	37,033	57,234	81,933	82,016
Total Liabilities and Capital	1,131,443	1,415,891	1,883,393	1,886,342

Note: One U.S. dollar approximately equals 280 yen.

Source: C. Itoh & Co. Ltd.

Table 3B-2. C. Itoh: Profit and Loss Statements, 1972–75 (in millions of yen; years ending March 31)

	1972		1973		1974		1975	
Recurring Profit and Loss								
Operating Profit and Loss								
Operating Revenue								
Net sales	2,773,269		3,173,698		4,468,995		5,231,747	
Others	5,111	2,778,380	6,209	3,179,907	8,407	4,477,402	13,350	5,245,097
Operating Expenses								
Cost of sales	2,724,200		3,103,360		4,366,026		5,142,400	
Selling, general, and administrative expenses	33,476	2,757,676	44,890	3,148,250	56,296	4,422,322	63,976	5,206,376
Operating Profit		20,704		31,657		55,080		38,721
Nonoperating Profit and Loss								
Nonoperating Income								
Interest and dividends	38,113		44,624		46,803		64,296	
Other income	5,603	43,716	8,642	53,266	5,354	52,157	14,768	79,064
Nonoperating Expenses								
Interest	41,059		46,531		68,438		100,402	
Writeoffs and reserves	5,549		13,788		8,422		2,707	
Other expenses	209	46,817	228	60,548	2,047	78,907	1,098	104,207
Recurring Profit		17,603		24,375		28,330		13,578
Nonrecurring Profit and Loss								
Special Profit								
Reversal of provision for price fluctuation					190		200	
Reversal of Special Account for replacement of fixed assets					571		–	

Reversal of provision for future losses on foreign exchange			2,700		3,455		–	
Reversal of provision for special depreciation					68		78	
Reversal of provision for overseas marketing research				2,700	1,463	5,747	1,197	1,475
Special Loss								
Extraordinary losses on foreign exchange	5,791		2,742				–	
Provision for future losses on foreign exchange	4,000		2,155				–	
Provision for price fluctuation					270		1,430	
Provision for overseas investment					8,608		4,970	
Stock issuing expenses			332		512		–	
Provision for replacement of fixed assets					565		–	
Other		9,791		5,229	6	9,961	94	6,494
Profit before Income Taxes		7,812		21,846		24,116		8,559
Corporation Tax, Business Tax, etc.		4,150		10,800		12,300		4,680
Net Profit for the Year		3,662		11,046		11,816		3,879
Unappropriated Surplus Brought Forward		362		521		799		1,200
Unappropriated Surplus at End of Period		4,024		11,567		12,615		5,079

Note: Intercompany transactions are eliminated from net sales and cost of sales. One U.S. dollar approximately equals 280 yen.
Source: C. Itoh & Co., Ltd.

feedgrains needed to support its growing animal population. Increasing demand for commercial feed caused growth in demand for corn and feedgrains. Table 3B-3 shows the related growth in compound-feed production from 1972 to 1974. Virtually all of Japan's feedgrain had to be imported, as Japan's farmland was very limited and committed to production of other crops. C. Itoh had been a leading importer of corn and milo for several years (see Table 3B-3).

Thailand was the second largest supplier of corn to Japan, following the United States. Production of corn had increased dramatically in Thailand during the 1960s (Figure 3B-1), due primarily to demand from Japan and later Taiwan (Table 3B-4). Although corn had not been a major Thai crop, Thailand was able to respond rapidly to the Japanese demand because it was self-sufficient in food, had experienced farmers and good agricultural land available for corn, and had an existing market structure and transportation system used for exporting rice. Thus, increasing demand for corn could be transmitted readily to producing areas.

The Thai government encouraged the development of corn production and export to Japan. The country had consistently experienced a trade deficit with Japan and was eager to find methods for reducing it. Among the activities undertaken by the government to improve the export potential of Thai corn were analyses of corn demand and price movements in various foreign markets, agreement to contractual sales arrangements involving mechanisms for determining quantity and price, and regulation of corn export to maintain efficiency in the marketing system.

The Japan-Thailand Agreement on Maize Trade

The agreement on maize trade, negotiated yearly, established the amount of corn to be purchased by Japan, the approximate timing of deliveries, and the method of pricing.

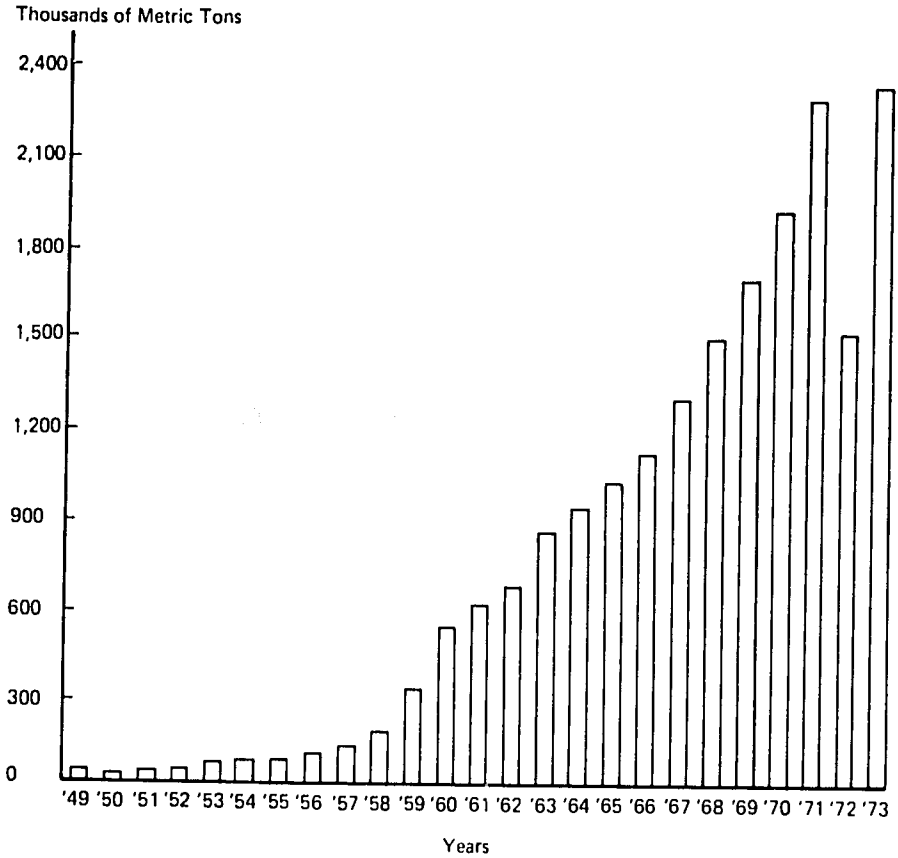
Quantity. The target quantity of corn to be purchased was determined by JFTA totaling the expected needs of its members in the coming year and comparing that amount to the anticipated October-November Thai corn harvest projected by BOT. The board set JFTA's annual allotments with a mind to avoiding excessive Thai dependence on Japanese buyers. In practice, however, the target quantity had come to represent a minimum amount, and JFTA agreed to purchase whatever quantity of corn was offered by BOT in established shipping periods.

Shipping Schedule. The periods used for shipping grain were the ten calendar months beginning with September and ending with June of the following year. The quantity of grain to be shipped in each of the first two months was established during the annual renegotiation of the agreement. The quantity to be shipped in the subsequent eight months was as follows:

Table 3B-3. Approximate Corn and Milo Imports to Japan by Importing Firm: 1970–74 (in thousands of metric tons)

	1970			*1971*			*1972*			*1973*			*1974*		
Firm	*Corn*	*Milo*	*Total*	*Corn*	*Milo*	*Total*	*Corn*	*Milo*	*Total*	*Corn*	*Milo*	*Total*	*Corn*	*Milo*	*Total*
C. Itoh	500	600	1100	400	600	1000	500	400	900	800	500	1300	800	400	1200
Mitsubishi	800	700	1500	500	600	1100	800	500	1300	900	600	1500	800	700	1500
UNICOOP	600	400	1000	600	500	1100	600	600	1200	1000	700	1700	1000	700	1700
Mitsui	700	600	1300	500	400	900	600	400	1000	1200	300	1500	1000	500	1500
Marubeni	700	400	1100	500	500	1000	600	400	1000	900	500	1400	900	800	1700
T.M.N.	500	100	600	300	100	400	400	100	500	600		600	400		400
Nichimen	300	200	500	200	300	500	200	400	600	300	500	800	300	600	900
S.S.K.	300	200	500	200	200	400	200	200	400	200	200	400	200	200	400
Nichiryo	100	200	300	100	-	100	100		100	100		100	100	100	200
Toshoku	200	100	300	100	100	200	200		200	200	-	200	200	100	300
K.G.	100	100	200	100	100	200	200	200	400	300	200	500	300	200	500
Yuasa	100	100	200	100		100	100	100	200	100	100	200	100	100	200
Ataka	100		100	100	100	200	100	100	200	100		100	100	100	200
Nissho	100	100	200	100	100	200	100	100	200	200	-	200	300	100	400
Other	100		100	100	100	200	-				100	100	200		300
Total	5200	3800	9000	3900	3700	7600	4700	3500	8200	6900	3700	10,600	6700	4600	11,300

Source: Casewriter's estimate, based on industry sources.



Source: Kasetsart University Bangkok, Thailand. Amounts for 1972 supplied by C. Itoh & Co., Ltd.

Figure 3B-1. Corn Production in Thailand: 1949-73 (in thousands of metric tons)

1. BOT advised JFTA of the tentative quantity of each period's shipment seventy-five days prior to the start of each shipment period.
2. The final quantity was determined by mutual consent between BOT and JFTA sixty days before the commencement of the shipping period involved.
3. The tentative and final quantities for a shipment period had to fall within limits determined during the annual negotiations. (See, for example, Table 3B-5.) If, between March and June, BOT announced a tentative quantity for a shipment period less than the stated minimum for that period, it was mutually agreed that the agreement was terminated as of the date of that shipment.

Buyers, Sellers, and Contracts. When the quantity for a particular shipment period had been agreed on, BOT furnished JFTA a list of registered exporters

Table 3B-4. Volume of Thai Corn Exports by Destination: 1957-74 (in metric tons)

Year	*Hong Kong*	*Singapore*	*Malaysia*	*Kuwait*	*Japan*	*Taiwan*	*Others*[a]	*Total*
1957	2,925	9,586	15,432	–	36,393	–	1	64,337
1958	3,879	14,880	14,471	–	129,683	–	1	162,914
1959	10,170	18,384	20,587	–	189,185	–	103	238,429
1960	11,327	35,601	24,865	–	441,046	2,052	50	514,941
1961	57,245	82,498	31,560	–	338,346	719	54,697	569,131
1962	104,300	97,551	50,596	–	229,686	–	1,995	484,123
1963	113,253	88,702	61,629	–	453,414	9,911	40,576	767,485
1964	111,325	88,063	64,883	–	844,936	9,573	28,152	1,146,932
1965	85,099	96,518	62,701	140	559,749	8,990	18,156	831,353
1966	80,597	165,676	82,515	1,525	826,289	57,116	47,838	1,261,556
1967	85,614	131,639	87,642	7,070	670,797	143,993	19,226	1,145,981
1968	140,378	186,826	135,903	10,525	566,272	395,476	22,819	1,558,198
1969	144,841	188,456	132,553	9,323	486,685	450,498	142,458	1,554,815
1970	112,078	109,706	92,798	16,802	649,903	447,299	19,369	1,447,955
1971	143,780	169,513	92,806	15,278	925,277	322,098	204,709	1,873,461
1972	119,978	225,959	107,962	9,665	842,204	502,775	35,076	1,843,619
1973	142,264	172,759	121,781	12,656	490,380	311,247	143,553	1,394,643
1974	127,292	283,071	100,704	–	781,443	251,571	327,866	1,871,847

[a]Including cornmeal.

Source: For 1957-73: Department of Customs, Government of Thailand. For 1974: C. Itoh & Co., Ltd.

Table 3B-5. Monthly Range of Corn Shipments from Thailand to Japan Called for by 1974 Corn Agreement (in metric tons)

November–December 1974		
Each Month's	Minimum:	140,000
	Maximum:	160,000
January–February 1975		
	Minimum:	130,000
	Maximum:	160,000
March 1975		
	Minimum:	90,000
	Maximum:	140,000
April 1975		
	Minimum:	80,000
	Maximum:	130,000
May 1975		
	Minimum:	60,000
	Maximum:	100,000
June 1975		
	Minimum:	60,000
	Maximum:	70,000

Source: *Agreement on Maize Trade Between Thailand and Japan for the 1974-1975 Season.*

who had received export allocation from Thai regulatory authorities. JFTA members were free to contract with any registered exporter within the limit of each exporter's allocation within ten days following receipt of the list. JFTA furnished BOT with details of such contracts within five days following expiration of the ten-day period. If JFTA members were unable to conclude contracts up to the quantity agreed on, JFTA informed BOT of the problem. Within five days, BOT had to furnish JFTA a list of alternative Thai exporters with whom JFTA members could conclude contracts to cover the remainder of the purchase. JFTA members were then required to conclude contracts with Thai exporters within five days.

Pricing. Since 1964, the price of Thai corn for export to Japan had been based on the price of U.S. #2 yellow corn on the Chicago Board of Trade, plus the f.o.b. premium over the Chicago futures price for transportation and loading aboard ship at U.S. Gulf ports. Determination of the U.S. base price was accomplished as follows:

1. Price selection dates were established for each shipment period (see Table 3B-

Table 3B-6. Relation of Shipment Periods, Price Selection Periods, Price-Fixing Days, and Chicago Futures Market Options for #2 Yellow Corn

Shipment Period		*Price-Selection Period*			*Price-Fixing Day*
September	1974	3 July	-	1 August	2 August
October	1974	2 August	-	31 August	1 September
November	1974	2 September	-	1 October	2 October
December	1974	2 October	-	31 October	1 November
January	1975	2 November	-	1 December	2 December
February	1975	3 December	-	1 January	2 January
March	1975	31 December	-	29 January	30 January
April	1975	31 January	-	1 March	2 March
May	1975	2 March	-	31 March	1 April
June	1975	2 April	-	1 May	2 May

Shipment Period	*Chicago Futures Market Corn Contract*
September	September
October, November, December	December
January, February, March	March
April, May	May
June	July

Source: *The Corn Industry of Thailand*, Unpublished Manuscript of the Southeast Asian Research Center for Graduate Study in Agriculture in cooperation with the Harvard Business School Project, *Agribusiness Management for Developing Countries*. Reproduced with permission.

6). The price of the corn to be exported during any shipment period was determined in a meeting between JFTA and BOT on the price-fixing day for that period.

2. The price of U.S. #2 yellow corn to be used as the basis for calculating the Thai price was the average of the Chicago futures closing quotations during the thirty days preceding the price-fixing date for that period. It had been agreed, however, that the three highest and three lowest quotations within these thirty days would be excluded from calculation of the averages.
3. The Chicago futures option used for determining the price for each shipment period was the nearest contract to that period (again, see Table 3B-6). Table 3B-7 shows a sample calculation of the U.S. corn price.

For the same shipment period, the f.o.b. premium at U.S. Gulf ports to be added to the calculated price of #2 yellow corn was determined in similar fashion, as follows:

1. On the same days on which closing futures quotations were selected for U.S. #2 yellow corn, two quotations of the f.o.b. premium at U.S. Gulf ports were obtained. JFTA had the right to select the two lowest f.o.b. premium quotations from among those quoted by Continental Overseas Corporation, Bunge Far East Agencies, Louis Dreyfus & Company (overseas) Ltd., Tradax (Japan) Ltd., and Cook & Company Far East Agencies, Inc.
2. On the price-fixing date for a shipment period, all of the f.o.b. premiums so obtained were averaged to obtain the f.o.b. premium for that period.
3. In case there was a difference in the f.o.b. premium quotations for U.S. #2 yellow and U.S. #3 yellow corn of more than seven cents per bushel, both JFTA and BOT agreed that the premium of U.S. #3 yellow corn with a maximum premium of seven cents per bushel would be used.
4. The average f.o.b. premium for the shipment period was added to the commodity cost of corn (calculated as described above) to determine the f.o.b. U.S. Gulf port price.

(Table 3B-8 contains examples of the calculation of the f.o.b. U.S. Gulf port

Table 3B-7. Calculation of U.S. Corn Price for October 1974 Shipment Period

Chicago Futures Quotations for #2 Yellow Corn (in cents per bushel):

August 2	347.00	(347.00)
5	338-340	(339.00)
6	349	(349.00)
7	359	(359.00)
8	358-356	(357.00)
9	347	(347.00)
12	337	(337.00)
13	347	(347.00)
14	357	(357.00)
15	351-352	(351.50)
16	361 1/2	(361.50)
19	357-359	(358.00)
20	348	(348.00)
21	347-346	(346.50)
22	356 1/2	(356.50)
23	363-362	(362.50)
26	352 1/2	(352.50)
27	344-343	(343.50)
28	348 1/2-350	(349.25)
29	343-344	(343.50)
30	341-343 1/2	(342.25)

Average: U.S. $3.5022 per bushel.

In calculating the average price, the three highest quotations (August 23, 16, and 7) and three lowest (August 12, 5, and 30) were deleted, as required by the agreement.

Source: Japan Feed Trade Association.

Table 3B-8. Calculation of f.o.b. Premium at U.S. Gulf Ports for October 1974 Shipment Period (in U.S. cents per bushel)

			Dreyfus		*Applicable Price*
			#2	*#3*	*(#2 basis)*
F.o.b. Premium per Bushel:					
August	2	(High)	33	23	29.00
		(Low)	31	21	
	5	(High)	33	23	29.00
		(Low)	31	21	
	6	(High)	33	23	29.00
		(Low)	31	21	
	7	(High)	33	23	29.00
		(Low)	31	21	
	8	(High)	33	23	29.00
		(Low)	31	21	
	9	(High)	33	23	29.00
		(Low)	31	21	
	12	(High)	43	33	39.00
		(Low)	41	31	
	13	(High)	43	33	39.00
		(Low)	41	31	
	14	(High)	43	33	39.00
		(Low)	41	31	
	15	(High)	33	23	30.00
		(Low)	33	23	
	16	(High)	33	23	29.50
		(Low)	32	22	
	19	(High)	33	23	29.50
		(Low)	32	22	
	20	(High)	33	23	29.50
		(Low)	32	22	
	21	(High)	33	23	29.50
		(Low)	32	22	
	22	(High)	33	23	29.50
		(Low)	32	22	
	23	(High)	33	23	29.50
		(Low)	32	22	
	26		31	21	28.00
	27		31	21	28.00
	28		31	21	28.00
	29		31	21	28.00
	30		31	21	28.00

Average: U.S. $0.3027 per bushel

The quotations of August 5, 7, 12, 16, 23, and 30 are not applicable. Quotations were available from one company only (Dreyfus) for #2 yellow corn. Note that the f.o.b. premium for #2 yellow corn was consistently more than U.S. $0.07 over that for #3 yellow corn.

Source: Japan Feed Trade Association.

Table 3B-9. Sample Calculation of Freight Rate from U.S. Gulf Ports to Japan: October 1974

Date	*Ship*	*Rate per Metric Ton (in U.S. dollars)*
August 2	*Mosberg*	16.73
6	*Roald Jarl*	17.81
15	*Myron*	21.41
15	*Rosenfeld*	16.73
15	*Mediolanum*	16.73
17	*Blue Master*	18.70
24	*Miho Maru*	19.19
28	*Federal Nagara*	19.19
Average:		18.3123

Note: The freight rate employed in the pricing formula was the average of all single voyage rates for heavy grains, sorghums, and soybeans reported in the Reuters Freight Report during the price-fixing period. Rates identified specifically in relation to wheat and barley were excluded. If two or more rates were quoted for one voyage, the average was taken. If rates were unavailable or not quoted similarly to these terms, the freight rate used in the previous shipment period was applied.

Source: Japan Feed Trade Association.

premium for corn for a specific shipment period.) This figure was then employed in the pricing formula defined in the agreement on maize trade.

Thai Pricing Formula. The formula for calculating the price of Thai corn to Japanese buyers f.o.b. Bangkok was as follows:

average futures price for #2 yellow corn in Chicago (determined as described above)

plus

average U.S. Gulf port f.o.b. premium for #2 yellow corn (determined as described above)

plus

freight from U.S. Gulf ports to Japan at prevailing rates (calculated as shown in Table 3B-9)

plus

U.S. fumigation fee of ten cents per metric ton

minus

freight from Bangkok to Japan at prevailing rates

less

allowance for shrinkage of 0.53485 percent

less

U.S. inspection fees of thirty cents per metric ton

equals

f.o.b. Bangkok stowed in bulk price per metric ton of Thai corn.

Table 3B-10. Calculation of Corn Price for October 1974 Shipment (in U.S. dollars)

A. Corn futures price per bushel (from Table 3B-7)		3.5022
B. U.S. Gulf f.o.b. premium per bushel (from Table 3B-8)		.3027
f.o.b. U.S. Gulf price per bushel:		3.8049
f.o.b. U.S. Gulf price per metric ton:[a]		149.7913
C. Gulf Japan Freight (from Table 3B-9)		18.3123
C. and F. Japan[b] price per metric ton:		168.1036
D. Fumigation fee per metric ton:		.10
		168.2036
E. Less: Bangkok to Japan freight:[c]	= $20 per metric ton	
Inspection fee =	$0.30 per metric ton	
Shortage (0.53485%) =	$0.8991 per metric ton	21.1991
F. Total:		147.0045 per metric ton
Bangkok stowed in bulk:		147.00 per metric ton

[a]One metric ton equals 39.368 bushels.

[b]C. and F. Japan means the unloaded price of corn in Japan consisting of commodity cost and freight.

[c]The freight rate from Bangkok to Japan for use in the pricing formula was negotiated at regular intervals during the life of each annual agreement between BOT and JFTA, based on prevailing freight rates. The figure shown in this exhibit was negotiated for the September-December 1974 periods.

Source: Japan Feed Trade Association.

Table 3B-10 summarizes the calculations made under this formula.

Alternate Pricing Arrangements. If, during a price-fixing period, the U.S. government announced export restrictions on corn to Japan that reduced by 15 percent or more the outstanding quantity contracted for shipment, an alternative price for Thai corn would be applied in the corresponding shipping month. It would be set as follows:

1. The alternative price would be the last Thai price fixed before imposition of U.S. export restrictions.
2. In case the alternative price had to be applied for more than one shipping month, the consecutive alternative prices would be:
   - Second month: the last price fixed before U.S. export restriction, plus 15 percent
   - Third month: the last price fixed before U.S. export restriction, plus 20 percent
   - Fourth month: to be negotiated.

When the United States lifted the export restrictions, normal price-fixing pro-

cedures would be employed for the corresponding shipping month. However, if announcement of the end of restrictions left fewer than ten trading days in that month on the Chicago futures market, the average price for ten business days starting from the date of the announcement would be used as the basis for pricing in the corresponding shipping month.

In the event of unforeseen circumstances that made the shipment of U.S. corn to Japan impossible for more than sixteen days during the price-fixing period, an alternative price to be applied during the corresponding shipping month would be calculated in one of two ways:

1. If the quantity purchased from other countries during the price-fixing period was more than 50,000 metric tons, the alternative price would be calculated by averaging two prices:
   - the price fixed for Thai corn (C. and F.[2] Japan) in the previous pricing period under the normal pricing formula
   - the weighted average of the C. and F. Japan price of the other corn for the corresponding shipping month purchased during the pricing period in question
   - the average of these two prices would be converted to f.o.b. Bangkok basis by deducting freight for Bangkok to Japan and inspection fees from the average C. and F. Japan price.
2. If the quantity purchased from other countries did not reach 50,000 metric tons, the alternative price would be the price fixed for Thai maize in the previous pricing period under the normal pricing formula plus U.S. $2.50 per metric ton, which would be increased by U.S. $2.50 per metric ton for each additional month the alternative price was applied for more than two consecutive pricing periods.

The right to invoke the alternative price was vested in BOT, but BOT had to declare to JFTA its intention to do so for a specific shipping period at both the tentative quantity-fixing date and the final quantity-fixing date. JFTA, in turn, had the right to reduce the tentative quantity to the minimum for that shipment period.

Export Regulation. At the request of BOT, the Department of Foreign Trade issued export permits only to exporters designated by BOT who had concluded contracts under this agreement with members of JFTA. Also, at the request of BOT, the Department of Foreign Trade did not issue export permits to Thai corn exporters who had, directly or indirectly, sold or agreed to sell corn to members of JFTA at prices other than those agreed upon by JFTA and BOT.

Breach of Contract. If an exporter committed a breach of contract that caused damage to a Japanese importer and then ignored the claim against such

damage made by the Japanese importer, the importer could submit the claim with supporting written evidence through JFTA to BOT. Upon receipt of sufficient evidence of default, BOT assumed responsibility and brought pressure to bear on the exporter.

When an importing member of JFTA committed a breach of contract—not opening a letter of credit within the specified time or sending ships to load the cargo as scheduled and refusing to pay the exporter's losses, for example—JFTA was similarly responsible. Claims with supporting written evidence were to be submitted to JFTA through BOT.

Breaches of contract had been infrequent under the agreement. In fact, one of the reasons for establishing it originally was to reduce the number of broken contracts occurring in the absence of any agreement.

The 1975 Negotiations

As the 1975 renegotiation of the Japan-Thailand agreement approached, management of Itoh's Feed Materials Department were considering proposing several changes in the agreement. These changes generally concerned pricing and scheduling of shipments to Japan.

The first proposal would substitute a point-selection method for determining the price of Thai corn for the existing method in which closing prices over thirty separate days were averaged. F.o.b. premiums could also be determined in this way, rather than averaging the quotes of four grain-trading firms on different days. The point-selection method would make management of the agreement simpler, bring the process of pricing Thai corn more into line with methods used elsewhere, and give Itoh an opportunity to employ its international information network and experienced commodity analysts to obtain a lower price. Itoh management was not optimistic, however, that this change would be acceptable to BOT.

The second change the Itoh management was considering involved grading and pricing. Japanese feed millers usually desired corn equivalent to U.S. #3 rather than #2 because it was cheaper (see Table 3B-11) and satisfactory for their requirements.[3] Japanese importers, however, were paying the price of #2 corn to their Thai suppliers. Although BOT asserted that the corn exported from Thailand satisfied the specifications of #2 corn, some Japanese importers questioned the validity of this assertion. Others overlooked it, feeling that it was a small price to pay for the convenience of having a major supplier much closer than the United States. Itoh management felt that the issue was worth pursuing because it could mean a reduction in the cost of Thai corn to Japanese buyers.

Finally, Itoh management was considering a recommendation that the size of monthly corn shipments be fixed at the time of the agreement's negotiation—or at least further in advance of the shipment month than currently. Sometimes under the existing arrangement the "tentative amounts" for export announced by BOT were significantly less than Japanese importers had hoped, and the

Table 3B-11. Quality Differentials and Corresponding Discounts for U.S. #3 Yellow Corn Relative to U.S. #2 Yellow Corn, by Quality Characteristics

Characteristic	*#2 Yellow Corn*	*#3 Yellow Corn*	*Discount to #2 Yellow Corn Price for #3 Corn*
1. Moisture content	15.5% maximum	17.5% maximum	$0.05–0.10 per bushel
2. Test weight	54 pounds per bushel minimum	52 pounds per bushel minimum	$0.01–0.02 per bushel
3. Damage	5% maximum	7% maximum	$0.01–0.02 per bushel
4. Cracked kernels and foreign matter	3% maximum	4% maximum	$0.01–0.02 per bushel
			$0.08–0.15 per bushel

Source: Interview with C. Itoh management.

timing of the announcement did not allow them time to obtain other supplies. Fixing the amounts further in advance would reduce uncertainty for Japanese importers. Itoh management was not certain, however, that the corn production and marketing system in Thailand was coordinated enough to regularly meet a schedule set several months in advance, but felt that perhaps their company could provide some assistance in this regard.

Itoh felt that these issues were of primary importance if any changes to the corn agreement were to be considered. They felt they should devise a plan for testing the support for such proposals among Japanese corn buyers and then submit them to BOT.

Summary of Relevance

In the C. Itoh case the Japanese were encouraged by Thailand to provide a guaranteed corn export market so that increased productivity in Thailand would be assured of an export market during the world corn surplus from 1960 to 1972. The cooperation of the Thai Board of Trade and the Japanese Feed Trade Association and the penalties for default backed by both organizations and their respective governments produced sanctity of the contracts that, in turn, reinforced the assured markets for Thailand producers and exporters and an assured source of supply for Japan and its feedgrain users. After 1972, when corn supplies became less plentiful, Thailand developed additional markets. Japan at the same time desired Thailand corn shipments not only as an alternative source of supply but as a means of improving the balance of trade with Japan, which was embarrassingly one-sided.

Although the 1975 contract difficulties seemed significant, provisions remained unchanged as of 1978. However, new factors developed as the assured Japanese market encouraged the development of an internal corn handling system in Thailand—with better storage facilities, domestic grading, and pricing procedures. The newly developed internal Thailand domestic market encouraged contract defaults. For example, if adverse weather conditions reduced local production and the resultant local prices rose more rapidly than "world corn prices," these higher local price could more than offset any price penalties for breaking the international contracts. Thus, the very success of the Thai-Japanese corn export agreement resulted in a stronger Thai domestic market, as we shall note more fully in Chapter 5. There is no doubt that the Thai-Japanese corn agreement provided market access and stimulation to the local Thai corn system. The success of the agreement may eventually lead to local domestic competition that lessens the dependence of Thailand on the agreement, which may encourage Japan to look for additional sources and additional agreements with other developing corn systems such as Brazil.

The main significance of the Thai-Japanese corn agreement is that its existence over seventeen years has encouraged both the commercial and subsistence production of corn in Thailand. The agreement has been flexible enough to meet

both the internal agricultural development plans of Thailand and the commercial and small-farm corn participants' needs. At the same time, it has well served the food policy of Japan and the many participants of that corn system. It has made effective use of the U.S. corn futures market as a fair transfer price mechanism and has served as a bridge for other institutions and arrangements to help the small corn farmer in Thailand, such as the direct cooperative-to-cooperative arrangements of Zen-Noh. It is one model that is transferable to other countries as noted in Japan's relationship with other developing corn economies.

NOTES

1. JFTA consisted of Japan's major feed grain importers.

2. "C. and F. Japan" means the unloaded price of corn in Japan, consisting of commodity cost and freight.

3. All commodities, including corn, are produced in varying degrees of quality. Quality differentials are reflected in price. Quality grading is based on the existence, or lack, of specific characteristics. Grading of corn is based on moisture content, color, existence of foreign matter in a sample, and certain other characteristics. U.S. #2 yellow corn is the standard grade traded in U.S. futures markets. Other grades of lesser quality sell at varying discounts to #2 yellow.

APPENDIX C
MITSUI & COMPANY*

In mid-1975, the general manager of Mitsui & Company's Planning Department was considering the future of his firm's involvement in a joint agricultural venture in Indonesia. The venture, P. T. Mitsugoro, had been established in 1969 with the Indonesian firm P. T. Kosgoro for the purpose of producing corn and other commodities for the local and export markets. The venture had encountered serious operating problems and had not been a financial success. Mitsui management therefore felt that continued involvement had to be weighed carefully against the firm's need to develop effective agricultural cooperation and coordination methods in Southeast Asia and its desire to do so through private enterprise.

Background of Mitsui & Company

Mitsui & Company was the oldest of the major Japanese trading companies. It was representative of Japan's general trading firms, and as such it was highly diversified, multinational, and multifunctional. It was involved in trading, manufacture and distribution, finance, joint ventures, resource development, development and application of new technology, leasing, production of forest products, and service industries.

The significance of Mitsui and similar firms in Japan's trade relations is demonstrated by Table 3C-1, which shows that Mitsui recently accounted for over 10 percent of Japan's exports and 12 percent of its imports. Mitsui's importance as a supplier of a variety of basic products (which it either manufactured or purchased from other companies) is shown in Table 3C-2. Like other large Japanese trading firms, Mitsui offered a variety of financial services to its suppliers and customers, including advances on purchase contracts and credit on sales contracts. Because the company obtained substantial bank credit for these activities, and because Japanese firms operate with relatively small amounts of equity capital, debt was an important part of Mitsui's capital structure, as shown in Table 3C-3.

Joint ventures were an important aspect of Mitsui's business strategy. In 1974, it was involved in 400 such ventures, half of them in Japan and the remainder elsewhere. Close to 100 of the overseas joint ventures were established for the purpose of development and import of raw materials. These projects involved metals, fuels, lumber, grains, and other commodities and had required

*This case was prepared by Richard C. McGinity, Research Associate, under the supervision of Professor R. A. Goldberg, as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Table 3C-1. Significance of Major Trading Companies in the Foreign Trade of Japan: 1973 (in millions of U.S. dollars; shares as a percentage)

	Exports		*Imports*		*Total*	
		(shares)		*(shares)*		*(shares)*
Mitsui	3,909	10.2	5,290	12.2	9,199	11.3
Mitsubishi	3,841	10.1	6,213	14.4	10,053	12.3
Marubeni	2,862	7.5	3,091	7.1	5,953	7.3
C. Itoh	2,292	6.0	3,420	7.9	5,712	7.0
Sumitomo Shoji	2,075	5.4	2,124	4.9	4,199	5.1
Nissho-Iwai	1,867	4.9	2,796	6.4	4,664	5.7
Toyo Menka	1,021	2.7	1,193	2.7	2,214	2.7
Nichimen	844	2.2	1,613	3.7	2,457	3.0
Kanematsu Gosho	805	2.1	1,121	2.6	1,926	2.4
Ataka	611	1.6	993	2.3	1,604	2.0
Total	20,127	52.7	27,853	64.2	47,980	58.2
Japan Total	38,176	100.0	43,398	100.0	81,574	100.0

Source: Mitsui & Co.

investments and loans of about $1 billion. Mitsui continually sought information on new technology and searched for new applications for it. Paralleling this effort was the company's emphasis on "future-oriented" projects such as leisure industries, regional development, and ocean-resource use. Given the breadth of its perspective and involvement, Mitsui justifiably considered itself a coordinator of industries, markets, resources, and capabilities.

Perhaps the best indicator of the scale of Mitsui's operations is its income statement (Table 3C-4). Its 1974 sales of 7.6 trillion yen were equivalent to about U.S. $27 billion, and the firm had over 13,000 employees. Table 3C-5 is a funds flow analysis for 1973 and 1974. The company's rapid growth since 1965 is summarized in Table 3C-6.

Mitsui's Role in Japanese Agribusiness

Companies within the Mitsui group were major competitors in Japanese agribusiness. Mitsui Toatsu Chemicals was the leading Japanese producer of urea, an important nitrogenous fertilizer; it held 30 percent of the Japanese market for that product. Nippon Flour Mills was the second-ranking wheat miller in Japan, with over 20 percent of the market for wheat flour. Another Mitsui subsidiary owned the largest Japanese sugar refining operation, accounting for about 25 percent of the total domestic capacity. Mitsui owned 28,000 hectares of forest land, and Oji Paper, a member of the Mitsui group, was the leading paper producer in Japan, with about 16 percent of the market.

Given the relatively low rate of food self-sufficiency in Japan—about 52 percent, according to 1973 estimates of the Ministry of Agriculture and Forestry—

Table 3C-2. Breakdown of Mitsui Sales: 1969-73 (in millions of U.S. dollars)

	Fiscal Year										
	1969		*1970*		*1971*		*1972*		*1973*		
		(percentage)		*(percentage)*		*(percentage)*		*(percentage)*		*(percentage)*	*Growth Rate (1969 = 100)*
Iron and Steel	2,456	27	3,430	29	3,292	26	3,248	24	4,491	25	183
Foodstuffs	1,279	14	1,539	13	1,844	14	1,996	14	2,624	15	205
Chemicals	1,191	13	1,461	12	1,564	12	1,688	14	2,192	12	184
Machinery	1,199	13	1,572	13	1,826	14	1,979	12	2,246	12	187
Textiles	793	9	966	8	1,129	9	1,328	10	1,801	10	227
Nonferrous Metals	949	11	1,274	11	1,122	9	1,140	8	1,689	9	178
Other	1,187	13	1,586	14	2,000	16	2,479	18	2,997	17	252
Total	9,054	100	11,828	100	12,777	100	13,858	100	18,040	100	199

Source: Mitsui & Co.

Table 3C-3. Mitsui & Co.: Consolidated Balance Sheets: 1973-74 (in millions of yen; years ending September 30)

	1974	*1973*
Current Assets:		
Cash	100,088	55,419
Time deposits	167,860	205,571
Marketable securities--at lower of cost or market	23,440	37,874
Receivables–Trade		
Notes and loans	924,718	757,362
Accounts	974,399	732,202
Associated companies	229,730	150,165
Allowance for doubtful receivables	(34,738)	(25,666
Unearned interest and commissions	(14,987)	(8,288
Inventories	344,630	213,585
Advance payments to suppliers	202,487	130,683
Prepayments, etc.	63,427	62,172
Deferred income taxes	4,852	3,271
Total current assets	2,985,906	2,314,350
Investments and Noncurrent Receivables:		
Investments in and advances to unconsolidated subsidiaries and associated companies	218,303	146,949
Other investments		
Securities–at cost, less allowance for impairment in value	133,683	113,444
Sundry–at cost	64,719	117,254
Noncurrent notes, loans, and accounts receivable–Trade, less unearned interest	383,161	335,428
Property leased to others–at cost, less accumulated depreciation: 1974, ≅ 1,897 million–$6,656 thousand; 1973, ≅ 662 million–$9,340 thousand	5,362	5,174
Total investments and noncurrent receivables	805,228	718,249
Property and Equipment–Principally at cost		
Land, land improvements, and timberlands	56,797	43,324
Buildings, including leasehold improvements	69,490	54,295
Equipment and fixtures	67,615	55,497
Ships	2,725	2,882
Projects in progress	9,925	12,998
Total	206,552	168,996
Less accumulated depreciation	46,306	34,169
Property and equipment–net	160,246	134,827
Miscellaneous Assets (less amortization)	29,359	23,746
Total	3,980,739	3,191,172

Note: One U.S. dollar approximately equals 280 yen.

Source: Mitsui & Co., *Annual Report.*

	1974	*1973*
Current Liabilities:		
Short-term bank loans	858,131	683,467
Current maturities of long-term debt	153,521	102,157
Notes and acceptances–Trade	1,070,879	907,726
Accounts payable–Trade	506,461	421,233
Notes and accounts payable–associated companies	107,787	66,636
Accrued expenses:		
Income taxes	16,720	9,479
Interest	19,206	11,603
Other	29,893	22,648
Advances under incomplete transactions	113,413	77,738
Deposits	38,673	25,429
Total current liabilities	2,914,684	2,328,116
Liability for Severance Indemnities and Accrued Pension Costs	16,899	12,871
Long-term Debt, Less Current Maturities	861,302	705,457
Minority Interests	3,669	2,966
Deferred Income Taxes–Noncurrent	20,555	12,853
Deferred Foreign Currency Exchange Gains	4,140	
Shareholders' Equity:		
Common stock, ¥ 50 par–authorized, 1,700,000,000 shares; issued and outstanding: 1974–665,775,847 shares; 1973–520,230,136 shares	33,289	26,012
Capital surplus	26,927	30,600
Special surplus	1,620	1,620
Retained earnings		
Appropriated for legal reserve	4,557	3,916
Appropriated for sundry reserves	26,955	23,625
Unappropriated	66,142	43,136
Total shareholders' equity	159,490	128,909
Commitments and Contingent Liabilities		
Total	3,980,739	3,191,172

Table 3C-4. Mitsui & Co.: Statement of Consolidated Income, 1973-74 (i millions of yen; years ending September 30)

	1974	*1973*
Revenues		
Gross trading profit		
Net sales	7,622,960	5,141,454
Cost of sales	(7,346,035)	(4,968,989)
Sales commissions	7,308	5,980
Total	284,233	178,445
Rent and warehousing income	5,424	3,811
Total	289,657	182,256
Expenses		
Selling, general, and administrative	141,538	1 17,896
Interest expense (net of interest income: 1974, ¥ 132,185 million–$463,807 thousand; 1973, ¥ 103,396 million–$362,793 thousand)	83,609	33,358
Provision for doubtful receivables	10,884	5,982
Total	236,031	147,23t
Operating Income	53,626	35,020
Other Income (Expense):		
Dividends	5,347	3,836
Loss on investments in securities–net	(3,730)	(1,329)
Sundry–net	4,407	2,350
Other income–net	6,024	4,857
Income before Income Taxes and Equity in Earnings	59,650	39,877
Provision for Income Taxes		
Current	31,311	18,973
Deferred	2,966	1,206
Total	34,277	20,179
Income before Equity in Earnings	25,373	19,698
Equity in Earnings of Unconsolidated Subsidiaries and Associated Companies–Net (less applicable income taxes)	5,738	2,051
Net Income	31,111	21,749

Note: One U.S. dollar approximately equals 280 yen.

Source: Mitsui & Co., *Annual Report.*

Table 3C-5. Mitsui & Co.: Statement of Changes in Consolidated Financial Position, 1973-74 (in millions of yen; years ending September 30)

	1974	*1973*
Source of Funds		
From operations:		
Net income	31,111	21,749
Charges (credits) to operations not requiring funds:		
Depreciation	11,378	10,153
Deferred income taxes–noncurrent	7,702	5,119
Other	(2,205)	1,981
Total from operations	47,986	39,002
Proceeds from sales of leased property and property and equipment	4,817	4,395
Increase of long-term debt	445,809	276,150
Issuance of common stock	3,604	28,073
Total	502,216	347,620
Application of Funds		
Increase in investments	33,108	32,959
Increase in noncurrent notes, loans, and accounts receivable	47,733	22,998
Additions to leased property and property and equipment	41,129	31,232
Reduction of long-term debt	289,964	222,820
Payment of cash dividends	4,134	3,427
Other–net	1,160	7,642
Total	417,228	321,078
Increase in Working Capital	84,988	26,542
Increase (Decrease) in Components of Working Capital:		
Current assets:		
Cash, time deposits, and marketable securities	(7,476)	(38,374)
Trade receivables	473,347	464,935
Inventories	131,045	48,190
Other current assets	74,640	21,656
Total	671,556	496,407
Current liabilities:		
Bank loans and current maturities of long-term debt	226,028	91,600
Trade payables	289,532	352,631
Other current liabilities	71,008	25,634
Total	586,568	469,865
Increase in Working Capital	84,988	26,542

Note: One U.S. dollar approximately equals 280 yen.

Source: Mitsui & Co., *Annual Report.*

Table 3C-6. Mitsui & Co.: Consolidated Ten-Year Comparison, 1965-74 (in millions of U.S. dollars; years ending September 30)

	1974	*1973*	*1972*	*1971*	*1970*	*1969*	*1968*	*1967*	*1966*	*1965*
Net Sales										
Domestic	14,488	10,430	8,073	6,992	6,401	4,880	3,887	3,461	2,798	2,390
Import	6,097	3,716	2,668	2,776	2,928	2,224	1,850	1,703	1,240	1,036
Export	4,302	2,799	2,448	2,428	2,100	1,609	1,316	1,197	1,090	939
Offshore	1,860	1,095	669	581	399	341	308	260	212	196
Total	26,747	18,040	13,858	12,777	11,828	9,054	7,361	6,621	5,340	4,561
Income before Extraordinary Items	109.2	76.3	62.0	53.1	50.2	29.2	22.6	17.3	9.6	9.1
Extraordinary Items, net of applicable income taxes				(24.9)				(4.4)		
Net Income	109.2	76.3	62.0	28.2	50.2	29.2	22.6	12.9	9.6	9.1
Cash Dividends Paid	14.5	12.0	11.2	10.9	8.4	6.7	6.7	6.6	6.5	6.5
Common Stock										
Share Outstanding (in thousands)	665,776	520,230	462,552	452,030	442,537	274,353	273,392	272,042	266,177	266,177
Number of Shareholders	68,720	59,857	58,568	79,683	85,086	70,292	62,716	65,833	64,160	63,453
Total Assets	13,968	11,197	9,176	7,651	6,210	4,713	3,566	2,930	2,521	2,280
Shareholder's Equity	560	452	290	233	211	134	110	90	83	80
Per 20 Shares of Common Stock (B)										
Assuming no dilution:										
Income before Extraordinary Items	3.29	2.41	2.15	1.89	1.85	1.24	0.96	0.74	0.42	0.40
Net Income	3.29	2.41	2.15	1.00	1.85	1.24	0.96	0.55	0.42	0.40
Assuming full dilution (C):										
Income before Extraordinary Items	3.20	2.31	2.11	1.82	1.75	1.12	0.93	0.72	0.41	0.39
Net Income	3.20	2.31	2.11	0.98	1.75	1.12	0.93	0.54	0.41	0.39
Cash Dividends Applicable to the Year	0.49	0.39	0.39	0.39	0.38	0.29	0.28	0.28	0.28	0.28

Note: One U.S. dollar approximately equals 280 yen.

Source: Mitsui & Co., *Annual Reports.*

one of Mitsui's most vital functions was that of food importing. Mitsui and closely affiliated companies accounted for about 24 percent of corn imports to Japan and about 11 percent of its milo imports (Table 3C-7). These feedgrain imports were raw materials needed to produce Japan's steadily growing livestock feed output. To inventory these imports, the Mitsui group owned about 17 percent of the elevator capacity in Japan, as shown in Table 3C-8.

Consistent with the Japanese government's policy of enlarging the sources of the country's food imports, Mitsui had sought to invest in food-commodity-production ventures in various countries. The Mitsugoro venture in Japan was one of its first efforts.

The Mitsugoro Joint Venture

P.T. Mitsugoro was a joint venture formed by Mitsui and P.T. Kosgoro of Djakarta for the purpose of agricultural development in Lampung, South Sumatra (see Figure 3C-1). The project received strong encouragement from the Indonesian government; the president of Indonesia and five of his cabinet members attended its dedication in April 1969. Paid-in capital was $1.5 million, and Mitsui owned 51 percent of the stock. The venture had five main goals, reflecting the interests of the participants and their respective governments:

1. creation of a model for private-sector agricultural cooperation between Japan and developing countries on a basis profitable to both sides
2. improvement in the income and standard of living of rural populations in developing countries by encouraging increased production through guaranteed purchases of corn at international prices
3. development of new sources of corn imports for Japan, and of foreign exchange earnings for Indonesia, so as to encourage bilateral trade
4. promotion of transmigration from densely populated Java to less densely populated Sumatra, a major goal of the Indonesian government
5. promotion of economic cooperation with developing countries on the part of the Japanese government.

The project was situated in a province that was densely populated (2.4 million hectares; 2.8 million people) yet had relatively large uninhabited areas. It was not highly productive agriculturally. Table 3C-9 shows the area's yields for a variety of crops and compares them to yields elsewhere in the world. The areas to be farmed were originally undeveloped and surrounded by jungle. Although access for the machines needed to remove the heavy shrub and grass cover was difficult, Mitsugoro established four farms in the area by mid-1975. They were of 100, 400, 1000, and 2500 hectares. The smallest was an experimental and demonstration farm for local farmers; the largest was not expected to be fully operational until late in 1975.

Initially, local cropping patterns for dry farming had been employed, as

Table 3C-7. Japanese Corn and Milo Imports in 1973, by Importing Organization (in metric tons)

	Corn		Milo		Corn/Milo	
	Quantity	*Percentage*	*Quantity*	*Percentage*	*Quantity*	*Percentage*
Mitsubishi Group						
Mitsubishi Corp.	898,268	13.1	595,446	16.0	1,493,714	14.1
Meiwa-Sangyo	34,541	0.5	–		34,541	0.3
Kinsho-Mataichi	10,000	0.1	–		10,000	0.1
Subtotal	942,809	13.7	595,446	16.0	1,538,225	14.5
Nishho-Iwai	194,116	2.8	40,919	1.1	235,035	2.2
Ataka-Sangyo	85,587	1.2	45,199	1.2	130,786	1.2
Subtotal	279,703	4.0	86,118	2.3	365,821	3.4
Total	1,222,512	17.7	681,564	18.3	1,904,076	17.9
Mitsui Group						
Mitsui & Co.	1,151,568	16.8	296,481	8.0	1,448,049	13.7
Rasa Shoji	34,054	0.5	–		34,054	0.3
Sanyo Beoki	33,410	0.5	–		33,410	0.3
Yuasa	109,463	1.6	63,982	1.7	173,445	1.7
Mihiryo	100,569	1.5	28,480	1.0	265,732	1.2
Toshoku	229,252	3.3	36,480	1.0	265,732	2.5
Total	1,658,316	24.2	425,613	11.5	2,083,929	19.7
Marubeni Group						
Marubeni	941,263	13.7	502,426	13.5	1,443,689	13.7
Kanematsu-Gosho	268,415	3.9	209,635	5.7	478,050	4.5
Total	1,209,678	17.6	712,061	19.2	1,921,739	18.2
Co-op						
Unicoop	971,443	14.1	689,833	18.6	1,661,276	15.7
Nichimen-Jitsugyo	281,091	4.1	495,334	13.3	776,425	7.3
Sumitomo Shoji	205,689	3.0	207,138	5.6	412,827	3.9
Total	1,458,223	21.2	1,392,305	37.5	2,850,528	26.9
Other Groups						
C. Itoh	766,356	11.2	501,114	13.5	1,267,470	12.0
Tomen	551,135	8.0	145	0.0	551,280	5.2
Others	5,376	0.1	95	0.0	5,471	0.1
Grand Total	6,871,596	100.0	3,712,897	100.0	10,584,493	100.0

Source: Industry sources.

Table 3C-8. Grain Silo Capacity in Japan: 1974 (in thousands of metric tons)

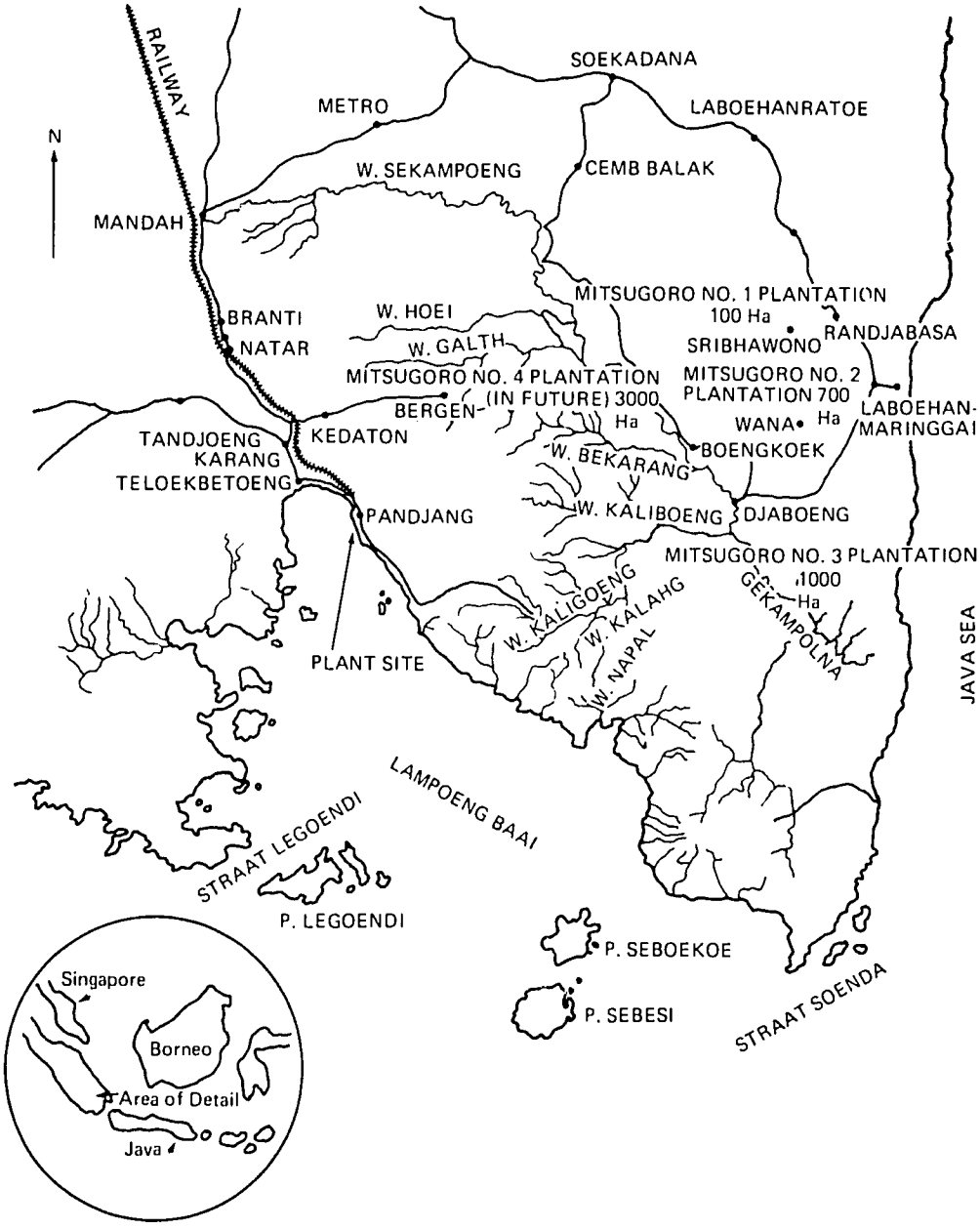
By Function	*Total*	*Percentage Located at Major Ocean Terminals*
Handling Silo	1987	71
Processor Silo		
Wheat	349	72
Feed Grains	846	15
Soybeans	456	65
	3,641	58

By Group (excluding wheat and soybeans)	*Handling Silo*	*Processor Silo*	*Total*
Mitsubishi group	128	219	347
Mitsui group	185	190	375
Marubeni group	196	74	270
C.I. group	133	122	255
Tomen	105	5	110
Zen-Noh	433	113	546

Source: Ministry of Agriculture and Forestry.

described in Table 3C-10. Crops on the unirrigated areas of the farms consisted of corn, rice, cassava, and soybeans. Only rice was planted in both irrigated and unirrigated areas. Mitsugoro had hoped to use strictly capital-intensive methods in its farming operations, but high local unemployment moved people in the area to request extensive use of manual labor, at least for planting and harvesting. Cultivation and fertilization were accomplished mechanically. Fertilizer was used in generous amounts, especially for each corn crop, as described in Table 3C-10.

Mitsugoro had sought to develop a higher yielding seed corn variety suited to the characteristics of the area, but had encountered little success. In 1971 and 1972 the company planted varieties of hybrid seeds produced by Pioneer Hi-Bred International of the United States, the International Center for the Improvement of Maize and Wheat (CIMMYT) in Mexico, the Thai Maize Research Center, and other organizations. Toward the end of 1973, an outbreak of mildew disease caused so much damage to the province's corn crop that the provincial governor prohibited planting corn until the varieties were made immune to the disease or until the disease was eradicated. In 1974, the company switched to two local disease-resistant seed varieties called Kretek and DMR, with yields of somewhat less than two metric tons per hectare. To further



Scale = 1:400,000
Source: Mitsui & Co.

Figure 3C-1. Map Showing Location of Mitsugoro Farming Operations

Table 3C-9. Harvested Area, Production, and Yields of Major Agricultural Commodities in Lampung Province, South Sumatra, Indonesia: 1968-70; and Comparison with Typical Yields Achieved in Higher Productivity Areas

	1968			*1969*			*1970*		
Crop	*Harvested Area*	*Production*	*Yield*	*Harvested Area*	*Production*	*Yield*	*Harvested Area*	*Production*	*Yield*
Paddy Rice	67,400	268,700	3.9	70,532	222,847	3.16	75,890	225,436	2.97
Upland Rice	170,400	237,000	1.4	158,000	144,100	.91	139,768	180,428	1.29
Subtotal	237,800	505,700	2.13	228,532	366,947	1.6	215,658	405,864	1.88
Corn	64,900	50,000	.77	62,500	45,667	.73	63,839	56,681	.89
Cassava	26,400	33,100	1.25	36,300	295,600	8.14	24,347	219,266	9.0
Sweet Potato	5,256	26,000	4.9	4,200	19,400	4.6	4,189	21,650	5.16
Peanut	4,223	1,600	.4	3,025	1,900	.63	2,930	1,743	.59
Soybean	21,904	17,450	.8	20,300	6,400	.32	11.844	6,857	.58
Green Bean	1,632	1,021	.63	1,950	372	.19	801	478	.60

Source: Mitsui & Co.

Comparison With Yields Achieved in Higher Productivity Areas (in metric tons per hectare)

Rice (Japan)	5.2	Sweet Potato (United States)	10.9
Corn (United States)	6.0	Peanut (People's Republic of China)	.99
Cassava	15.5	Soybean (Japan)	1.3
		Green Beans (Japan)	1.6

Source: USDA

Table 3C-10. Cropping Patterns and Fertilization of Mitsugoro Farming Operations

Cropping Patterns		
	Seeding	*Harvesting*
1st Crop	October	January
2nd Crop	February	May
3rd Crop	June	September
Use of Fertilizer		
Application/Type	*Urea*	*Triple Super Phosphate*
Basic	50 kilograms per hectare	50 kilograms per hectare
1st top dressing	50 kilograms per hectare	50 kilograms per hectare
2nd top dressing	50 kilograms per hectare	50 kilograms per hectare
3rd top dressing	10 kilograms per hectare	50 kilograms per hectare

Source: Mitsui & Co.

reduce the threat of disease, the firm decreased its corn acreage and planted more of other crops such as grain sorghum and cassava.[1]

Although Mitsugoro's corn yields were significantly below those attained in high productivity areas of the world, the company had nonetheless achieved some improvement over the previous yields of local producers. The typical farmer in the area worked a very small plot of one hectare and harvested three crops totaling less than a metric ton per year. Mitsugoro had achieved yields of 2.5 to 3 tons per hectare. Table 3C-11 shows the improvement of the operation's production.

In addition to improving its own yields, Mitsugoro sought to establish a marketing system to encourage local farmers to increase their own production. Mitsugoro purchased corn from local farmers at a price based on the Chicago price for #2 yellow corn, which was significantly higher than what local merchants previously paid. To improve the quality of the corn, the company encouraged farmers to husk the corn in the field at harvest and store it in a relatively dry place. It also provided shelling machines free of charge.

Because Indonesia set no official specifications on the quality of corn for export, the company applied its own standard and sold its corn under the trademark "MG." Its efforts in grading enabled Mitsugoro to obtain a premium in the Singapore market (the closest major market for Lampung corn) over the usual quality of Lampung corn.[2] An indication of the success of Mitsugoro's marketing effort was the growth of corn exports from Lampung's port of Pandjang shown in Table 3C-12.

Despite the progress of the Mitsugoro operation, serious problems in transportation, labor, management, and financing remained. Transportation was

Table 3C-11. Record of Mitsugoro Farm Operation

		First Year (4/69-9/69)		*Second Year (10/69-9/70)*		*Third Year (10/70-9/71)*		*Fourth Year (10/71-9/72)*		*Fifth Year (10/72-9/73)*	
Opened											
No. 1 Farm	(Sribhawono)	112 Ha.		–		–		–		–	
No. 2 Farm	(L. Maringgai)	160 Ha.		230 Ha.		–		–		–	
No. 3 Farm	(Djabung)	–		1,000 Ha		–		–		–	
	Total: (Hectare)	272 Ha.		1,230 Ha.		–		–		–	
Plantation		Harvested Hectare	Metric Ton	Harvested Hectare	Metric Ton	Harvested Hectare	Metric Ton	Harvested Hectare	Metric Ton	Harvested Hectare	Metric Ton
No. 1 Farm	Maize	100	40	210	428	256	611	165	405	153	500
	Soybean	–	–	–	–	21	4	6	1	–	–
	Peanut	–	–	–		–	–	48	7	119	83
	S. Total:	100	40	210	428	277	615	219	413		
No. 2 Farm	Maize	–	–	385	406	368	430	210	178	425	1,010
	Peanut	–	–	–	–	82	5	200	29	208	146
	Rice	–	–	108	92	139	126	4	7	–	–
	S. Total:	–	–	493	498	589	561	414	214		
No. 3 Farm	Maize	–	–	225	292	1,617	2,568	1,659	2,851	1,650	4,410
	Soybean	–	–	–	–	172	60	165	109	–	–
	Peanut	–	–	–	–	–		35	–	220	132
	S. Total:	–	–	225	292	1,789	2,628	1,859	2,960		
Grand Total	Maize	100	40	820	1,126	2,241	3,609	2,034	3,434	2,228	5,920
	Soybean	–	–	–	–	193	64	171	110	–	–
	Peanut	–	–	–	–	82	5	283	36	547	361
	Rice	–	–	108	92	139	126	4	7	–	–
Purchases from Other farmers (Metric Ton)	Maize	293		5,042		5,288		5,842		NA	
	Soybean	–		507 (Tapioca 463)		85		21			
Sales											
Maize (Metric Ton)	Export	335		4,867		7,225		10,922		NA	
	Domestic	–		71		–		100			
	S. Total:	335		4,938		7,225		11,022		NA	
Others (Metric Ton)		–		1,050		70		224			

Notes: Maize : Dry basis
Soybean : Dry basis
Peanut : Shelled dry basis

Source: Mitsui & Co.

Table 3C-12. Export Record from Pandjang Port (in metric tons)

Year	*Rubber*	*Coffee*	*Pepper*	*Maize*	*Tapioca Chips and Meal*	*Copra*	*Lumber*	*Others*	*Total*
1960	35,351	6,061	8,429		800	2,150		329	53,121
1961	48,800	14,005	15,629		470	3,733		535	83,898
1962	48,991	11,563	3,757			864		10	65,185
1963	38,990	18,398	13,489	200	600	1,058		340	73,045
1964	52,399	13,554	16,654			3,873		139	86,619
1965	53,119	33,203	11,048	4,400	9,200	2,638		1,200	115,303
1966	44,659	28,618	13,282	29,871	5,843	4,893	289	2,263	132,327 + 289
1967	44,465	42,662	29,295	26,650	6,366	4,330	4,512.2	3,540.5	156,490 + 4,512.2
1968	50,592	24,935	20,756	29,047	16,250	4,250	5,904.12	8,649	152,529 + 5,904
1969	53,902	40,579	10,910	38,546	46,750	3,600	24,716.32	9,156	1.303,064 + 24,716.32
1970	42,060	26,985	1,263	46,221	74,191	5,828	81,649	6,537	203,085 + 81,649
1971	29,610	24,623	17,639	69,000	89,449	6,032	224,510	4,094	240,447 + 224,510
1972 (Jan.-Oct.)	21,339	21,897	18,505	44,977	103,131	9,640	483,360	2,645	222,134 + 483,360

Source: Mitsui & Co.

difficult because only one poorly paved and circuitous road linked the farms to the port. The road's rough 130 kilometers made vehicle operation and maintenance costs very high. To relieve this problem, Misugoro had requested that the World Bank help establish a direct road to Pandjang and reduce the road distance to 60 kilometers. The bank had done a feasibility study on the project, and the Japanese government was sponsoring the road's planning and construction.

The labor difficulties were lack of skill among the workers and high turnover. Mitsugoro regularly employed 200 salaried workers and as many as 1,500 more for planting and harvest. Seasonal workers were paid about fifty cents per eight-hour day, significantly more than they could make elsewhere in the area. Because local employment opportunities were so limited, Mitsugoro had to give each family an equal chance for seasonal jobs so the region's standard of living would improve evenly. Training was vital for salaried workers (especially machine shop, bulldozer, and tractor operators), so Mitsui instructed them in Japan.

Finally, the operation's costs relative to its yields were so high that Mitsugoro was not yet competitive with major corn producers elsewhere in the world. Production costs were approximately $311 per hectare (Table 3C-13), and yields of about 2.5 to 3 tons per hectare resulted in a production cost per metric ton of about $124. When the costs of transportation, handling, and tax were added, Mitsugoro's cost per metric ton of corn f.o.b. Pandjang was about $165. In comparison, the recent price of U.S. corn placed aboard ship at the U.S. Gulf had fluctuated between $106 and $164 per metric ton. Table 3C-14 compares U.S. and Mitsugoro corn yields, costs, f.o.b. premiums, and prices in metric and English measurements.

Because the f.o.b. U.S. Gulf price for corn was the primary international price for this commodity in East Asia, Mitsugoro usually had to sell its corn for substantially less than its production and loadout costs. As Table 3C-15 shows, despite Mitsugoro's proximity to the Asian market, freight-rate differentials for grain shipped between Pandjang harbor and Tokyo and between U.S. Gulf ports and Tokyo were too small to eliminate the cost differential between the company's corn and American exports. Consequently, Mitsugoro had accumulated deficits of 840 million yen ($2.8 million) by late 1974.

The current U.S. corn price of about $2.60 per bushel translated to an f.o.b. Gulf price of about $110 per metric ton. Corn yields in Mitsugoro's farming operation had to exceed four tons per hectare in order for its f.o.b. price to compete with that of the United States. And if the 1975 U.S. corn harvest proved to be the largest in history and drove the Chicago corn price down to $2.15 per bushel, the f.o.b. U.S. Gulf price would probably drop to less than $90 per ton. A yield of almost seven tons per hectare would then be required for Mitsugoro to be competitive. Clearly, Mitsugoro had to cut costs, improve productivity, or seek preferential pricing arrangements from existing or potential buyers.

Table 3C-13. Direct Costs of Corn Production at P.T. Mitsugoro

Item	Cost (rupiahs per hectare)	Cost (U.S. dollars per hectare)
Seed	4,000	9.64
Fertilizer and Insecticide	30,000	72.29
Labor	22,000	53.01
Fuel	11,000	26.51
Parts and Repairs	29,000	69.88
Depreciation	27,000	65.06
Other	6,000	14.46
Total	129,000	310.84
Cost of Production per Metric Ton (assuming yield of 2.5 tons per hectare)	51,600	124.34

Cost of Transportation of Corn from P.T. Mitsugoro to Pandjang Port and Loading aboard Ship

Item	(rupiahs per metric ton)	(U.S. dollars per ton)
Truck	6,000	14.46
Loading	650	1.57
Unloading and Warehousing	1,900	4.58
Shiploading and Stevedoring	1,800	4.34
Tax (if corn is purchased from a farmer)	1,000	2.41
Export Tax	5,600	13.49
	16,950	40.84
Total Pandjang f.o.b. Cost per Ton of Corn	68,550	165.18

Note: One U.S. dollar equals about 415 rupiahs.
Source: Interview with Mitsui Management.

Mitsui's Situation

Mitsui management faced a dilemma. Should it liquidate an unprofitable operation or should it continue its effort to develop agricultural cooperation and coordination in Southeast Asia? It appeared that Mitsugoro's corn yields would improve only slowly. Some costs of the operation might be cut, though the extent to which such cuts could be made was unclear.

And there were other issues to consider. The Indonesian government was interested in Mitsugoro's survival because of the employment it provided and because it might become the nucleus of a feedgrain export industry like Thailand's. The Japanese government was also interested in developing a new source of feedgrains close to the home islands. Mitsui management wondered what criteria to use in deciding on their firm's future involvement in P.T. Mitsugoro.

Table 3C-14. Comparison of U.S. and Mitsugoro Corn Yields, Costs, f.o.b. Premiums, and Prices in Metric and English Measurements

	Metric	*English*
Yield		
Mitsugoro	2.4-3.3 metric tons/hectare	38-52 bushel
U.S. Average	6.0 metric tons/hectare	95 bushel
Costs of Production		
Mitsugoro	$320/hectare	$130/acre
	$128/metric ton	$3-2.50/bushel
U.S. Average	$469/hectare	$190/acre
	$84.60/metric ton	$2.00/bushel
Prices		
Mitsugoro:	Export: $100-158/metric ton	Export: $2.50-3.95/bushel
	Domestic: $37.50/metric tons	Domestic: $0.94/bushel
U.S.:	$100-158/metric ton	$2.50-3.95/bushel
F.O.B. Premium		
Mitsugoro	$42/metric ton	$1.20/bushel
U.S. average	$6/metric ton	$0.15/bushel
F.O.B. Prices		
Mitsugoro	$170/metric ton	$3.70-4.20/bushel
U.S.	$106-164/metric ton	$2.65-4.00/bushel

Sources: Mitsui & Co., ERS-USDA.

Table 3C-15. Ocean Freight Rates for Grain, Selected Dates and Ports: 1971-75 (per metric ton; in U.S. dollars)

Date	*Pandjang/ Japan*	*Pandjang/ Singapore*	*U.S. Gulf/ Japan*	*U.S. Gulf/ Singapore*
February 1971	14.00	Not Available	9.00	Not Available
May 1973	14.30	5.65	15.00	Not Available
May 1974	26.00	13.37	27.50	Not Available
April 1975	22.00	10.96	9.50	Not Available
August 1975	22.00	10.70	9.50	17.00

Note: Freight rates between the U.S. Gulf and Japanese ports vary widely to reflect international supply and demand of ocean cargo space. Although data are sparse, rates between the U.S. Gulf and Singapore tend to show parallel movement. As shown in the table above, Pandjang/Japan rates show a different pattern. Rates in this route are maintained at a relatively stable level by the Indonesia-Japan Freight Conference and do not show the fluctuation apparent in the Gulf/Japan market. The Pandjang/Singapore route is a local market whose rates are based on local freight supply and demand circumstances.

The main grain-discharging terminals in Japan are generally equipped with high volume facilities capable of accomodating large bulk carriers of 25,000 to 50,000-ton capacity. Vessels of this type carry almost all of the corn from the U.S. Gulf to Japan. The smaller vessels preferred for transporting grain within Indonesia and between Indonesia and Singapore are unsuited to discharging grain in Japan, except in smaller and less modern ports.

Source: Mitsui & Co.

Summary of Relevance

Although it entailed considerable financial losses, the project had many redeeming features. First, it led to the use of new lands, creating a new agricultural production area and a town for its support in a country suffering from excessive population pressures and underused labor. Second, it was and is a "learning model" for future economic development projects in other developing nations. Third, it suggests the importance of careful agronomic tests, early planning, and pilot testing before full-scale operations are undertaken. Finally, Mitsui & Company's experience recommends a flexible joint-management mechanism in such ventures so that drastic changes can be made if original project assumptions prove incorrect.

In September 1977, Professor Yoshi Tsurumi of the Graduate School of Business Administration of Columbia University recommended the "Indonesianization" of the agricultural operations in Lampung, in a research report to the Indonesian National Science Council.[3] The adjacent farms have obtained both better seeds and markets than existed before the project began, and the intensive labor they apply to timely planting, weeding, and harvesting have produced more than the large-scale mechanized units can—once the small family farm operators have been supplied improved seeds, modern farming knowledge, and appropriate fertilizer. The transfer from the large-scale project to small family farms has been suggested through the establishment of cooperative ventures of family-based farms. This approach appears to work well in other parts of the world and in other crops. These projects start with a central farm base as an example and as a preliminary assured supply to local processing. Once the first stage of the project is completed, satellite small farm developments are formed that surround the project. Both the problems and action alternatives of the Mitsugoro project in facing up to these problems will be useful to other development projects involving governmental agencies and multinational firms.

NOTES

1. In the tropics, continuous use of land for corn encourages mildew disease. By allowing the land to lie fallow for a time between crops, farmers reduce the probability of a severe outbreak.

2. The corn market in Singapore was a limited one with an annual demand of about 700,000 tons, of which over 60 percent was accounted for by Thai corn. Thai corn usually dominated the market during the August-December period. Indonesian corn came into the market during the January-July period, but in relatively small quantities. Although it was eventually affected by Chicago corn price movements, the market often experienced independent price movements reflecting local supply and demand.

Lack of quality control had caused Lampung corn to be sold at a discount of three to five dollars per metric ton below Thai corn. Since Mitsugoro had come into the market, however, its Grade-A "MG" corn had enjoyed a premium

of three to five dollars over the usual Lampung variety. Even after mildew disease broke out in 1973, Mitsugoro managed to obtain a premium for its corn in Singapore. The general quality of Lampung corn began to improve, however, as shippers started paying more attention to quality in order to compete with Mitsugoro.

3. "Transformation of the Mitsugoro Pilot Farms: Action Plans and Implementation," Research Report No. 4. Indonesian National Science Council (LIPI), 30 September 1977. Working paper of Professor Yoshi Tsurumi soon to be part of a book on the total project (1978).

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Chapter 4

System Response to Growth in Demand: The Case of the United States

Because the United States is a dominant factor in the world corn system and more specifically in the development of the Japanese and Southeast Asian markets, this chapter focuses on trends and factors that have and will affect the U.S. corn system, and which in turn will affect the Southeast Asian corn system described in Chapter 5. The chapter further describes the interrelated factors that affect private and public managers in the American system. These factors, coordinating arrangements, and new technological developments require attention because they affect the international corn system. They also may provide examples of unique coordinating institutions and arrangements that may prove useful as subsistent corn systems become commercial.

DYNAMICS OF THE U.S. SYSTEM

From the mid-1960s to the fall of 1978, corn was the top crop dollar earner for U.S. farmers. It also is and has been the major feed crop for the U.S. livestock, dairy, and poultry industries. Thus, the corn crop affects the cost structure of the entire food system more than any other single factor. The dynamics of the U.S. corn system are best understood through an analysis of all the domestic consumption and supply factors affecting the system as well as the international markets that currently (fall 1978) utilize 29 percent of the U.S. corn crop.

Trends in Consumption

The use of corn in the United States has grown consistently. Demand for corn as feed has increased steadily as domestic consumption of livestock and poultry has expanded. Export demand soared abruptly in the early 1970s when rising

incomes in developed countries encouraged greater consumption of meat, poultry, and dairy products, boosting international demand for feed ingredients. And the production of processed corn products, the third largest American use for corn, has for more than two decades expanded to meet growing industrial demand for corn as starch, oils, and sugar.

Feed. About 60 percent of the corn crop is used domestically as animal feed (see Table 4-1). As income levels have risen, American consumption of red meat and poultry has increased. For example, between 1955 and 1976 per-capita beef consumption increased 52 percent, pork consumption remained stable, and poultry consumption doubled.[1] Nearly all of the growth in poultry consumption was in the form of broiler meat produced in increasingly sophisticated hatching and growout complexes with feed mills and processing facilities. Similarly, growth in beef production became concentrated in confined feeding operations housing hundreds or thousands of animals and integrated with feed mills and, in some cases, slaughter facilities.

Consequently, the use of corn as a feed ingredient also increased: Table 4-1 records a 45 percent increase between 1950 and 1976. In the crop year 1974-1975, however, high prices induced by drought and heavy foreign demand forced U.S. livestock producers to cut back their production and use of feedgrains. Corn used for feeding purposes declined from 107 million tons in 1973-74 to 82 million tons in 1974-75. Half of this decline was due to the liquidation of large numbers of cattle and the substitution of roughage feed for cornfeed. Corn consumption recovered in 1975, 1976, and 1977 as cattle prices improved slightly and as corn supplies and stocks increased.

All types of cattle are the largest corn consumers in the United States. They accounted for just over 40 percent of the corn consumed as feed in 1975. Milk cows consumed about 15 percent and cows used for beef consumed the rest. In the United States producing a pound of beef requires about two pounds of corn and four pounds of feed ingredients, mostly roughage. In sharp contrast, swine consume between five and six pounds of corn for every pound of pork produced, and corn accounts for about two-thirds of their total feed intake. Hogs consumed about 35 percent of American feed corn in 1975, more than the corn used in producing either beef or dairy products.

Poultry—primarily broilers and layers—consume about 25 percent of the total feed corn, far less than cattle or hogs. Egg production accounts for slightly more corn consumption than broiler production. Broilers consumed about one-and-a-half pounds of corn for every liveweight pound of chicken products, while a pound of corn produces about 3.8 eggs. Corn composes somewhat less than half of the total feed fed broilers and layers.

Export. The second largest and most rapidly growing segment of demand for U.S. corn is the export market. Between 1950 and 1978, corn exports increased

Table 4-1. Supply and Use of Corn in the United States: 1950-1976 (in millions of metric tons)

Year Beginning October 1	Supply: Beginning Stocks	Supply: Production	Supply: Imports	Supply: Total	Use: Domestic Use: Food	Use: Domestic Use: Alcoholic Beverages	Use: Domestic Use: Seed	Use: Domestic Use: Feed	Use: Domestic Use: Total	Use: Exports	Use: Total Use	Ending Stocks, September 30: Government Owned[a]	Ending Stocks, September 30: Privately Owned[b]	Ending Stocks, September 30: Total
1950-51	21.4	70.2		91.7	4.8	1.8	0.3	63.0	69.9	3.0	72.9	10.1	8.7	18.8
1951-52	18.8	66.8		85.6	4.5	1.4	0.3	64.9	71.1	2.1	73.2	7.4	5.0	12.4
1952-53	12.4	75.7		88.1	4.7	1.2	0.3	58.7	64.9	3.7	68.6	6.0	13.5	19.5
1953-54	19.5	73.2		92.8	4.5	1.3	0.3	60.6	66.8	2.6	69.4	8.8	14.5	23.4
1954-55	23.4	68.8		92.2	4.8	1.2	0.3	57.0	63.3	2.6	65.9	15.8	10.5	26.3
1955-56	26.3	73.0		99.3	4.9	1.4	0.3	60.1	66.7	3.0	69.7	19.0	10.6	29.6
1956-57	29.6	78.1		107.7	4.9	1.5	0.3	60.4	67.0	4.7	71.7	22.2	13.9	36.0
1957-58	36.0	77.4		113.4	5.0	1.4	0.3	64.4	71.0	5.1	76.1	26.6	10.7	37.3
1958-59	37.3	85.2		122.6	5.4	1.7	0.3	70.7	78.0	5.8	83.9	28.4	10.3	38.7
1959-60	38.7	97.1		135.9	5.5	1.6	0.3	77.3	84.7	5.8	90.5	32.6	12.8	45.4
1960-61	45.4	99.2		144.7	5.6	1.6	0.3	78.5	86.0	7.4	93.4	33.4	17.8	51.2
1961-62	51.2	91.4		142.6	6.0	1.8	0.3	81.6	89.6	11.1	100.7	20.6	21.4	42.0
1962-63	42.0	91.6		133.6	6.3	1.6	0.3	80.2	88.4	10.6	98.9	14.4	20.3	34.7
1963-64	34.7	102.1		136.8	6.7	1.7	0.3	76.4	85.1	12.7	97.8	20.7	18.3	39.0
1964-65	39.0	88.5		127.6	6.9	1.7	0.3	75.1	84.0	14.5	98.4	13.2	15.9	29.1
1965-66	29.1	104.2		133.4	7.0	1.8	0.3	85.4	94.5	17.5	112.0	2.4	19.0	21.4
1966-67	21.4	103.9		127.3	7.0	1.9	0.3	84.7	93.9	12.4	106.3	3.5	17.5	21.0
1967-68	21.0	123.5		144.5	7.0	1.9	0.3	89.5	98.7	16.1	114.8	4.6	25.1	29.7
1968-69	29.7	113.0		142.7	6.9	1.9	0.3	91.6	100.7	13.6	114.3	7.4	21.0	28.4
1969-70	28.4	119.1		147.5	7.1	1.9	0.3	97.1	106.4	15.5	122.0	5.0	20.5	25.5
1970-71	25.5	105.5	0.1	131.1	7.6	1.8	0.4	91.3	101.0	13.1	114.2	2.5	14.5	16.9
1971-72	16.9	143.4		160.4	7.7	1.8	0.4	101.6	111.5	20.2	131.8	4.0	24.6	28.6
1972-73	28.6	141.7		170.4	8.6	1.9	0.4	109.5	120.5	31.9	152.4	0.1	17.9	18.0
1973-74	18.0	144.0		162.1	8.9	2.0	0.4	106.8	118.2	31.6	149.8	–	12.3	12.3
1974-75	12.3	119.4		131.8	9.3	1.7	6.5	81.9	93.4	29.2	122.6	–	9.2	9.2
1975-76[c]	9.2	148.1		157.3	10.1	1.8	0.5	91.2	103.7	43.5	147.2	–	10.1	10.1
1976-77[c]	10.1	159.2	0.1	169.4	10.7	1.9	0.5	91.1	104.1	42.8	146.9	–	22.5	22.5

Note: Independent rounding in each column has caused some data totals to appear to be in error. Quantities less than 1/20 of a unit are shown as blanks; zero quantities as dashes.

[a]Uncommitted inventory only

[b]Residual; total stocks–government-owned stocks.

[c]Preliminary.

Source: Compiled by the Commodity Economics Division (CED); Economics, Statistics and Cooperatives Service (ESCS); USDA–from sources in USDA and elsewhere.

steadily from 4 percent to 28 percent of total crop usage. From 1950 to 1978 corn exports increased from 2.6 million metric tons to 49.5 million metric tons. During this latter period the United States was the world's largest corn exporter, yet the government still maintained an inventory that averaged five million tons between 1966 and 1971.[2]

Before 1973, programs mounted under the Agricultural Trade and Development Act of 1954 were the primary stimulants to the export of American corn. Public Law 480, as the act is commonly called, was enacted originally to encourage the export of agricultural surpluses to needy countries without the hard currency to purchase food. Amendments enacted in 1966 gave expression to additional objectives and reduced the emphasis on concessional sales. Today, most transactions are made under long-term credit arrangements. Under Public Law 480, as Table 4-2 shows, over twenty-two million tons of corn were exported between 1955 and 1977. In 1956, exports under government-financed programs actually constituted more than 50 percent of total exports, but such exports declined as emphasis on commercial sales increased and as the government sought to reduce its grain stocks.

In 1972 the coincidental effects of two unrelated developments added to the increasing foreign demand for U.S. grain supplies. Between 1970 and 1973, the dollar declined in value relative to other currencies (see Table 4-3). And just as the dollar's fall reduced the cost of U.S. grain to foreign buyers, production declines in many parts of the world greatly increased demand for U.S. grain. The effect of these two events was dramatic. From 1971 to 1972, corn exports increased 54 percent (again, see Table 4-1). Exports slipped somewhat following the drought and high prices of 1974 but climbed sharply again in 1975-76 to forty-three million tons.

Exports in the year beginning 1 October 1977 were about 49.5 million tons. U.S. projections for 1985 are for coarse grain exports to reach sixty-two million metric tons with corn accounting for over 50 percent of the increase or over fifty million metric tons.[3] In 1977, increased world corn production moderated demand for U.S. corn, prices fell, and stocks began to accumulate once again.

Manufacturing. Wet and dry millers, distillers, and breakfast-food makers are the third major source of demand for the U.S. corn crop. With the exception of the corn-based sweetener segment of the wet-milling industry, corn processing industries are relatively mature. Consequently, growth in corn consumption for manufacturing has been slow, as Table 4-4 shows.

Wet processing has been the most rapidly growing manufacturing use of corn and it now accounts for about two-thirds of all corn used for manufacturing purposes in the United States. About 60 percent of wet-milled cornstarch is converted into corn syrups and corn sugars. Corn syrups account for two-thirds of this conversion, and corn sugar or dextrose accounts for the rest.[4] Table 4-5 reveals that these sugars are capturing a growing share of the caloric sweetener

Table 4-2. Government-Owned Corn Inventories, Exports Under Government-Financed Programs and Total Corn Exports: 1955-1977 (In thousands of metric tons, years beginning July 1)

	Government-Owned Inventory[a] *July 1*	*Total Exports Under Government Programs Year Beginning July 1*	*Total Exports Year Beginning July 1*
1955	14,751	414	3,317
1956	17,835	2,096	4,037
1957	20,404	1,940	5,084
1958	26,113	1,187	5,562
1959	26,511	1,046	5,928
1960	29,421	1,412	7,059
1961	32,031	1,252	10,421
1962	16,734	2,221	10,565
1963	12,501	977	12,063
1964	18,680	1,023	13,754
1965	12,268	783	17,593
1966	7,104	725	13,076
1967	3,582	887	14,847
1968	3,465	448	13,360
1969	6,860	263	16,025
1970	6,679	627	13,301
1971	2,341	450	17,065
1972	3,942	765	29,273
1973	2,063	869	35,439
1974	203	316	28,865
1975	5	52	40,039
1976	6	184	42,629
1977	10	2,556[b]	20,220[c]

[a]Committed as well as uncommitted stocks.
[b]New fiscal year (October-September).
[c]Six months.
Source: Compiled by the CED, ESCS, USDA—from sources in USDA and elsewhere.

market. Typical of the dilemmas and decisionmaking in this expanding area of the market is the case of CPC International, described in Appendix A to this chapter. Dry-corn millers, producing grits and corn meal used principally in baked goods, are a distant second in the volume of corn they process. Additional small quantities of corn are used in distilled spirits and breakfast foods, each of these uses consuming less than 1 percent of the total farm production of corn.

Increasing consumption of corn-based sweeteners has been stimulated by Clinton Corn Processing Company's license of a Japanese process for mass producing a new form of corn syrup called levulose, or high fructose corn syrup (HFCS). HFCS has about 85 percent of the sweetness of refined sugar, sells for approximately the same price as other corn-based products that are less sweet, and is usually cheaper than sugar. As HFCS was entering the market, prices for

Table 4-3. Import Unit Values for Corn in Domestic Currency Prices and Weighted Exchange Rates; 1969-1976, Japanese Yen and Dutch Guilders (years beginning October 1)

	Japan				*Netherlands*			
Year	*Dollars/Ton*	*Yen/Ton*	*Weighted Exchange Rate Per Dollar*	*Change from Previous Year (Percentage)*	*Dollars/Ton*	*Guilder/Ton*	*Weighted Exchange Rate Per Dollar*	*Change from Previous Year (Percentage)*
1969	64.48	23,194	359.7	–	62.60	226	3.610	–
1970	74.46	26,698	358.6	- .3	69.80	247	3.539	- 2.0
1971	63.63	19,899	312.6	-12.8	61.62	201	3.262	- 7.8
1972	81.35	22,438	275.8	-11.8	95.37	268	2.810	-13.9
1973	137.41	39,094	284.5	+ 3.2	126.73	356	2.809	- .1
1974	156.74	46,850	298.9	+ 5.1	144.22	363	2.507	-10.4
1975	133.35	39,790	298.4	- 0.2	127.63	341	2.671	+ 6.5
1976	124.78	35,073	281.1	- 5.8	117.44	293	2.495	- 6.6

Source: H. Christine Collins, "Price Changes and Price Spreads Between Farm and Foreign Markets for Wheat, Corn, and Soybeans–Evaluated from Unit Values," *Foreign Agricultural Trade of the United States*, October 1976, p. 26.

Table 4-4. Corn: Distribution for Food, Industrial, Beverage, and Seed Use (marketing year beginning October)

Item	*1968*	*1969*	*1970*	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*[b]	*1977*[c]
Shipments–(food, industrial and alcohol use)				*(in millions of bushels [grain equivalent])*						
Wet corn milling (grind)	207	216	242	246[a]	284	295	315	343	362	380
Dry milling										
Cornmeal (regular & degermed)	33	28	24	21[a]	20	19	18	18	17	17
Corn flour, etc.	4	6	8	10[a]	12	14	13	15	17	18
Hominy grits (food)	21	19	17	14[a]	13	13	10	11	10	10
Breakfast foods[d]	22	23	23	24[a]	24	25	24	24	25	25
Alcoholic beverages										
Distilled liquors	33	31	24	25	29	33	16	21	21	22
Fermented malt liquors	42	43	45	45	45	47	49	50	53	56
Total shipments	362	366	383	385	427	446	445	482	505	528
Seed	12	13	17	15	16	18	18	20	20	19
Trade–corn products				*(in thousands of bushels [grain equivalent])*						
Imports										
Meal	11	6	7	73	27	65	125	42	15	
Exports										
Meal (relief programs and commercial sales)	9,996	9,239	7,915	5,486	8,004	8,458	5,781	6,441	5,912	
Hominy grits	1,536	1,928	4,309	1,758	2,114	1,641	1,275	1,124	1,098	
Starch	1,915	1,522	1,385	1,394	1,896	2,676	3,229	2,011	2,396	
Sugar (dextrose)	1,180	1,085	1,015	1,571	2,310	2,383	2,346	2,145	1,713	
Syrup (glucose)	669	426	419	357	391	480	468	466	500	

[a]Numbers are largely based on the 1972 Census of Manufactures; intra-Census years are interpolations. See May 1976 issue of *Feed Situation* for earlier years.

[b]Preliminary.

[c]Forecast, January 1978.

[d]Assumes sizable quantities of corn flour are purchased by breakfast food manufacturers from the dry-milling industry.

Source: CED, ESCS, USDA.

Table 4-5. Caloric and Noncaloric Sweeteners: Per-Capita U.S. Consumption, 1961-1977 (in pounds)

	Refined Cane and Beet Sugar						*Corn Sweeteners*[a]				*Minor Caloric*[a]				*Noncaloric Sweeteners*[b]		
	U.S. Grown Sugar			*Cane Sugar*			*Corn Syrup*										
Year	*Beet Sugar*	*Cane Sugar*	*Total*	*Imported*	*Total*	*Total*	*High-fructose*	*Other*	*Dextrose*	*Total*	*Honey*	*Edible Syrups*	*Total*	*Total Caloric*	*Saccharin*	*Cyclamate*	*Total Noncaloric*
1961	26.1	28.7	54.8	43.0	71.7	97.8	–	8.6	3.4	12.0	1.1	.8	1.9	111.7	2.1	.4	2.5
1962	24.5	27.4	51.9	46.0	73.4	97.9	–	9.3	3.6	12.9	1.1	.9	2.0	112.8	2.5	.4	2.9
1963	27.2	28.2	55.4	41.9	70.1	97.3	–	9.9	4.3	14.2	1.1	.7	1.8	113.3	3.0	.7	3.7
1964	28.6	30.3	58.9	37.9	68.2	96.8	–	10.9	4.1	15.0	1.0	.7	1.7	113.5	3.5	1.3	4.8
1965	29.1	30.1	59.2	37.8	67.9	97.0	–	11.0	4.1	15.1	1.1	.7	1.8	113.9	4.0	1.7	5.7
1966	28.3	28.7	57.0	40.3	69.0	97.3	–	11.2	4.2	15.4	1.0	.7	1.7	114.4	4.5	1.9	6.4
1967	26.6	29.6	56.2	42.3	71.9	98.5	–	11.9	4.2	16.1	.9	.5	1.4	116.0	4.8	2.1	6.9
1968	27.8	26.8	54.6	44.6	71.4	99.2	–	12.6	4.3	16.9	.9	.7	1.6	117.7	5.0	2.2	7.2
1969	30.3	25.3	55.6	45.4	70.7	101.0	–	13.2	4.5	17.7	1.0	.6	1.6	120.3	5.3	1.6	6.9
1970	31.3	25.0	56.3	45.5	70.5	101.8	–	14.0	4.6	18.6	1.0	.5	1.5	121.9	6.2	(c)	6.2
1971	31.1	22.8	53.9	48.5	71.3	102.4	–	15.0	5.0	20.0	.9	.5	1.4	123.8	5.7	(c)	5.7
1972	30.4	25.4	55.8	47.0	72.4	102.8	0.9	15.6	4.4	20.9	1.0	.5	1.5	125.2	5.7	(c)	5.7
1973	30.4	24.9	55.3	46.2	71.1	101.5	1.4	16.7	4.8	22.9	.9	.5	1.4	125.8	5.7	(c)	5.7
1974	26.1	21.0	47.1	49.5	70.5	96.6	2.3	17.4	4.9	24.6	.8	.4	1.2	122.4	7.0	(c)	7.0
1975	30.5	24.9	55.4	34.8	59.7	90.2	4.7	17.7	5.1	27.5	.9	.4	1.3	119.0	7.0	(c)	7.0
1976	32.5	22.7	55.2	39.5	62.2	94.7	7.1	17.7	5.1	29.9	1.0	.4	1.4	126.0	8.0	(c)	8.0
1977[d]	30.3	23.3	53.6	42.1	65.4	95.7	9.0	17.7	5.1	31.8	.9	.4	1.3	128.8	9.0	(c)	9.0

[a]Dry basis. Recent corn sweetener consumption may be under stated due to incomplete data.
[b]Sugar sweetness equivalent–assumes saccharin is 300 times as sweet as sugar, and cyclamate is 30 times as sweet as sugar.
[c]Cyclamate food use was banned by the Food and Drug Administration, effective in 1970.
[d]Preliminary.

Source: CED, ESCS, USDA. *Sugar and Sweetener Report* September, 1978, page 31.

refined sugar were climbing rapidly and eventually peaked in 1974 at six times their historic levels. Corn-based sweeteners were therefore very competitive with sugar during 1974, but the 1976 decline of sugar prices to below-normal levels eliminated their temporary advantage. However, the Farm Act of 1977, which includes a support for beet and cane sugar, could restore the corn sweetener's competitive edge. As the technology of HFCS production develops further, the product will probably become increasingly competitive with sucrose, even at relatively low price levels.

Nevertheless, although HFCS is an interesting example of innovation and product substitution in agribusiness, it is unlikely to alter the U.S. corn system significantly. HFCS is actually much more important to sugarcane and sugar beet producers. In a statement prepared for the annual Agricultural Outlook Conference of the U.S. Department of Agriculture in November 1975, the president of Clinton Corn Products Company demonstrated that replacing all 1974 U.S. sugar imports (5.8 million short tons) with HFCS would require only 324 million bushels of corn--less than 6 percent of the 1976 corn crop.

Outlook. It appears that increases will probably continue in corn exports, corn feeding, and in consumption by the wet-milling industry. Although per-capita income in developed countries has not risen as fast as projected prior to the quadrupling of world energy prices in 1973 and 1974, foreign demand for U.S. corn supplies will continue to be strong. In the United States, similarly, slowly increasing real per-capita incomes are likely to stimulate continued growth in demand for livestock products and thus for livestock feed ingredients. Finally, continued development of corn sweetener technology will add a new increment to corn demand. In short, the trends in consumer income and preference that brought about a major increase in demand for corn in developed countries during the 1960s and early 1970s should continue. The substitution of feed wheat for feed corn and increasing cultivation of sorghum and tropical crops such as cassava will only moderate the growing demand.

A major uncertainty in assessing future demand for corn involves income and dietary trends in developing countries. To what extent will incomes increase and consumers seek greater amounts of animal protein in their diets? To what extent will such demand stimulate animal feeding industries and additional world demand for corn and feed grains? As we saw in Chapter 2, it appears likely that incomes will rise and that developing areas will increase significantly the international demand for corn. Barring development of unforeseen products or technology that would revolutionize animal-feed formulations or feeding technology, American corn will continue to provide an important share of the energy needs of the world's livestock and poultry.

Trends in Supply

As the largest user of crop land in the United States, the corn farmer is one of the focal points of the public food policymakers. The interplay between public

policy objectives and domestic and international supply responses is noted in the analysis below.

Production. Corn is harvested each fall in the "corn belt" states of Illinois, Indiana, Missouri, Iowa, and Ohio. Over the past twenty years, the area harvested for grain has averaged about 64 million acres (26.1 million hectares). Government acreage-control and price-support programs kept corn acreage fairly stable through the 1960s. Farmers participating in the government production-control programs for corn during the 1950s and 1960s were able to devote increasing acreage to soybeans, for which there was rapidly increasing demand and a ready market. Following the end of acreage controls and the escalation of corn prices well above support levels in 1973, corn farmers expanded their corn acreage to its currently high level of about 70 million acres. The 1977 Farm Act, setting aside 20 percent of acreage for wheat and 10 percent for feedgrains, now acts as the main determinant of corn acreage.

Constant application of new technology to cultivation and harvesting has provided the farmer with rewards and difficulties. With the aid of improving hybrid seed varieties, fertilizers, chemicals, machines, and two decades of relatively favorable climatic conditions, the U.S. corn producer's yield per acre has more than doubled since 1955 (Table 4-6). At the same time, however, harvesting equipment of increasing size and power has created inventory-management difficulties. With harvest periods of days instead of weeks and with a crop twice the size of twenty years ago, producers now face increased pressure for on-farm and off-farm storage and assembling facilities and strained transport facilities. Higher required investment in machinery and other inputs has also increased the farmer's financial vulnerability by raising his breakeven cost at a time when technology seems to be leveling off.

The size of U.S. corn farms has been increasing. One reason is that the technical aspects of corn production have made it increasingly capital-intensive, and farmers need larger production units over which to distribute their increased fixed costs. Until the dramatic price increases of 1973, this pressure on cost-price differentials impelled producers to expand their operations to maintain their incomes. In the subsequent environment of higher corn prices and wider margins, farmers have chosen to invest much of their additional income back into land. Consequently, farm size continues to grow and agricultural land values appreciate dramatically. The cost of production of corn growing has increased from $117 per acre in 1974 to $146 per acre in 1977. Therefore any unusual price drop or yield decline places the corn farmer in a precarious position, especially with the average value of corn land in 1977 at $1285 per acre.[5]

Factors Influencing Production. Steadily rising costs combined with relatively stable government-supported farm prices to cause a profit squeeze on corn farmers during the 1960s. Farm wages and real estate costs both increased at rates in excess of 5 percent per year, while machinery costs increased about 3.5

Table 4-6. Corn Acreage, Yields and Production United States: 1955-1977

Year	Acreage Withheld from Production	Acreage (millions) Planted for All Purposes	Harvested For Grain	Harvested For Silage	For Hogging Down, Grazing and Forage	Yield Bushels per Acre (Harvested for Grain)	Production Million Bushels
1955	–	80.9	68.5	7.0	3.9	42.0	2,873
1956	–	77.8	64.9	6.5	3.8	47.4	3,075
1957	–	73.2	63.1	6.1	2.7	48.3	3,045
1958	–	73.4	63.5	6.3	2.4	52.8	3,356
1959	–	82.7	72.1	7.0	2.8	53.1	3,825
1960	–	81.4	71.4	7.2	2.1	54.7	3,907
1961	19.1	65.9	57.6	6.3	1.5	62.4	3,598
1962	20.3	65.0	55.7	7.2	1.5	64.7	3,606
1963	17.2	68.8	59.2	7.7	1.4	67.9	4,019
1964	22.2	65.8	55.4	8.6	1.4	62.9	3,484
1965	24.0	65.2	55.4	8.1	1.2	74.1	4,103
1966	23.7	66.3	57.0	7.9	.9	73.1	4,168
1967	16.2	71.2	60.7	8.4	1.0	80.1	4,860
1968	25.4	65.1	56.0	7.9	.7	79.5	4,450
1969	27.2	64.3	54.6	7.9	.6	85.9	4,687
1970	26.1	66.9	57.4	8.1	.6	72.4	4,152
1971	14.1	74.2	64.1	8.8	.7	88.1	5,646
1972	24.4	67.1	57.5	8.4	.5	97.0	5,580
1973	6.0	72.3	62.1	9.0	.6	91.3	5,671
1974	–	77.9	65.4	10.8	.6	71.9	4,701
1975	–	78.6	67.5	9.8	.6	86.3	5,829
1976	–	84.4	71.3	11.3	.9	87.9	6,266
1977[a]	–	82.7	70.0	9.3	.9	90.8	6,357

[a]Preliminary.

2.47 acres = 1 hectare.

Sources: USDA, *Agricultural Statistics, 1976* and earlier years. *Crop Production*, 12 September 1977. Updated by CED, ESCS–from departmental sources.

percent annually. Only fertilizer prices, reflecting overcapacity in the agricultural-chemical industry, failed to rise over this period, but producers seeking to offset rising costs through greater productivity increased their use of fertilizers sharply. Table 4-6 shows that productivity per acre increased by 33 percent over the decade.

In the early 1970s the cost-price spread improved dramatically in favor of corn farmers. From 1971 to 1973 the seasonal average price per bushel increased 136 percent from $1.08 to $2.55. In this same period, the index of prices paid by farmers increased less than 30 percent. Profitable operation was therefore generally possible in 1974 despite a drought and in 1975, 1976, and 1977, despite a decline in corn prices to about $2.54 per bushel in 1975, $2.15 in 1976, and between $2.00 and $2.10 in 1977.

Costs are rapidly catching up with recent increases in commodity prices, however, as Tables 4-7 and 4-8 prove. It appears that the huge increase in the profitability of corn production in the early 1970s has substantially eroded. For this reason farmers and their political allies pressed for an improved target price and subsidy system based on the 1973 program and for increases in current loan rate

Table 4-7. Summary of U.S. Average Corn Production Costs Per Planted Acre and Per Unit: 1975-1978 (in U.S. dollars)

	1975 Final	*1976 Final*	*1977 Preliminary*	*1978 Projected*
Per Planted Acre				
Variable	91.21	93.49	95.83	99.00
Machinery Ownership	22.77	26.17	28.16	31.54
Overhead	8.39	9.04	9.57	10.02
Management	14.76	12.41	11.97	12.24
Total	137.13	141.11	145.53	152.80
Land				
Current	75.72	73.56	81.56	88.67
Acquisition	54.20	46.58	47.43	49.56
Per Bushel				
Variable	1.06	1.07	1.06	1.08
Machinery Ownership	.27	.30	.31	.34
Overhead	.10	.11	.11	.11
Management	.17	.14	.12	.13
Total	1.60	1.62	1.60	1.66
Land				
Current	.88	.84	.90	.96
Acquisition	.63	.53	.52	.54
Yield Per Acre	85.7	87.1	90.7	92.0

Source: ERS, USDA, *Costs of Producing Selected Crops in the United States 1976, 1977, and Projections for 1978*, prepared for the Committee on Agriculture and Forestry, U.S. Senate.

Table 4-8. Corn: Value of Production, Cost of Production, Return to Land, and Debt Load Supportable by Land Earnings per Acre if Earnings in the Year Specified are Expected to Continue for 25 Years: 1974-1977[a] (in dollars per acre)

Year	*1974*	*1975*	*1976*	*1977*
Value of Production	216	218	207	183
Cost	117	132	143	146
Net to Land	99	86	64	37
Debt Load Supportable by Land Earnings	973	789	625	358

[a]Assumes a 25-year mortgage at 9% interest amortized over the loan period.
Source: USDA, Economics, Statistics and Cooperative Service (ESCS-33), August 1978.

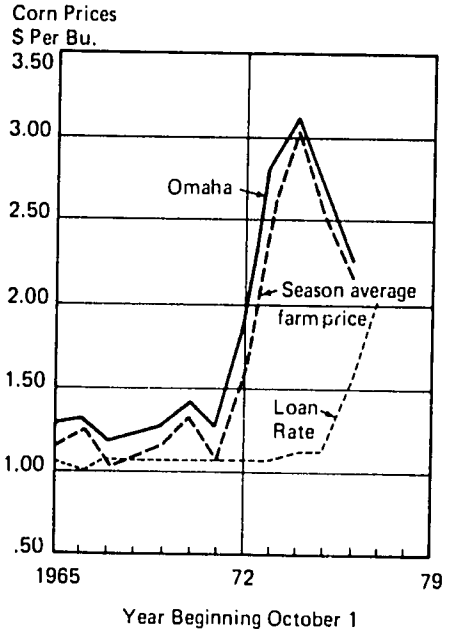
levels under which farmers can use their crops as collateral for nonrecourse loans. The 1977 Farm Act is the result of these concerns. The act, as the Secretary of Agriculture noted, "will maintain a workable and profitable export stance for agriculture while cushioning farmers and consumers alike against wild swings in prices and supplies."[6]

Land that will produce corn will also produce other crops, and in many regions of the country soybeans, in particular, compete with corn for acreage. In making their annual production plans, farmers must consider the outlook for returns from each crop. Other considerations aside, the advantage is considered to shift from soybeans to corn when the expected ratio of soybean to corn prices falls below two, a ratio which varies from region to region. Such forecasts by farmers were influential in altering planted acreage patterns from 1975 to 1976. Corn acreage rose from 77.9 to 84.1 million acres, and soybeans declined from 54.6 million to 49 million acres.[7]

Outlook for Production. The projected growth of worldwide animal protein consumption, the comparative advantage of the United States in corn production, and the lack of new substitute feed ingredients on a large scale in the foreseeable future imply continued growth in demand for American corn. At the same time, yield improvements are likely to continue steadily, although many are concerned that technology may be leveling off even if there are no significant changes in climatic patterns. The set-aside government programs to restrict production in 1977-78 and again in 1978 and 1979 will lead to a temporary slowdown in U.S. corn production, but long-term global demands will eventually result in continued expansion.

Trends in Prices

Following World War II the United States offered high price supports on basic crops such as corn to maintain producer and rural incomes and to encourage the



Year[a]	*Support or Target Price*	*Seasonal Average Price Received by Farmers*	*Average Support Payment to Participants*[b]	*Seasonal Average Price Plus Payment*	*National Average Loan Rate*[c]
1961	0	1.10	0	1.10	1.20
1962	0	1.12	0	1.12	1.20
1963	1.25	1.11	.15	1.26	1.07
1964	1.25	1.17	.15	1.32	1.10
1965	1.25	1.16	.17	1.33	1.05
1966	1.30	1.24	.25	1.49	1.00
1967	1.30	1.03	.20	1.23	1.05
1968	1.35	1.08	.24	1.32	1.05
1969	1.35	1.16	.24	1.39	1.05
1970	1.35	1.33	.28	1.61	1.05
1971	1.35	1.08	.19	1.27	1.05
1972	1.41	1.57	0	1.57	1.05
1973	1.64	2.55	0	2.55	1.05
1974	1.38	3.03	0	3.03	1.10
1975	1.38	2.54	0	2.54	1.10
1976	1.57	2.15	0	2.15	1.50
1977[d]	2.00	2.00–2.10	0	2.00–2.10	2.00

[a]Crop year beginning October 1.

[b]Computed on the basis of total price support payments and the estimated production on participants' farms.

[c]Available to producers participating in the feedgrain program

[d]Preliminary.

Source: ERS, USDA. Updated by the CED, ESCS, from departmental sources.

Figure 6-1. Corn Prices

development of a modern agricultural sector. These price supports were generally above world and domestic market prices. When overproduction resulted, the government entered the market as a buyer to maintain the price-support level. Eventually, the government came to own large surplus corn stocks (Table 4-2), which kept domestic prices close to the price-support level.

Figure 4-1 shows the relation between corn prices and support rates between 1961 and 1977. Note that the "price received" by farmers hovered close to the loan rate from 1961 through 1971, except for 1966 and 1970. The former, a year of considerable uncertainty about the adequacy of world food supplies, saw considerable buying in international markets, though not on the scale of 1973-74. The U.S. corn crop was attacked by southern corn leaf blight in 1970, about 15 percent of that year's crop was lost, and anxiety caused another temporary rise in U.S. corn prices.

Price-support and storage programs provided a foundation of relatively low domestic grain prices, on which American agribusiness was able to build. Domestic surpluses of wheat, corn, soybeans, and other commodities also kept prices relatively stable in both the domestic and international markets. The stocks were a reliable supply of cheap feed for the poultry and livestock industries, inducing stability in a major segment of their cost structure as well. Thus, price-support and storage programs were important to the commercial supplier, the grain and livestock farmer, the grain processor, the exporter, and ultimately to the consumer.

In the later 1960s Democrats and Republicans sought to move American food policy away from high price supports and towards a market economy. Their intentions were to reduce the costs of price-support and surplus storage programs and to become more competitive in world markets. This change in policy produced dramatic consequences when poor world crops in 1971-72, rising incomes, and increased population swelled foreign commercial demand and liquidated U.S. inventories of corn and other grains in 1973 and 1974. With U.S. grain reserves essentially nonexistent, a 3 percent decline in world grain production resulted in the 250 percent change in American corn prices that Figure 4-1 records. Table 4-9 shows the prices of products in which corn is an important ingredient and suggests the impact that corn prices have on many aspects of the total U.S. food system.

Trends in Logistics

The logistical management of corn and other grains has become increasingly challenging in the last two decades. Annual American grain production doubled between 1955 and 1975, but grain sold from farms tripled. In 1962, 57.5 percent of annual grain production was sold from the farm; in 1974, 72 percent was so marketed. The figures are somewhat lower for corn because farmers hold a larger percentage of that crop for hog and cattle feeding. But in 1962, 43 percent of corn was sold from the farm, and by 1974 the figure was 63 percent.

Table 4-9. Annual Average Wholesale Prices for Corn and Its Products: 1959-1976

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Seasonal Average Farm Price (per bushel)[a]	$ 1.05	1.00	1.10	1.12	1.11	1.17	1.16	1.24	1.03	1.08	1.16	1.33	1.08	1.57	2.55	3.03	2.54	2.15
Chicago Price (#3 yellow, per bushel)[b]	1.17	1.10	1.11	1.19	1.20	1.26	1.27	1.36	1.12	1.17	1.15	1.44	1.18	1.82	2.86	3.23	2.69	g
Gluten Feed[c] (per ton)	37.65	38.30	37.50	43.20	40.70	43.00	47.40	50.10	44.90	43.70	47.80	49.50	47.10	75.20	90.20	88.20	93.80	107.35
Hominy Feed[c] (per ton)	39.45	38.55	40.10	42.70	44.00	44.60	44.20	46.00	39.00	41.10	43.20	45.70	39.20	60.90	93.50	90.60	85.40	74.30
Corn Oil, Crude[d] (per pound)	0.118	0.131	0.183	0.146	0.121	0.111	0.140	0.161	0.124	0.152	0.140	0.165	0.198	0.164	0.226	0.407	0.323	0.258
Corn Oil, Refined[e] (per pound)	NA	NA	NA	0.182	0.153	0.137	0.168	0.192	0.154	0.185	0.172	0.197	0.229	0.193	0.261	0.447	0.367	0.309
Hybrid Seed[f] (per bushel)	11.10	11.30	11.50	11.70	11.70	12.00	12.20	12.30	12.90	13.90	13.70	15.70	18.80	21.50	22.20	25.00	36.50	36.50

[a]Market year (October-September) average-weighted by carlot sales.
[b]Market year (October-September) simple average.
[c]Chicago basis. Market Year (October-September) simple average.
[d]Tank cars, f.o.b. Midwest mills, Calender year (January-December) simple average.
[e]Tank cars, New York.
[f]Retail price. 1959-67, February-May average; 1968-76, 7-day average (April 15).
[g]Discontinued.
NA = Not Available.
Source: *Agricultural Statistics, 1977* and earlier years.

These increases are the result of three structural changes in the U.S. grain system:

1. increasing specialization among farm operators, including the separation of grain production from livestock farming
2. large increases in grain exports
3. a large increase in soybean production, almost all of which is sold off-farm.

As grain production has increased each year, as the period of harvest has been shortened by higher capacity farm machinery, and as more grain is sold off-farm, storage and transportation capacity has had to be increased.

A significant portion of grain is stored on-farm before it is delivered into the distribution system. In the 1970s, as farm production increased and grain prices became more volatile, farmers tended to delay their marketing and hold more production on-farm until they felt the market price was to their advantage. Industry sources estimate that on-farm storage capacity totaled ten billion bushels (about 250 million tons) in 1977: six billion for corn and two billion each for wheat and soybeans. Table 4-10 shows on-farm grain stocks as of January 1 for the last fourteen years.

The 10 billion bushel on-farm capacity is augmented by an additional 7 billion bushels (about 175 million tons) of off-farm commercial storage capacity of which 1.6 billion bushels is in terminal capacity and an additional 400 million bushels is in port storage. Country and subterminal elevators account for the residual 5 billion bushels. (An accurate breakdown between these two types of

Table 4-10. Stocks of Major Grains on U.S. Farms—1964-1977 As of January 1 (in thousands of bushels)

	Corn	*Wheat*	*Soybeans*	*Total Three Grains*	*As Percent of Year's Production of Three Grains*
1964	3,209,566	310,200	260,422	3,780,188	69
1965	2,737,489	389,672	190,728	3,317,889	53
1966	3,096,601	405,337	284,312	3,786,250	59
1967	2,928,817	406,879	344,394	3,680,090	50
1968	3,453,956	505,227	350,816	4,309,999	61
1969	3,310,694	576,932	410,168	4,297,794	59
1970	3,390,099	609,443	372,069	4,371,611	66
1971	2,755,306	526,092	391,960	3,673,358	44
1972	3,555,260	64,549	397,631	4,017,440	48
1973	3,692,724	510,202	428,798	4,631,724	52
1974	3,371,270	364,382	607,233	4,342,885	56
1975	2,560,883	446,289	484,978	3,492,150	37
1976	3,196,266	547,623	590,466	4,334,355	45
1977	3,345,496	665,407	473,120	4,484,023	44

Source: Compiled by the CED, ESCS, USDA—from departmental sources.

facility is not available because a standard definition of a subterminal has not ye evolved.) We know that storage capacity has increased throughout the syster because, although production has increased substantially, the percentage of th crop held on farms has not.

When it is sold, most grain is delivered to a country elevator close to the farm The available capacity in country elevators increased throughout the 1950s an early 1960s for two reasons. First, faster harvesting caused higher peak stock and required increased short-term storage. Second, much of the grain productio of the 1950s and 1960s became part of an ever-growing surplus stock that ha to be properly housed. During this period the government offered incentives t firms willing to build and employ grain storage facilities. Since 1963, the numbe of country elevators has declined because grain now tends to take a more direc route to its final market, sometimes bypassing interior elevators. But despit this trend, the bulk of all grain still moves to a country elevator or country sub terminals.

Subterminal elevators are larger than country elevators and are located at key transportation points en route to terminal markets. At one point, the USDA tried to differentiate subterminals from country elevators by requiring that any facility designated as a subterminal receive more than half its grain from country elevators. But specialized truck trailers have lowered transportation costs from the farm and allowed subterminals to compete with country elevators in the direct procurement of grain. Subterminals are actually distinguished from country elevators by their method of transporting grain closer to ultimate markets. Strategically positioned subterminals make profitable use of specialized trains. Their size, location, and handling capacity allow them to accumulate sufficient quantities of grain to load trains pulling 65 to 100 specially designed hopper cars. This capability dramatically reduces car switching and results in greater throughput. The railroad (or other owner) enjoys more efficient use of its equipment, which can lower costs. The freight rate advantages are also substantial.

Terminal elevators, located close to the primary markets, assemble grain from the producing areas for redistribution to processors and exporters. The importance of commercial terminal elevators has declined somewhat as larger processors have built their own facilities or arranged for more direct procurement. Terminal elevators located at ports, on the other hand, have grown rapidly in importance in the last few years of heavy exports. Port elevator owners have concentrated not on their storage capacity but on improving the unloading speed from trains and barges, and they have substantially increased their ability to load larger vessels with deeper drafts. Storage capacity takes a substantial amount of time to increase, not only because of the basic construction time, but also because of the time necessary to deal with local authorities.

The flow of corn from the surplus Midwest to deficit areas and ports of export is affected by geography, freight rates and rate zones, the availability of equipment, and changes in transportation technology. Weather also plays a role.

In the winter, when the St. Lawrence Seaway and many river routes are not usable, the flow of corn can become restricted to rail and road transport. The Interstate Commerce Commission controls all rail rates, which it establishes for various defined territories, but negotiations of interterritorial rates can be difficult. The routing and exchange of rail cars among railroads can also speed or impede the flow of corn among rate zones and territories.

Changes in freight rates and zones have affected the fortunes of corn-system participants. Alterations of railroad "milling-in-transit" rates in the 1960s, which permitted more rail competition with truck and barge shipments of grain, placed firms that had located their mills based on the previous rates at a disadvantage. Formerly, the milling-in-transit rail customer was charged the same freight rate as any of his competitors located in production or consumption areas, because he was allowed to process his grain while it was enroute. When truck and water carriers began to provide cheaper forms of transport at certain shipping and distribution points, several railroads also reduced rates at these points for all but their milling-in-transit customers, whose only major transportation option was rail. These "captive customers" found themselves in a poor bargaining position and at a disadvantage with competitors who could take advantage of alternative modes of transportation. By the early 1970s, milling-in-transit rates--and the numerous feed and grain mills that had depended upon them--had ceased to exist.

Partly as a result of freight rate changes, many feed-milling firms have also had to decentralize and relocate their production facilities. Other developments have encouraged locational changes in the feed-milling industry. These include decentralization from large continuous-mixing mills to regional and satellite batch-mixing plants, the development of bulk delivery capability, the entry of grain marketing firms into feed manufacture, and development of large broiler and layer operations in grain-deficit regions.

As pressure to move larger volumes of grain has increased, railroads and barge lines have enlarged the size of individual units as well as the size of their fleets. For instance, large covered hopper cars were introduced in the mid-1960s to replace traditional boxcars. The typical covered hopper carries 60 tons of corn, compared with the boxcar's 35-ton capacity. Hopper cars are more efficient in loading and unloading as well: it takes about 800 of these cars to load a 50,000-ton ship, as contrasted to more than 1,400 boxcars. Furthermore, the 800 hopper cars can be unloaded in about two days while the boxcars would require almost two weeks. Since 1969, when railroads began keeping track of graincar loadings, large hoppers have come to dominate the graincar fleet (see Table 4-11). Note that although the total number of cars has only increased 3.5 percent, the total transport capacity has increased by over 20 percent. Even with this increase in capacity there is a boxcar shortage that has led to the development of privately owned transport fleets of rail cars and trucks, some as divisions of major grain firms.

The growth in grain exports has caused ocean freight rates to exert increasing

Table 4-11. The U.S. Grain Car Fleet: 1969-1975 (As of January 1 each year)

Year	*Boxcars*[a]	*Covered Hoppers*	*Total Grain Cars*	*Total Capacity in Bu.*
1969	202,402	152,771	355,173	863,117,000
1970	180,547	160,319	340,866	842,051,000
1971	207,257	169,926	377,183	924,292,000
1972	189,506	179,144	368,650	925,444,000
1973	172,508	186,219	358,727	903,673,000
1974	163,895	204,926	368,821	1,024,538,000
1975	148,119	219,362	367,481	1,042,068,000
7-Year Change	-27%	+44%	+3.5%	+20.7%

[a]40 foot narrow-door boxcars. 1971 increase due to reclassification of boxcars with 8-foot doors from wide to narrow door.

Source: Stephen Ailes, "Freight Car Utilization in the Shipment of Grain," *Corn Annual*, 1975, p. 8.

influence over domestic grain movements. Ocean freight costs make up between one- and two-thirds of total transport costs from U.S. farms to foreign ports. Table 3-10 in the preceding chapter, for instance, showed that in the 1970s it has usually been more costly to move grain from U.S. farms to U.S. gulf ports than it has been to move it from those ports to Japan. Changes in ocean freight rates at different U.S. ports to a common destination can affect the direction grain follows from inland elevators to port areas. Lowering freight rates from West Coast ports to Japan, below those from Gulf ports to Japan, for example, can result in significant flow of grain from the Midwest to West Coast ports.

Just as the technology of inland transport has evolved so has that of ocean transport. Vessels capable of carrying over 50,000 tons of corn are increasingly common. Where harbor depths and port facilities permit it, ships of this size offer significant economies as indicated in Table 4-12.

Their use has led to large storage, processing, and distribution complexes in the United States, Europe, and Japan. Such facilities encourage increased integration of grain markets throughout the world.

Table 4-12. Comparison of Operating Costs for Various Types and Sizes of Ships

Ship Type	*All Purpose Cargo*			*Bulk Carrier*		
Tonnage	2,500	4,500	6,500	15,000	30,000	50,000
Cost per ton mile	$.7138	.6542	.6213	.0701	.0585	.0515

Source: Arthur D. Little, Inc., *Southeast Asian Regional Transport Survey*, Book One, Asian Development Bank, 1972, quoted in A.J. Nyberg, "Outlook for the Indonesian Maize Industry" in SEARCA, *Proceedings of the Indonesian Corn Commodity System First National Agribusiness Seminar Workshop*, 20-30 December 1975, p. 71.

Government Programs

Regardless of their ideological outlook, private participants in the U.S. corn system realize that their decisions must have some reference to the likely course of government policy. At the same time, agricultural and other policymakers are aware that the positions and constraints of private participants must be weighed when considering new or altered policies.

With the 1977 Farm Act, the U.S. government has returned to subsidies, price supports, surplus storage, and a set-aside acreage-control program. Many other government programs affect grading standards, the food and drug provisions of antitrust laws, food stamp usage, and corn export agreements with other nations. Special-purpose agencies enforce a variety of regulations. The Commodity Futures Trading Commission is informed of each firm's position in the futures markets. Other government agencies track export shipments, storage levels at different positions in the system, and the quantity and quality of export shipments.

From 1971 to 1974, wage and price controls affected all parts of the corn system. Even though cash and futures prices of primary agricultural commodities were not controlled, controls on product and by-product prices beyond the primary commodity stage affected the decisionmaking process throughout the corn system. This situation was particularly acute during the control program's second price-control period from 13 June 1973 to 18 July 1973. During this time, price controls were extended to futures contracts for all but raw agricultural products. Thus, for example, corn contracts were not controlled, but pork bellies (a processed commodity) were. The freeze on cash and futures prices of commodities beyond the raw-product stage distorted price spreads and rendered useless one of the most sensitive and subtle signals sent by futures markets.[8] Participants in the corn system who used price spreads between commodities, products, by-products, and time periods found themselves without their most reliable indicator of relative prices by which to make decisions regarding procurement, plant operating rates, inventory levels, and similar operating judgments. Further since the control period was to last only sixty days, futures prices for deferred months escalated rapidly while those in nearby months remained stable. Businessmen using spreads and straddles in their procurement and pricing progams took heavy losses during this time.

Price controls were placed only on the wholesaling, manufacturing, and retailing segments of the food system under the assumption that excess capacity existed at the farm level. Overcapacity had, in fact, been the case up to 1973, but the worldwide grain shortage of 1972 and the selloff of U.S. reserves had eliminated that excess capacity. Increasing demand and prices at the farm level were occurring just as the freeze was imposed. Livestock producers and corn processors were squeezed between rapidly rising input ingredient costs and fixed wholesale and retail prices for their output.

The lesson learned from the experience of 1971-74, and especially from the 1973 price-control period, is that food price controls covering only a part of a

commodity system will not be effective. Controls on wholesaling, manufacturing, and retailing without corresponding regulations for primary producers and exporters cannot fail to cause distortion, artificial shortage, and further price increases.

> In general wage and price controls applied across the U.S. economy in the effort to constrain inflation are a limited and special purpose tool in peace time. Any resort to direct controls must involve the participation of representatives of a broad spectrum of industry and agriculture for prices, and labor and management representatives for wage and benefit controls if they are to be effective. The consent of the controlled is essential if wage and price regulations are to persist for a considerable period and to reflect the least amount of distortions and post-controls dislocations.[9]

STRUCTURE OF THE U.S. CORN SYSTEM

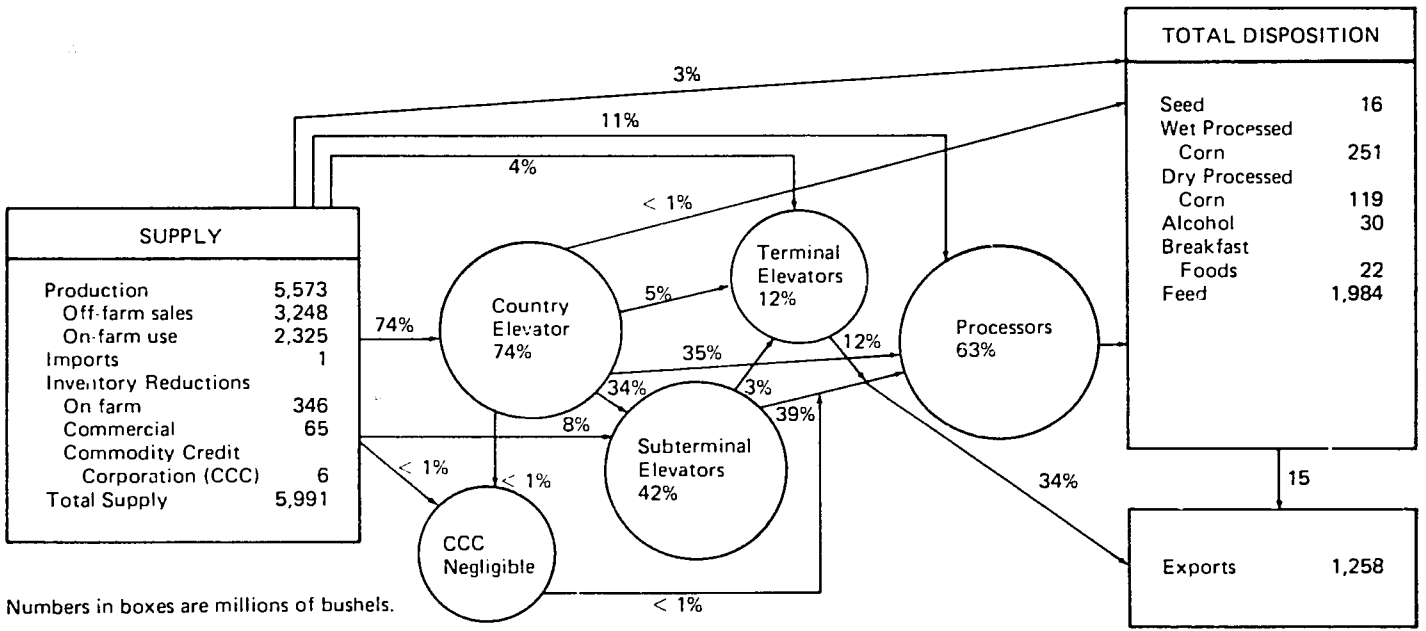
During the rapid expansion of the U.S. corn system, a structural and technological revolution also occurred and affected various channels of distribution. This is described below.

Channels

Some 58 percent of total U.S. farm production moves into the various marketing channels depicted in Figure 4-2. This chart indicates that the primary purchasers of the farmers' crop are country elevator operators, who bought about 74 percent of farm corn production in 1972-73. These elevator operators act as buying agents for feed millers, corn refiners, and other corn processors, who tend to build their plants close to areas that have a large supply of corn and other grains. Processors buy directly from country elevators and subterminals rather than from terminal elevators. Shorter harvest seasons, improved highway facilities, and increased corn production on larger farms continue to stimulate the construction of larger elevators and country subterminals to handle farm sales. Likewise, construction of larger corn and feed mills has forced country elevators to expand in order to serve their customers' needs.

Figure 4-2 indicates that terminal elevators are bypassed by much of the corn flowing from producers to processors and exporters. The figure for terminals (12 percent) is understated, however, since it does not reflect the volume handled by export terminal facilities. In fact, terminal elevators handled not only 3.7 million tons directly from farmers, 4.7 million tons from country elevators, and 2.8 million tons from country subterminals, but also 31.2 million tons for export. Growing export demand will bring increased corn flow through export terminals in the future.

The Commodity Credit Corporation, the government's instrument for implementing price-support and storage programs, is of minor importance in the flow



Source: Estimates based on available USDA figures.

Figure 4-2. U.S. Corn Marketing Channels: 1972–1973

of corn from producer to consumer. This situation was not the case in the 1960s, as Table 4-2 evidences, and it may not be the case in the future if U.S. production exceeds aggregate domestic and foreign demand. Some agency will have to maintain stability in such a situation and it will likely be the Commodity Credit Corporation.

Over the years, major changes in the marketing channels of corn have occurred as a result of:

1. technological developments in harvesting and farm storage, which encouraged developments of subterminal markets essentially nonexistent in the 1940s and early 1950s
2. growth in the livestock and poultry industries
3. more recent growth in foreign demand for U.S. corn
4. changing government policies and programs regarding price support, surplus storage, and export promotion.

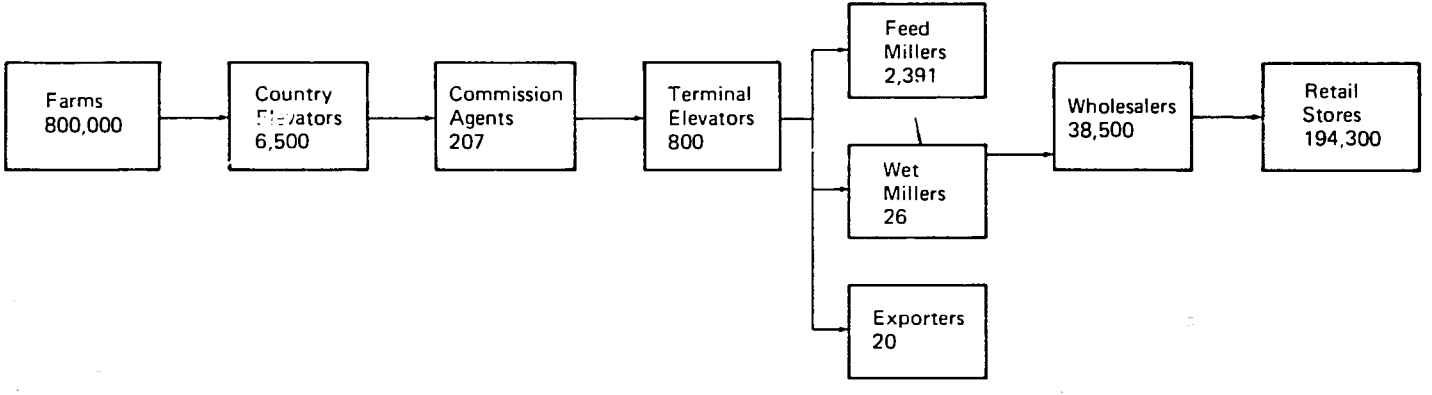
Further changes in each of these areas will continue to affect corn marketing channels.

Firms and Entities

The 50 percent increase in corn production and use since 1960 and changes in government policy have also resulted in changes in the number, size, and type of enterprises making up the U.S. corn system. The corn economy in crop year 1972, as described in Figure 4-3 consisted of 800,000 farmers raising corn for grain; 6,500 country elevators; 207 commission and brokerage firms; 2,391 mixed feed manufacturers; 38,500 wholesalers; 194,300 retail stores; and twenty export firms, with most export volume being handled by six companies.

Decisionmaking in the major segments of the U.S. corn system appears relatively unconcentrated, except perhaps in the wet-milling and export segments and both of these have new entrants and increased competition. Table 4-13 and 4-14 summarize changes in the number of firms, dollar value of shipments, and share of dollar value shipments by larger firms between census years 1958 and 1972 for major sectors in the corn economy and for 1974 in the Agricultural Census. It shows that as corn acreage was declining by 13 percent and the number of corn farmers was decreasing by 62 percent, corn production was increasing by 66 percent and crop value by 279 percent. A more detailed analysis of the farm sector would show that an increase in the number of corn farms occurred in the larger farm categories. Nonetheless, the producing sector can hardly be said to be concentrated.

Although census data tend to indicate that the feed-milling industry may have concentrated slightly during this period, other information suggests the contrary. In a 1969 survey, the USDA found 7,917 establishments manufacturing 1,000 tons or more of formula feed per year, many more than the 2,300-odd estab-



Source: ESCS, USDA and Bureau of the Census.

Figure 4-3. Firms and Entities in the Corn Economy: Crop Year 1972

Table 4-13. Number of Firms, Dollar Volume of Shipments, and Percentage of Dollar Shipments by Largest Companies in Major Sectors of the Corn System

				Farms[a]						
				Number of Corn Farms						
Year	*Number*	*Value of Crop*	*Acres Harvested (millions)*	*1-24 Acres*	*25-74 Acres*	*75-99 Acres*	*100-499 Acres*	*500-749 Acres*	*750-999 Acres*	*Over 1,000 Acres*
1959	1,989,622	3,871MM	70.1							
1964	1,006,649	3,756MM[b]	53.8							
1969[b]	795,646	4,927MM	50.7	277,808	295,039	66,231	152,792	2,712	586	478
1974[b]	765,193	14,667MM	60.7	- - - - - - - - - - - - - not reported in 1974 census - - - - - - - - - - - - -						

				Companies[c]					
				Percentage of Value of Shipments by Largest Firms					
Year	*Establish-Ments*	*Value of Shipments*	*Number of Firms*	*4 Largest*	*8 Largest*	*20 Largest*	*50 Largest*	*Coverage Index*	*Value Added By Manufacture*
				Prepared Animal Feeds					
1958	2,379	3,238.4	2,016	11	30	43	56	.91	798.9
1967	2,355	4,796.9	1,835	23	31	42	58	.94	1,226.8
1972	2,341	6,439.0	1,726	NA	NA	NA	NA	.94	1,714.3
1975[d]	6,340								
				Wet Corn Milling					
1958	59	751.3	53	73	92	99	99+	.96	249.4
1967	45	528.5	32	68	89	99+	100	.96	353.6
1972	41	832.3	26	NA	NA	NA	NA	.97	331.2

[a]Farms producing field corn for grain. Source: Based on Bureau of the Census, *1974 Census of Agriculture*, Vol. 1, Part 1, Chapter 1. *1969 Census of Agriculture*, Vol. II, Chapter 6. 1959 figures: *1959 Census of Agriculture*, Vol. II, Chapter 7.

[b]Farms with sales in excess of $2,500 producing field corn for grain.

[c]Source: 1958 Bureau of the Census, *1967 Census of Manufacturers*, 1967, Vol. II, Part I, except concentration ratios, Volume I. 1972: *1972 Census of Manufacturers*, Industry Series, Grain Mill Products.

[d]*The Structure of the Feed Manufacturing Industry, 1975*. USDA, ESCS, Statistical Bulletin #576, Feburary 1978, page iii.

Table 4-14. Number of Firms or Entities Operating as Country Elevators, Terminal Elevators, Exporters, Wholesalers, and Retailers in the Corn Economy: 1948, 1958, 1967, and 1972

	1948	*1958*	*1967*	*1972*
Country Elevators	11,200	8,549	6,477	6,500
Commission Firms	300	200	NA	NA
Terminal Elevators	350	690[a]	767[a]	800
Exporters	15	20	20	20
Wholesalers	39,329	42,555	40,055	38,500
Retailers	378,320	259,796	218,130	194,346

[a]Includes country subterminals.

Sources: 1948: R.A. Goldberg, *Agribusiness Coordination*, p. 115. 1958-1967: Carl Vosloh, Jr., Grain Marketing, ERS 321, pp. 218-219; Bureau of the Census, *1967 Census of Business: Wholesale Trade*, Vol. III; and *1967 Census of Business: Retail Trade*, Vol. 1, 1967. 1972: Bureau of the Census, *1972 Census of Wholesale Trade: Establishment Size and Firm Size; 1972 Census of Retail Trade: Establishment Size and Firm Size;* U.S. Department of Commerce, *Report to the Congress: Foreign Direct Investment in the United States*, Vol. 4, Appendix E, "Foreign Investment in the U.S. Grain Trade," p. E-7.

lishments reported by the census. Together, these firms were manufacturing over 100 million tons of formula feed.[10] Data comparable to those of the 1969 survey were collected for 1975 and indicate that 6,340 establishments produced 104.5 million tons of formula feed in 1975[11] (Table 4-15). Cooperatives had about 26 percent of the establishments and about 20 percent of the volume. Industry sources indicate that the feed-manufacturing industry has become less centralized in recent years as cattle- and broiler-feeding operations have proliferated, grown in size, and incorporated their own feedmills, and as cooperatives have become significant competitors in the feed-milling industry.

Although thorough studies of feed industry concentration have not been published, industry interviews tend to corroborate census indications that the four largest feed manufacturers account for between 20 and 25 percent of primary feed shipments, and that the eight largest firms account for about a third of all manufactured feed. Table 4-16 lists the market shares of the largest feed manufacturers. Especially noteworthy is the role played by cooperatives: five of them—Farmland Industries, Land O'Lakes, FS Services, Agway, and Goldkist—rank among the top ten of this list. Cooperatives, in fact, account for about 20 percent of mixed feed sales in the United States. The figures for national market share hide important regional differences, especially for cooperatives. Farmland Industries, FS Services, Land O'Lakes, and Agway each enjoy considerably higher market shares within their local areas than is indicated in the table. In certain areas of the Midwest, Purina feeds enjoy market shares in excess of 10 percent. Obviously, participation in the feed-milling industry has expanded

Table 4-15. Selected Data for the Formula Feed Industry: 1975

Item	*Feed Manufacturing Establishments*	*Formula Feed*
	Number	*Tons*
Operating establishments:	6,340	104,530,681
Stationary establishments	6,122	–
Mobile establishments	540	–
Establishments by size:		
Up to 999 tons	750	400,184
1,000-9,999 tons	3,704	14,576,913
10,000-24,999 tons	902	13,378,531
25,000-49,999 tons	427	14,949,807
50,000 tons and over	556	61,225,246
Total	6,340	104,530,681
Primary manufacturers:		
Production by type of feed:		
Dairy feed	2,122	14,209,181
Beef and sheep feed	2,216	17,217,401
Horse feed	1,269	1,540,314
Hog feed	2,370	9,821,805
Turkey feed	465	3,077,873
Broiler feed	527	12,694,702
Starter-grower, layer-breeder	1,959	12,131,721
All other	1,005	3,079,583
Total	3,385	73,772,580
Secondary manufacturers:		
Production	4,483	29,856,362
Unallocated production	–	901,739
Ownership and production:		
Corporation	3,234	69,573,087
Partnership	471	6,004,226
Single owner	1,012	8,467,228
Farmer cooperative	1,623	20,486,140
Total	6,340	104,530,681
Channels of feed disposition:		
Wholesale	1,199	25,226,546
Retail	3,778	24,697,897
Feed to own animals	454	9,541,146
Custom feeding	1,153	26,458,168
Custom grinding and mixing	3,646	18,606,924
Total	6,340	104,530,681

Source: *Structure of the Feed Manufacturing Industry, 1975*, USDA, ESCS, Statistical Bulletin No. 596, February 1978.

with the entry of cooperatives, the proliferation of smaller mills, and the diversification of the early feed manufacturers out of the industry. Concentration of decisionmaking thus appears to have decreased.

Corn processors other than feed millers account for a relatively small percentage of the annual corn crop. Consuming 251 million bushels in 1972-73, wet corn milling is a fairly concentrated industry with only forty-one processing

Table 4-16. Estimated Share of Industry Shipments Accounted for by U.S. Feed Manufacturers: 1975

Firm	*Market Share*
Ralston-Purina	10
Allied Milling	6
Central Soya	5
Gargill	5
Moorman	2
Farmland Industries[a]	2
Land O'Lakes[a]	2
FS Services[a]	2
Agway[a]	2
Goldkist[a]	2
Conagra	2
Alberz	2
1700 Others	58
	100

[a]Cooperative.

Source: Industry interviews and Bureau of Census figures for prior years.

Table 4-17. Estimated Share of Industry Shipments Accounted for by Leading U.S. Corn Wet Millers: 1978

Firm	*Market Share Percentages*
CPC International	21
Archer Daniels Midland	15
Staley	15
Cargill	12
Standard Brands	10
American Maize	8
Grain Processing	6
H.J. Heinz	6
National Starch	3
Amstar	2
Anheuser-Busch	2

Source: Estimates based on industry interviews.

establishments and twenty-six companies. Of these, the four largest currently account for about 63 percent, and the eight largest for 93 percent, of industry shipments. Table 4-17 ranks the leading wet processors by market share. CPC International is the leading starch producer with about 21 percent of industry shipments, but its share has shrunk considerably due to an unfavorable antitrust ruling and to competition from new and increasingly strong companies like Cargill, Staley, Standard Brands, and Archer Daniels Midland (ADM).

Dry corn milling establishments outnumber wet millers but consume con-

siderably less corn. Two systems are used for dry corn milling: degerming, and nondegerming. Nondegerming is relatively noncapital-intensive and permits a rather large number of small mills, particularly in the Southeast where corn meal and grits are a common part of the diet. Between 1,000 and 1,200 mills were operating in Georgia alone in 1950. The degerming method is more capital-intensive and efficient and it produces a more desirable product that keeps longer and tastes less oily. In 1965 the *Milling and Baking News, Directory of Mills and Milling Executives* listed only 152 mills with a capacity of 50 hundred weight per day or more in operating or standby condition. In 1969, the number had declined to 115. Dry millers therefore appear to be consolidating.

Grain exporters are relatively few in number, and the industry is highly concentrated. While fifty-eight firms were reported to have exported grain from the United States in crop year 1974-75,[12] twenty firms handle over 90 percent of U.S. exports and six firms account for between 50 and 60 percent. The six dominant entities are Cargill, Continental Grain, Cook Industries, Bunge, Louis Dreyfus, and Garnac. The first four of these firms alone were reported in 1975 to have handled 42 percent of corn exports. Table 4-18 shows an estimated ranking of U.S. corn-exporting firms based on U.S. Department of Commerce information and on total grain export data for the twenty member firms of the North American Grain Export Association (see Table 4-19). These figures seem to show that decisionmaking in the export segment of the corn industry is highly concentrated, though not to the extent it is in the wet-milling industry. Many new firms are seeking to enter the industry from both within the United States and from other countries; for example, Mitsui of Japan recently (1978) purchased Cook's export elevator and Cook is no longer in the export grain business. Major U.S. cooperatives are developing an international grain network with overseas cooperative and multinational firms, as competition for the expanding export market becomes more intense.

BEHAVIOR AND PERFORMANCE IN THE U.S. CORN SYSTEM

The previous discussion of product movement and institutional organization suggests the complexity of the corn market structure in the United States. Recognition of that complexity should impress the private manager and the public policymaker alike with the need to know about every level of a commodity system before making decisions affecting any particular part of it. In this section we will deal with the vital relations between corn movement and system participants.

Storage

The U.S. corn system, like many other commodity systems, deals with year-round consumption of an end product harvested once a year in September and

Table 4-18. Estimated Share of U.S. Corn Exports Accounted for by Leading Grain Exporting Firms: 1975

Firm	*Share of Shipments*
Cargill Corporation Continental Grain Company Cook Industries, Inc. Louis Dreyfus	42.0
Bunge Garnac Grain Co. Toepfer Archer Daniels Midland	21.8
Twelve other members of the North American Grain Export Association	29.5
Others	6.7
Total	100.0

Source: Based on ranking of export volume of member firms in North American Grain Export Association, and on U.S. Department of Commerce, *Foreign Direct Investment in the United States*, Vol. 4, Appendix E, p. E-14, April 1976.

October. This pattern requires storage of the crop at various places and points in the system during the year. Table 4-20 shows the inventory situation at six times during the year beginning 1 October 1976 and ending 1 January 1978. Comparison of these figures with those for total production and supply in Table 4-1 allows several observations. Early in October, just as the new harvest is underway, stocks at all points are low. The fact that farmers' corn stocks are sharply lower than the July figure reflects the seasonal necessity of clearing out on-farm inventories to make room for new crops. On 1 January 1977, 57 percent of the previous fall's harvest remained in the hands of producers. Some 22 percent of the previous fall's crop had been consumed, but 27 percent of the year's total supply (that year's crop plus beginning stocks) had already been used, indicating some pressure on off-farm inventories. By April, farmers still held over a third of the previous harvest and two-thirds of the national corn inventory. (Actually, farmers *owned* considerably more, which they stored off the farm at mills elevators, and warehouses.) By June, their holdings were 27 percent and 67 percent, respectively. By 1 January 1978, 60 percent of the previous fall's harvest remained in the hands of producers.

The implications of Table 4-20 are three. First, the amounts and locations of stored grain vary tremendously in the course of a year. Second, the United States has sufficient storage capacity at or near its farms to permit a fairly smooth flow of corn through the market system. Third, producers are in an excellent position to bargain with processors and exporters. Their storage capacity is substantial; they market grain smoothly after January 1; and they can use

Table 4-19. Selected U.S. Grain Export Statistics: 1971-1976

Firm	*1971 Fiscal Year Volume (Bushels)*	*1972 Fiscal Year Volume (Bushels)*	*1973 Fiscal Year Volume (Bushels)*	*1974 Fiscal Year Volume (Bushels)*	*1975 Fiscal Year Volume (Bushels)*	*1976 Fiscal Year Volume (Bushels)*
Archer Daniels Midland Co.	–	40,000,000	55,237,986	77,000,000	65,000,000	79,692,296
Bunge Corporation	134,016,152	167,400,000	362,505,600	362,046,000	299,693,000	349,973,000
Cargill, Inc.	453,721,000	533,428,000	775,946,000	625,368,000	720,363,000	759,916,000
Central Soya Co., Inc.	–	26,200,000	29,400,000	36,770,000	49,266,000	71,901,564
Continental Grain Co.	341,881,197	563,143,148	752,375,569	606,312,635	622,701,756	767,646,824
Cook Industries, Inc.	257,490,000	285,222,000	475,871,000	448,958,000	613,728,000	793,000,000
Fox, C.B. Company	24,301,000	33,276,000	53,889,000	46,700,000	32,500,000	38,300,000
Garnac Grain Company	92,023,806	128,905,979	240,533,261	247,884,699	286,349,051	317,073,989
Inter-Continental Grain Co.	–	5,994,233	11,125,930	11,057,265	14,992,537	12,988,761
Louis Dreyfus Corp.	107,702,139	181,933,913	403,250,763	439,607,941	477,471,973	656,501,921
North Pacific Grain Growers, Inc.	22,706,350	21,884,960	32,307,630	28,740,200	41,771,983	44,382,136
Peavey Company	29,096,000	41,469,000	58,525,000	55,770,000	61,350,000	68,289,000
Tabor & Co.	–	50,110,600	82,427,269	61,466,468	35,000,000	–
The Agro Company of Canada Limited	51,516,800	53,457,300	66,346,000	44,111,568	40,274,213	48,000,000
The Andersons	–	43,932,000	27,538,000	28,707,903	54,381,765	63,436,553
Tidewater Grain Co.	14,678,667	37,439,051	40,781,200	46,154,294	54,049,893	62,405,820
Union Equity Cooperative Exchange	69,087,161	55,245,426	142,308,220	–	–	–
Mid States Terminal	–	–	–	–	15,344,176	39,023,236
Koppel	–	–	–	–	19,000,000	18,500,000
Toepfer	–	–	–	–	195,543,322	215,419,744
	1,598,220,272	2,280,041,610	3,610,368,428	3,166,654,973	3,698,780,669	4,406,450,844

Note: Statistics from North American Export Grain Association, Inc. (does not represent total volume of U.S. grain exports, only the volume of N.A.E.G.A. membership).

Table 4-20. Corn Stocks in the United States at Selected Locations: 1 October 1976 through 1 January 1978 (million metric tons)

Locations	*Oct. 1, 1976*	*Jan. 1, 1977*	*April 1, 1977*	*June 1, 1977*	*Oct. 1 1977*	*Jan. 1, 1978*
On Farms	5.9	85.0	54.2	40.1	11.4	96.2
Off Farms[a]	4.2	39.2	29.4	20.0	11.1	42.0
Commodity Credit Corp.	0	0	0	0	0	0
Total	10.1	124.2	83.6	60.1	22.5	138.2

[a]Includes stocks at mills, elevators, warehouses, terminals, and processors.

Source: Crop Reporting Board, Statistical Reporting Service, USDA, *Grain Stocks*, January 1978.

holding tactics to their own advantage. The significant amounts that corn farmers hold off the farm in cooperative and private commercial storage facilities further strengthen their bargaining position. The shortage of improved transportation facilities in the face of both increased storage and expanded international markets means that transportation pressures will play a more important role in price volatility than they have in the past.

Consumption

Year-to-year changes in corn consumption can be almost as dramatic as seasonal inventory changes. In the 1974 crop year, for example, total production was almost 20 percent below the preceding and subsequent years. This drop in production caused a sharp price increase, which effectively rationed available supplies. Total corn use declined by twenty-seven million metric tons in 1974-75, most of the reduction coming from a drop in feed use. Livestock producers, unable to control the prices of their products were not able to pass on the sharp increases in their costs to consumers.

Similarly, in unofficial USDA projections for per-capita consumption of the U.S. corn crop for various years—depending on income levels in the U.S. and overseas, inflation rates, cost-price relations, by-product substitutions for corn, and U.S. and foreign governmental policies—the 1985 projections vary from a low of 98 pounds per capita to a high of 107, versus a 1974-76 average of 80 pounds per capita. In 1990 the spread is projected to be 102 pounds to 111, and by the year 2000, from 108 to 117. The 1990 projections translate to a potential U.S. corn export market of 50 million metric tons and a U.S. feed market of 114 million metric tons. The significance of these widely varying estimates is that demand uncertainties are as great as or greater than supply uncertainties and that public monetary, labor, and foreign diplomacy and technology policies as well as domestic and foreign agriculture policy will add to the uncertainties in estimating corn demand.

Price Spreads and Relations

Significant price spreads and relations exist in both the domestic and international markets. In the United States, prices vary between markets and between corn and corn-related products such as feed, corn-fed meat products, and processed products. Internationally, there are important relations between U.S. prices and prices in world markets.

On the average, the prices received by U.S. farmers differ only slightly from cash market prices in Chicago. This small but important difference, or "basis," results from transportation and storage costs and availability from farm to market. It varies with the farm's distance from the price-determining market and whether the farm is in a corn-surplus or corn-deficit area. Knowing the basis for his local area and the Chicago price, a farmer can judge the attractiveness of cash prices offered for his corn.

The major factor affecting the price of corn is the domestic demand for livestock products. Participants in the U.S. corn livestock economy calculate their margins primarily on the basis of livestock-to-corn price ratios: that is, the price of a unit of livestock production divided by the price of the corn required to produce that unit. The most important ratios are the beef-, hog-, broiler-, egg-, and milk-feed ratios (see Table 4-21). Until the 1970s, these ratios generally reflected changes in the supply and price of feed products because corn prices were stable. In 1974, the corn shortage caused a much faster rise in corn prices than in comparable feed products and resulted in very low feed-price ratios. Since agronomic factors prevent feed-product prices from reflecting higher costs

Table 4-21. Selected Livestock-Corn Price Ratios: 1970-1976 (annual averages)

Year	*(Oct.-Sept.) Beef Steer/ Corn*[a]	*(Oct.-Sept.) Hog/Corn*[b]	*(Oct.-Sept.) Broiler/Feed*[c]	*(Oct.-Sept.) Egg/Feed*[d]
1970	22.2	12.8	2.8	7.4
1971	28.8	21.5	2.9	7.1
1972	24.8	22.4	3.2	7.7
1973	15.4	13.5	2.6	7.3
1974	14.2	15.3	3.0	6.9
1975	15.4	18.7	3.0	7.7
1976	18.8	18.6	2.6	7.4

[a]Bushels of #2 yellow corn equivalent in value to 100 pounds of beef steers, all grades, sold out of first hands at Omaha for slaughter.

[b]Bushels of corn equal in weight to 100 pounds of hog, liveweight, based on local market prices.

[c]Number of pounds of broiler feed equal to 1 pound of broiler, liveweight.

[d]Number of pounds of laying feed equal to one dozen eggs.

Source: ERS, USDA, *Livestock Feed Price Relationships, National and State*, Supplement to Statistical Bulletin 530, and *Feed Situation*, February 1978.

in the short term, livestock producers had to cut back on their purchases of corn until livestock prices had a chance to adapt.

Beef. Since 1950 demand for beef in the United States has increased fairly steadily. With beef prices rising faster than corn prices, it was profitable to feed beef in feedlots. However, consumer resistance developed to especially sharp price hikes in 1973. To maintain the high prices, cattlemen withheld their beef from market. Prices did, in fact, remain high for a short time, but they eventually plummeted because of the inevitable build-up of cattle inventories. As beef prices fell, corn prices rose rapidly and dragged down the steer-corn ratio. Feedlot operators suffered severely. In the short term, the decline in beef steer-corn price ratios forced the sharp curtailment in the use of commercial feed and corn evident in Table 4-22.

During the corn shortage of 1974, consumption of corn by cattle on feed dropped even further, while the consumption of corn by other beef cattle remained almost unaffected in absolute terms. The number of cattle on feed is much more sensitive to corn prices than is the number of other beef cattle; it declines sharply when feed prices advance without a corresponding increase in beef prices. Beef cattle can be kept longer on pasture or not put in the feedlot at all.

Hogs. The shorter production cycle for hogs explains the greater volatility of the hog market than the beef market. The hog-corn price ratio was influenced primarily by the price of hogs and alternative meat and poultry supplies rather than by corn until 1973-1974. High corn prices in those years and cyclically low hog prices caused deterioration in the ratio and forced many hog producers to operate at a loss. Because hogs cannot be turned out to pasture and expected to forage for themselves, hog producers liquidated their herds and reduced farrowings. The result, as Tables 4-21 and 4-22 show, was to sharply reduce corn consumption by hogs.

Table 4-22. Consumption of Corn by Selected Types of Livestock: 1972-1977 (millions of tons)

Year	*Cattle on Feed*	*Hogs*	*Broilers*	*Layers*[a]
1972	33.0	31.5	6.4	8.7
1973	29.9	28.1	5.9	8.8
1974	14.2	22.1	4.6	7.3
1975	19.2	27.2	5.2	7.9
1976[b]	18.7	32.6	6.8	8.8
1977[b]	21.5	32.3	7.1	9.0

[a]Hens and pullets

[b]Preliminary.

Source: ERS, USDA, *Feed Situation*, November 1978, pages 26-27.

Poultry. Corn accounts for about 45 percent by weight of poultry feed, so it figures heavily in broiler-feed and egg-feed price ratios. Before the early 1970s poultry producers, like livestock producers, could count on relatively stable corn prices. The price of eggs and broilers was the main variable in their decisionmaking. The development of corn price volatility increased the risks in broiler and egg production, however, and complicated the decisionmaking process significantly. Although the relatively short production cycle for broilers and eggs permits rapid cutbacks by producers in reaction to adverse margins, the industry structure works against such adjustment. Broilers and eggs are produced largely on the basis of contracts between individuals and large integrated processing firms that are able to risk some financial loss for the possibility of increasing their market share. Nonetheless, the poultry industry responded much more quickly than cattle and hog producers to adverse price-product ratios in 1973 and 1974. Tables 4-21 and 4-22 show the coincident declines in feed-price ratios and total corn consumption in those years.

Dairy. The dairy farmer has little flexibility in the event of a cost-price squeeze; he is directly exposed to the rising costs. High fixed costs in the form of milking equipment, dairy barns, and dairy herds limit possible responses to short-term fluctuations in the milk price-feed ratios. Selling production stock and his accumulation of corn or feed is not an option for the dairy farmer because it requires a long time to build dairy herds and herd productivity. He can protect himself somewhat by downgrading his feed with increased portions of hay, pasture, and harvested forage, although this strategy reduces milk yields.

Because of this inability to react to adverse margins in the short term, policymakers have passed laws to control U.S. milk prices and ensure the economic viability of the farmer and a steady milk supply for the consumer. Thus, milk prices are more insulated from feed-price changes than those of other livestock products, except when the government is slow to respond to economic changes.

U.S./Foreign Corn Price Relations.

The world corn price is generally accepted as that reported in Chicago and c.i.f. Rotterdam. Europe is the world's leading corn importing region, and much of its corn imports from the United States and Argentina flow through Rotterdam. Rotterdam prices reflect corn prices in the United States, plus the elevation and transport costs of moving grain from the U.S. interior or exporting nations to Europe. This cost and price structure is elaborated in Table 4-23. Note that it costs more to move corn from the interior to Gulf ports than it does to ship it from the Gulf to Rotterdam.

Until 1972, the difference between Gulf and Rotterdam prices fluctuated between 5 dollars and 10 dollars per ton. When cargo space was short as a result of the world economic boom and grain shortage of 1972, ocean freight rates rose dramatically. The recent worldwide recession has brought both ocean trade

Table 4-23. Unit Values, Transport, and Handling Charges between U.S. Producers and Dutch Importers: 1969-70/1976-77 (in millions of U.S. dollars per ton)

Item	*1969-70*	*1970-71*	*1971-72*	*1972-73*	*1973-74*	*1974-75*	*1975-76*	*1976-77*
Seasonal average price received by farmers	45.67	52.36	42.52	61.81	100.39	119.28	99.99[a]	84.64
Implicit U.S. inland storage, handling, and freight costs	8.21	8.53	10.92	14.07	16.61	21.18	20.47[b]	21.35
U.S. export unit value to Netherlands	54.08	67.37	53.49	75.81	117.03	134.36	118.62[c]	105.22
Ocean freight to Netherlands	7.48	5.39	3.47	8.10	15.57	6.92	5.72[d]	5.09
Dutch import unit value	62.60	69.80	61.62	95.37	126.73	144.33	127.63[b]	117.44
Unexplained difference	+1.04	-2.96	+4.66	+11.46	-5.87	+2.94	+3.29	+7.13

[a]Through May 1976.
[b]Calculated; not included in cited article.
[c]Through June 1976.
[d]ERS estimate.

Source: H. Christine Collins, "Price Changes and Price Spreads Between Farm and Foreign Markets for Wheat, Corn, and Soybeans-Evaluated from Unit Values," *Foreign Agricultural Trade of the United States*, October 1976, p. 22. Updated by USDA.

Table 4-24. Estimated Value Added to Corn by Transport from Farm to Rotterdam: December 1974 and December 1976 (in U.S. dollars per bushel)

	1974[a]	*1976*[b]
Iowa farm price, December 15	3.24	2.27
Value added by transportation & handling		
Farm to elevator	.04	.05
Elevator to U.S. port	.30	.19
U.S. port to Rotterdam	.25	.28
Total transportation cost	.59	.52
Estimated value added (percentage)	18	23

[a]Source: Farmer Cooperative Service, USDA, *Improving the Export Capability of Grain Cooperatives*, p. 30.
[b]Source: C. Itoh & Co. (America), Inc.

and ocean freight rates back to more normal levels. Consequently, the difference between the Rotterdam price and the U.S. farm price has also declined.

The interaction of domestic and ocean freight rates is important because it can affect the domestic flow of grain and because transport charges are an important part of the value of grain imports. If, for example, it became cheaper to transport corn from Chicago to the Pacific Northwest rather than to Gulf ports, corn would surely flow from the upper Midwest to ports in Oregon and Washington. The significance of changes in ocean transport costs, especially for lower priced grains, is shown in Table 4-24. In 1974, transportation costs added 18 percent to the value of corn. By 1976, transportation costs--although lower than before--made up a greater portion of corn's import value.

Even when corn prices and transport costs are relatively low, tariffs may make corn expensive to the ultimate user. For instance, EEC grain tariffs are adjusted daily to make the price for grain imported through Rotterdam equal to that for grain under EEC price support.

Prices fluctuate daily in the corn market as system participants react to the changing price relations between corn and alternative ingredients and between corn and end-product prices that result from their commercial strategies. Throughout the system, the comparative advantages of local supplies and markets are constantly shifting with freight rates and prices for end products and exports.

Profitability

Until the fall of 1977, corn was a relatively profitable crop for U.S. farmers (see Table 4-8). Profits have not always been substantial, however, especially during the period of price supports and acreage controls, when the number of corn farmers declined by about 50 percent. Given average costs and average farm prices for late 1977, farmers were then operating at breakeven. (The 1978 corn crop year was a slightly more profitable one.)

Figure 4-4 depicts the effects of high corn and other feed prices on livestock producers. Note the sharp rise in breakeven costs in 1972 for all sectors of the livestock economy. Those costs have generally remained at much higher levels than existed prior to the suspension of price supports and the liquidation of the grain surplus. Their elevation directly reflects higher corn prices, since corn is a major part of feed. Given the rapidly increasing production costs facing the corn farmer, the higher cost structure appears to have become permanent. It was not until 1978 that livestock producers had positive margins. Hog and poultry producers fared better (see Figure 4-5).

Feed milling has varied in profitability over the last few years. In the early 1970s, feed milling firms were squeezed by controls on the prices for their products and lack of controls on their ingredient costs. After controls ended, they were caught between rapidly escalating ingredient costs and sluggish demand from livestock producers. Plant operating rates and profitability declined. More recently, as corn prices have declined, feed use of corn has increased and millers' profitability has improved. Vertically integrated feed millers have lately been able to make profits on the storage, handling, and transportation of corn as well as on its processing. Smaller millers with higher per-unit production costs and less vertical integration have been at a disadvantage (their costs ranging from seven dollars to fifteen dollars a ton versus large millers' of from five dollars to nine dollars a ton).[13]

The following excerpts from the discussion of operations by the management of a major integrated feed miller offer some sense of this difficult period for feed millers.[14]

> *1974.* In fiscal 1974 sales increased 50 percent over fiscal 1973. Most of this increase merely reflects passing on higher raw material costs. Increased cost of sales (56 percent) reflects higher grain costs and two other major items. In Puerto Rico the company faced severe government price control programs. Both feed and flour operations were penalized by these controls by approximately $4 million. The impact upon flour operations was that the company could not effectively hedge its wheat inventories against the government's ceiling price policy. The resultant selling prices of flour were not sufficient to recover the cost of wheat used in manufacture. New price control regulations were established in Puerto Rico after the conclusion of fiscal 1974.
>
> Another major problem created a drain on fiscal 1974 earnings of approximately $9 million. This represents principally costs related to corn and soybean meal which the Registrant purchased for manufacturing formula feeds, which are both sold to third party customers and used in the manufacture of the Registrant's broiler chickens. In an attempt to protect inventory values and improve profit margins, the Registrant purchased substantial quantities of these ingredients. When the price of these ingredients increased well above historic levels, futures options were sold against the ingredients owned, to protect against expected price declines.

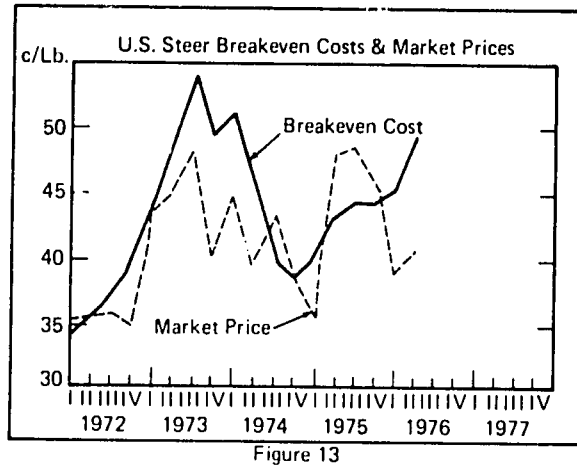
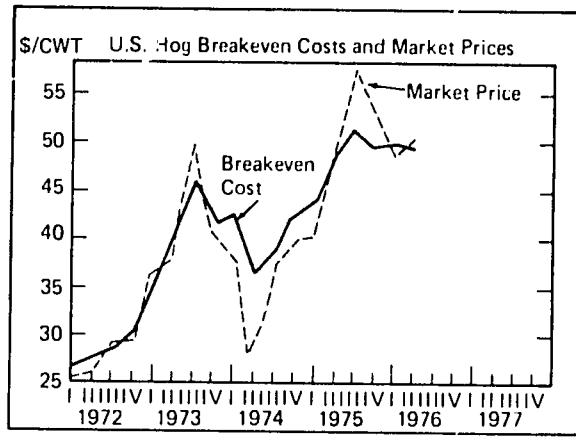
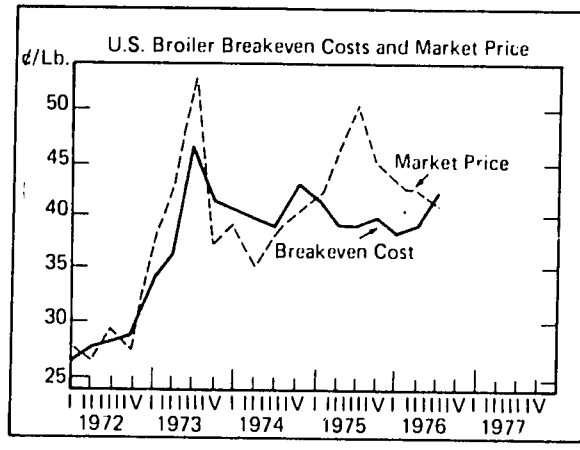


Figure 13





Source: Quentin West, *The U.S. Farmer in the International Food Situation*, ERS, USDA (ERS 651), February 1977, p. 8.

Figure 4-4. Breakeven Costs and Market Prices in U.S. Livestock Production: 1972-1976

Unfortunately, prices subsequently increased substantially during times of chaotic market conditions and unprecedented uncertainty concerning worldwide scarcity. As the prices increased further, the Registrant bought back its short futures position. The resultant high feed ingredient costs were only partially recoverable in end-product selling prices. This problem was compounded by a significant decrease in the market price for chicken products.

Other income in fiscal 1974 decreased 184 percent. During 1974 the company disposed of its Kansas City corn milling facility. The loss on the sale of this plant amounted to $1,575,000, which is reported in other income (deductions) . . . .

1975. In fiscal 1975 sales decreased approximately 10 percent from 1974 levels. This decrease may be attributed mainly to two factors. Primarily this decrease reflects lower ingredient costs incurred in fiscal 1975. The second factor was the sale of a portion of the company's branded grocery products business with annual sales of approximately $20 million.

Cost of sales was reduced 12 percent in fiscal 1975 mainly due to the elimination of 1974 problems relating to unusual ingredient costs and generally lower grain markets and revisions in the company's inventory management policy . . . .

Net earnings for fiscal 1975 were $4,071,317, compared to an operating loss ($11,853,118) in fiscal 1974. In addition to the reasons cited above, the following items also improved the company's 1975 net earnings:

1. the elimination of Puerto Rican price controls
2. reductions in corporate staff of 20 percent and corporate expense of 41 percent
3. improved poultry margins during the second half of fiscal 1975.

1976. During 1976 the Registrant changed its fiscal year to end on the last Sunday in May instead of the last Sunday in June as heretofore. This change resulted in fiscal year 1976 being 48 weeks in length. This "short" fiscal year was the major cause of the decline in dollar sales in 1976, with the discontinuance of certain marginal operations at the end of fiscal year 1975 also having an effect.

Cost of goods sold decreased approximately 8 percent after giving effect to the "short" fiscal year. Lower commodity prices in fiscal 1976 were the main reason for this decrease . . . .

Net earnings for fiscal 1976 were $19,125,828 compared to earnings of $4,071,317 in fiscal 1975. The 1976 pretax earnings were more than three times higher than the Registrant's previous best year. In addition to the reasons stated above, the following matters also improved the company's 1976 net earnings:

1. favorable market conditions in the Poultry Division
2. Increased unit volume, reduced costs, and improved operating efficiencies in the Grain Milled Products and Caribbean Division.

Federally Inspected Hog Slaughter

Work Ended 1978[a]	*1974*	*1975*	*1976*	*1977*	*1978*
			(Thousands)		
Jan. 7	1,566	1,588	1,407	1,399	1,247
14	1,577	1,432	1,326	1,357	1,473
21	1,598	1,385	1,227	1,495	1,376
28	1,328	1,450	1,203	1,344	1,261
Feb. 4	1,185	1,424	1,208	1,388	1,527
11	1,541	1,419	1,234	1,520	1,437
18	1,403	1,340	1,168	1,470	1,551
25	1,564	1,352	1,255	1,379	1,348
Mar. 4	1,554	1,453	1,273	1,534	1,424
11	1,555	1,395	1,422	1,632	1,579
18	1,493	1,393	1,403	1,568	1,508
25	1,637	1,315	1,383	1,609	1,422
Apr. 1	1,589	1,404	1,388	1,518	1,452
Apr. 8	1,519	1,439	1,387	1,502	1,508
15	1,602	1,478	1,290	1,488	1,608
22	1,515	1,401	1,271	1,576	1,504
29	1,547	1,368	1,321	1,522	1,588
May 6	1,678	1,301	1,309	1,527	1,498
13	1,534	1,221	1,316	1,439	1,522
20	1,626	1,221	1,197	1,336	1,377
27	1,392	1,101	1,257	1,283	1,329
June 3	1,621	1,294	1,038	1,112	1,138
June 10	1,596	1,254	1,199	1,383	1,377
17	1,343	1,163	1,155	1,298	1,283
24	1,285	1,132	1,103	1,253	1,297
July 1	984	853	1,024	1,164	1,266
July 8	1,313	1,061	941	949	1,054
15	1,242	1,100	1,159	1,232	1,385
22	1,326	1,055	1,181	1,214	1,372
29	1,476	1,027	1,265	1,287	
Aug. 5	1,443	1,051	1,342	1,264	
12	1,454	1,157	1,344	1,315	
19	1,377	1,057	1,332	1,342	
26	1,482	1,169	1,401	1,368	
Sept. 2	1,347	996	1,350	1,411	
Sept. 9	1,628	1,267	1,227	1,270	
16	1,622	1,258	1,579	1,568	
23	1,600	1,198	1,508	1,590	
Oct. 2	1,585	1,188	1,593	1,547	
Oct. 7	1,602	1,159	1,647	1,505	
14	1,541	1,193	1,660	1,582	
21	1,491	1,163	1,669	1,597	
28	1,475	1,194	1,599	1,487	
Nov. 4	1,583	1,275	1,729	1,685	
11	1,574	1,336	1,706	1,603	
18	1,594	1,376	1,646	1,655	
25	1,305	1,069	1,385	1,308	
Dec. 2	1,654	1,372	1,644	1,623	

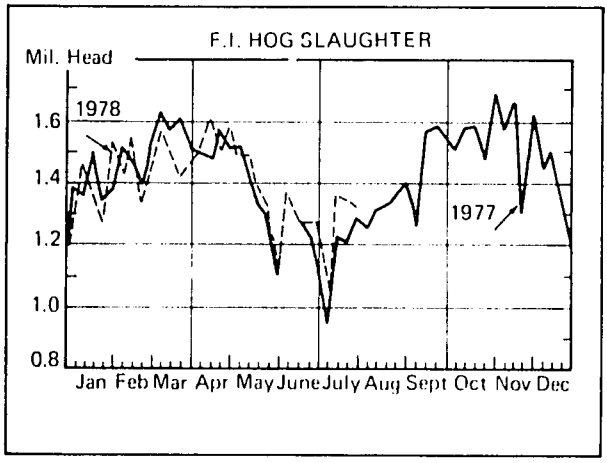
Source: ESCS, USDA

Figure 4-5. Hog and Beef Prices, Costs, and Net Margins

Federally Inspected Hog Slaughter

Work Ended 1978[a]	*1974*	*1975*	*1976*	*1977*	*1978*
Dec. 9	1,574	1,237	1,614	1,462	
16	1,492	1,219	1,522	1,504	
23	1,015	949	1,140	1,369	
30	1,014	970	1,206	1,187	

[a]Corresponding dates: 1974, January 12; 1975, January 11; 1976, January 10; 1977, January 8.



Hog prices, costs, and net margins[b]

Year	*Barrows & Gilts 7 Markets*	*Feed and Feeder*	*Breakeven*	*Net Margins*
		(dollars per cwt.)		
1975				
October	58.52	39.60	46.82	+11.70
November	49.74	39.58	46.90	+2.84
December	48.33	42.29	49.66	-1.33
1976				
January	48.40	47.31	55.12	-6.72
February	48.85	44.77	52.80	-3.95
March	46.71	39.81	47.56	-.85
April	47.89	37.87	45.48	+2.41
May	48.89	39.29	46.94	+1.95
June	50.80	41.23	49.15	+1.65
July	48.26	40.49	48.35	-.09
August	44.00	41.81	49.79	-5.79
September	39.39	39.96	47.74	-8.35
October	32.66	39.21	46.84	-14.18
November	32.05	36.20	43.57	-11.52
December	38.05	34.70	41.85	-3.80
1977				
January	39.52	33.60	40.65	-1.13
February	40.18	28.62	35.46	+4.72
March	37.53	27.23	34.14	+3.39

(continued)

Figure 4-5. continued

Hog prices, costs, and net margins[b]

Year	*Barrows & Gilts 7 Markets*	*Feed and Feeder*	*Breakeven*	*Net Margins*
April	36.97	30.41	37.42	-.45
May	41.79	30.75	37.83	+3.96
June	43.86	34.91	42.43	+1.43
July	45.76	37.99	45.70	+.06
August	44.38	39 89	47.71	-3.33
September	41.40	39.25	47.21	-5.81
October	40.83	35.71	43.48	-2.65
November	39.33	34.15	41.96	-2.63
December	43.99	33.45	41.22	+2.77
1978				
January	45.99	31.89	39.58	+6.41
February	48.83	30.64	38.25	+10.58
March	47.50	31.63	39.31	+8.19
April	46.04	31.00	38.62	+7.42
May	49.17	33.44	41.32	+7.85
June	48.31	36.97	45.40	+2.91
July	46.78	41.37	50.09	-3.31
Aug.		43.88	52.71	
Sept.		43.58	52.26	
Oct.		39.60	48.01	
Nov.		38.71	47.13	

[b]Selling price required to cover costs of feeding 40-50 lb. feeder pig to 220 lb. slaughter hog in Corn Belt.

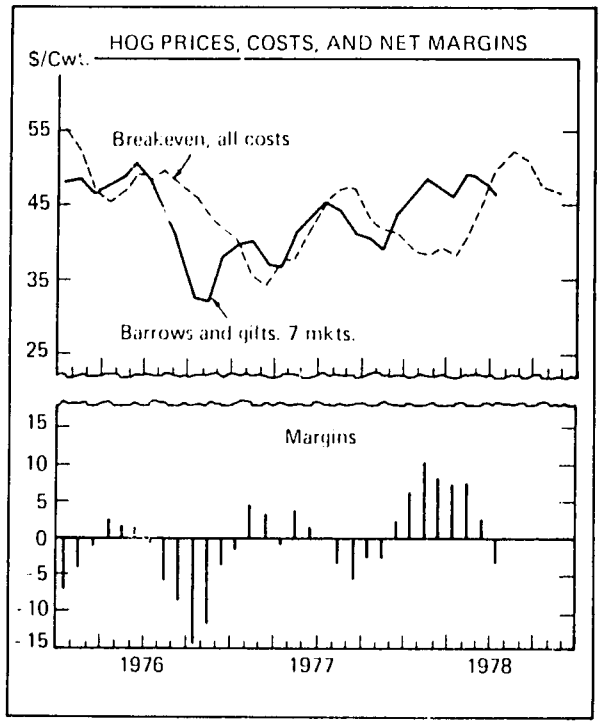


Figure 4-5. continued

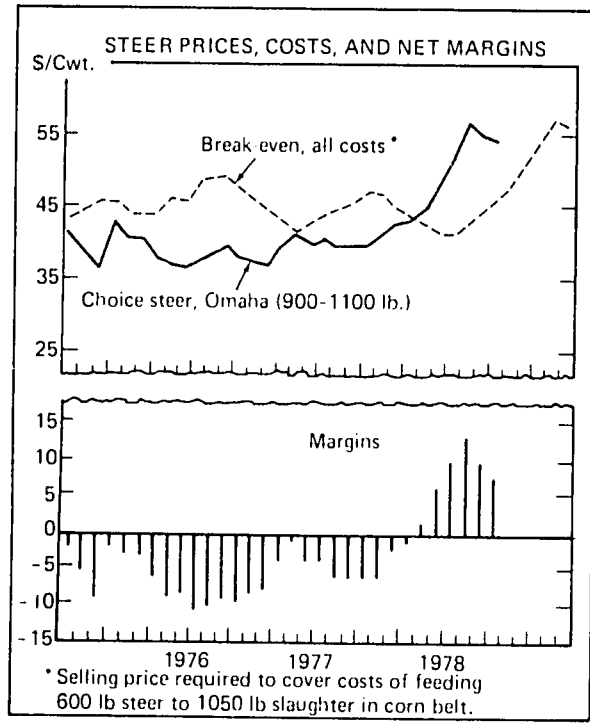
Steer Prices, Costs, and Net Margins[c]

Year	*Steers Omaha*	*Feed & Feeder*	*Breakeven*	*Net Margin*
		(dollars per cwt.)		
1976				
Jan.	41.18	37.83	43.50	-2.32
Feb.	38.80	39.05	44.67	-5.87
Mar.	36.14	40.04	45.79	-9.65
Apr.	43.12	39.39	45.30	-2.18
May	40.62	38.15	44.01	-3.39
June	40.52	38.12	43.98	-3.46
July	37.92	38.34	44.17	-6.25
Aug.	37.02	40.40	46.40	-9.38
Sept.	36.97	39.94	45.94	-8.97
Oct.	37.88	42.53	48.68	-10.80
Nov.	39.15	43.28	49.42	-10.27
Dec.	39.96	43.37	49.49	-9.53
1977				
Jan.	38.38	40.85	47.82	-9.44
Feb.	37.98	40.46	46.35	-8.37
Mar.	37.28	39.25	45.06	-7.78
Apr.	40.08	37.86	43.66	-3.58
May	41.98	36.24	42.07	-0.09
June	40.24	37.73	43.58	-3.34
July	40.94	38.50	44.41	-3.47
Aug.	40.11	39.28	45.31	-5.20
Sept.	40.35	40.01	46.10	-5.75
Oct.	42.29	41.46	47.65	-5.36
Nov.	41.83	40.77	47.04	-5.21
Dec.	43.13	38.88	45.09	-1.96
1978				
Jan.	43.62	38.04	44.27	-0.65
Feb.	45.02	36.92	43.12	+1.90
Mar.	48.66	35.76	41.92	+6.74
Apr.	52.52	35.80	41.95	+10.57
May	57.28	37.34	43.54	+13.74
June	55.38	38.57	44.82	+10.56
July	54.59	40.01	46.42	+8.17
Aug.		42.03	48.70	
Sept.		45.20	52.04	
Oct.		47.74	54.71	
Nov.		50.83	57.91	
Dec.		49.63	56.66	

[c]Selling price required to cover costs of feeding 600 lb. feeder steer to 1,050 lb. slaughter in Corn Belt.

Figure 4-5. continued

(continued)



July 1 Feeder Cattle Supply

Item	*1975*	*1976*	*1977*	*1978*	*%*[f]
			1,000 head		
Calves under 500 lb.					
On farms	42,793	39,370	38,321	34,767	-9
On feed[d]	403	442	533	687	+29
Feeder supply	42,390	38,928	37,798	34,080	-10
Steers and heifers over 500 lb.[e]					
On farms	24,981	27,121	27,164	26,570	-2
On feed[d]	8,507	10,055	9,677	10,723	+11
Feeder supply	16,474	17,066	17,487	15,847	-9
Total feeder supply	58,864	55,994	55,285	49,927	-10

[d]Estimated U.S. steers and heifers.
[e]Not including heifers for cow replacements.
[f]Percent change from 1977.

Figure 4-5. continued

Feeder steer prices consistent with break-even, given corn and fed steer prices[g]

Corn (Farm price)	*Choice Steers, $/cwt.*					
	40	*45*	*50*	*55*	*60*	*65*
$/bu.	Feeder steers, $/cwt.					
1.75	33	42	51	59	68	77
2.00	31	40	49	58	66	75
2.25	29	38	47	56	64	73
2.50	28	36	45	54	63	71
2.75	26	34	43	52	61	69
3.00	24	33	41	50	59	68
3.25	22	31	39	48	57	66
3.50	20	29	38	46	55	64

[g]Assuming all other costs at June 1978 levels. (see corn belt cattle feeding table).

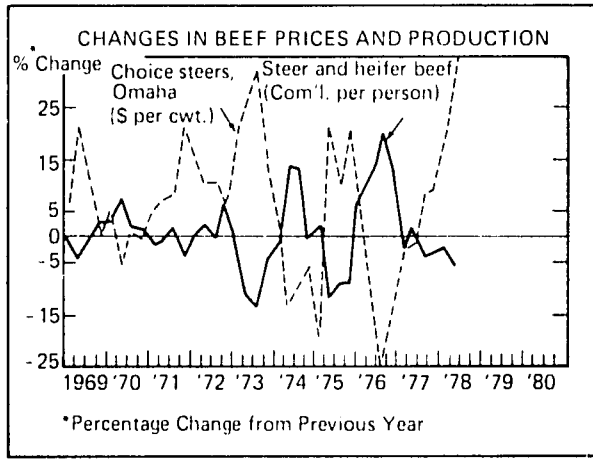


Figure 4-5. continued

Wet millers in the United States also found market conditions of the mid-1970s challenging, as shown by the following excerpt:[15]

> In 1972 the corn wet milling industry experienced the lowest price structure for corn syrup in 25 years. Although government price control regulation restricted both the degree and timing, prices for corn syrup, and, to a lesser extent, corn starches, improved significantly in 1973 and 1974.
>
> In the latter part of 1974, demand for corn syrup increased, due in part to (1) some diversion of the industry's corn syrup capacity to the production of high fructose corn syrup; (2) higher sugar prices; and (3) a lifting of government restrictions on usage of corn syrup in jams and jellies. These factors, combined with removal of government price controls, led to

higher corn syrup prices. By the end of 1974, corn syrup prices had almost quadrupled from the severely depressed November 1972 level.

Unit sales volume increases of 11.3 percent and 6.6 percent in 1973 and 1974, respectively, also contributed to sales and profit improvement in those years.

In 1975, unit sales volume was less than 1974, and at December 31, 1975, prices for both corn syrups and starches were lower than at December 31, 1974. However, sales and operating profits for the full year 1975 were both substantially higher than 1974 due to the following factors: (1) the average prices realized on corn syrups and starches were higher in 1975 than in 1974; (2) corn costs were lower in 1975; and (3) incentive compensation costs were reduced by changes in the Registrant's compensation plans.

Information concerning profitability among grain trading firms is scanty. Cargill, the largest of the trading firms, revealed its sales and profits for 1970-71 through 1975-76 to a congressional committee. Public information regarding this firm appears in Table 4-25. The publicly owned Cook Grain Company publishes its financial results in trading margins rather than in sales volume. Because of income changes in the grain industry from 1976 to 1977, Cook saw its profits deteriorate from $22 million in 1975-76 to a loss of close to $81 million in 1977 with a subsequent sale of its grain and processing operations to Mitsui and Marubeni, Japanese multinationals, and to Goldkist, an American farm cooperative.

Competition

Previous discussions of technological innovation, profit levels, and price responsiveness suggest the competitive character of the U.S. corn system. Nevertheless, the economies of scale we mentioned in connection with farm size also

Table 4-25. Cargill Reported Earnings Before and After Taxes: 1970-1976 (millions of dollars)

	Average	*1970-1971*	*1971-1972*	*1972-1973*	*1973-1974*	*1974-1975*	*1975 1976*
Earnings of "Domestic" Consolidated Companies Before Federal Income Taxes	145.8	39.6	47.9	70.1	358.6	214.4	144.0
U.S. Income Tax	59.7	17.5	14.6	31.7	158.6	91.1	45.3
Aftertax Income	86.1	22.1	33.3	38.4	200.0	123.3	98.7
Worldwide Earnings Before Income Taxes	229.3	59.1	62.7	172.8	432.1	371.4	277.7
U.S. and Foreign Taxes	85.0	22.9	21.7	41.4	200.9	138.8	84.1
Aftertax Income	144.3	36.2	41.0	131.4	231.2	232.6	193.6

Source: Senate Committee on Foreign Relations.

constitute disadvantages for small operators in the feed-milling and wet-milling industries. For instance, the equipment, plant, and land for feed mills in the 6- to 10-ton-per-hour group require a total investment from $384,000 to $557,000. In the large 35- to 50-ton group, total investment ranges from $1.4 million to $1.9 million. On an annual ton capacity basis, investment for plants in the 6- and 10-ton class range from $30.80 to $26.77 per ton, respectively. In the 35- and 50-ton group, the costs range from $19.17 to $17.99, respectively. Given the investment and operating costs per ton for feed mills of varying capacities, it would seem that the smaller miller operates at a competitive disadvantage. However, transportation costs tend to restrict the geographic area that can be served by one feed mill. Thus smaller, higher cost mills are able to operate in local markets, especially if they are integrated with a livestock feeding operation.

The degree of concentration in the U.S. corn system varies, as noted earlier. The farm sector is fragmented, but a trend toward fewer and larger farms continues as farmers advance in age and as the capital investment required per farm increases. Table 4-17 shows that the wet milling industry is relatively concentrated but new entrants have made it less so and more commodity-competitive, while the feed-milling industry is extremely competitive. The export segment is concentrated, but again new entrants from within and outside the United States have made this segment more competitive. A USDA study of export firms and grain exports shows the four largest exporters handling 49 percent of total exports and the eight largest accounting for 69 percent (see Table 4-26). The four cooperative entrants into the export market are increasing their market share of that business, and Cook's problems and sale of various properties to Japanese multinationals and U.S. farm cooperatives has reduced concentration in the industry and increased competition. Observe that export concentration varies among grains. Wheat trading is most heavily concentrated in the hands of

Table 4-26. Concentration Ratios of Exporting Firms in Exports of U.S. Grain: 1974-1975

Export Firms	*Food Grains*	*Feedgrains*	*Oilseeds and Products*	*Total*
Percent of exports by:				
Four largest	58.3	43.6	41.6	48.6
Next four largest	19.5	20.4	21.1	20.2
Next twelve largest	10.1	29.2	24.6	21.3
Cumulative shares:				
Four largest	58.3	43.6	41.6	48.6
Next four largest	77.8	64.0	62.7	68.8
Next twelve largest	87.9	93.2	87.3	90.1

Source: Sales Monitoring Branch, FAS, USDA, February 1976, reported in U.S. Department of Commerce, *Report to the Congress: Foreign Direct Investment in the United States*, Vol. 4, Appendix E, p. E-13, April 1976.

Table 4-27. Concentration Ratios of Export Firms in Total Export of U.S. Grain, by Type of Grain: 1974-1975

Export Firms	*Wheat*	*Corn*	*Sorghum*	*Soybeans*
Percent of exports by:				
Four largest	61.0	42.0	47.3	40.5
Next four largest	20.7	21.8	15.8	23.2
Next twelve largest	7.5	29.5	30.9	27.1
Cumulative ratio:				
Four largest	61.0	42.0	47.3	40.5
Eight largest	81.7	63.8	63.1	63.7
Twenty largest	89.2	93.3	94.1	90.8

Source: Sales Monitoring Branch, FAS, USDA, February 1976, reported in U.S. Department of Commerce, *Report to the Congress: Foreign Direct Investment in the United States*, Vol. 4, Appendix E, p. 14, April 1976.

the four largest exporters but corn and soybeans, as Table 4-27 demonstrates, are not.

Despite the apparent concentration in wet-milling and export segments, all parts of this commodity system appear highly competitive. Farmers as a group are not in a position to control the marketing of their grain. The growth of cooperatives as feed manufacturers and the diversification of old-line feed millers indicate healthy competition in that segment.[16] The decline in CPC International's share of the starch market, the 1974 rush by several firms to install high fructose capacity, and the subsequent financial difficulties of many of these ventures suggest significant competition in wet milling as well.

In the export segment, competition appears to be more intense than indicated by share-of-export figures. Exporters must compete with domestic feed manufacturers, processors, and livestock producers for corn.[17] National share-of-export figures also mask significant differences among regions and individual markets. They do not reveal that Union Equity—a farmer cooperative—is a major exporter of hard red winter wheat; thus they fail to reflect the considerable competition in local areas and in the trading of certain commodities. The entry of several Japanese firms into the export industry and efforts by farmer cooperatives to enlarge their shares of the export business further prove the existence of effective competition. The financial problems of Cook Grain Company also have added new competition in the industry in 1978.

OVERVIEW OF COORDINATING ARRANGEMENTS

Low margins per bushel and significant price volatility have stimulated participants in the U.S. corn system to develop ways of reducing or spreading risk. The mechanisms for doing this include vertical integration, contractual rela-

tions, cooperatives, the futures market, trade associations, government activities, and econometric modeling.

Domestic Coordination

As the corn system expanded, a host of institutions and arrangements were developed to coordinate this dynamic system.

Vertical Integration. American farmers have made a considerable effort to integrate with the aid of cooperatives. Appendixes C and E describe two particular instances of such arrangements. The trend among farmer cooperatives is to attract more skilled and sophisticated managers and to integrate further forward to secure the benefits of direct market access. In 1973, farmer cooperatives owning about 41 percent of country elevators accomplished 58 percent of American corn marketing. Regional coops own about 19 percent of terminal and subterminal elevators and about 28 percent of port elevators. However, choosing to let export companies deal with the uncertainties of foreign markets and currencies, they export directly only about 5 percent of the farm sales of corn.[18] Cooperatives account for almost a fifth of U.S. feed manufacture. To date, however, they have been reluctant to expose themselves directly to the risks of industrial and consumer marketing by entering the wet-milling and other corn processing industries.

Several cooperatives are coming to rival large private firms in size. Farmland Industries, Associated Milk Producers, Agway, the Grain Terminal Association, Land O'Lakes, and Far-Mar-Co. all had sales exceeding $1 billion in 1975. In the same year, ten large cooperatives accounted for 20 percent of all cooperative sales.[19] Farmers' expanding ownership in key functional areas of several commodity systems is indicated by the merger of Farmland Industries, the nation's largest supply cooperative, and Far-Mar-Co., the largest grain cooperative. The merged cooperatives, with sales in excess of $3 billion, are involved in practically all aspects of farm supply and crop marketing.

Constantly exposed to the complicated risks of the international markets, exporters feel safer investing in activities directly related to their own grain areas. As a result, one finds that all six major exporters own subterminal elevators, and four of them manufacture feed and feed their own stock to some degree.

The oldest feed manufacturers such as Ralston Purina and Central Soya first pursued vertical integration many years ago. Then, as the industry matured following World War II and as competition from cooperatives increased, they diversified into domestic nonfeed activities and into foreign markets. Ralston sold its nonbranded poultry operations but maintains its oil crushing and feed operations. It is moving into the fast-food business and other consumer-oriented operations.

In the past wet millers and processors seem to have done the least backward

integration into the corn system. However, the entrance of Cargill and Archer Daniels Midland into the wet-milling business has added commodity-oriented vertically integrated firms to the structure of the industry. Inactivity in this regard in the past was encouraged by the relative stability of corn prices and relatively less pressure to protect sources of supply.

Contractual Integration. Relations similar to those of vertical integration can be constructed by contract. In the soybean system, where capacity on the farm has ordinarily been somewhat less than domestic and export demand, these contracts have been used for some time. Because corn traditionally has been in excess supply, feed millers have rarely used direct contracts with producers, processors, and exporters. But millers may write such contracts with farmers or their cooperatives if supplies of corn again become tight.

Futures Markets. The futures market establishes a free market price for grain reflecting the assessments of participants throughout the domestic and international corn economy of supply and demand conditions. It also helps the trader manage his risks by allowing him to lock in the basis, or price spread, between the cash and futures price of the commodity. Establishing the best possible spread between the local cash-market price and the terminal futures market quotation is the most important use of the futures market by hedgers.

Corn is one of the most heavily traded commodities in the U.S. futures markets. Since 1972 it has topped all other commodities in numbers of transactions and in average open interest. In the same period, it has been second only to soybeans in trading value. The Chicago futures market for corn is, in effect, the corn futures market for the entire world.

Fluctuations in futures trading activity ordinarily reflect changing supply and demand pressures and inventory conditions. In the years before 1972, the U.S. government's price-support and grain-storage programs caused corn prices to be remarkably stable. Consequently, domestic sellers and buyers of corn had relatively little need for a futures market as a hedging device. But when government corn inventories declined in 1973 and 1974, would-be corn buyers were forced to use the futures market and the total volume and value they traded increased dramatically, as shown in Table 4-28. Exporters and foreign purchasers of corn have always used the futures market; many American firms that did not have to use it previously do so now.

Government Programs. The U.S. government played a major coordinating role throughout this nation's corn system until 1974. Its price-support program set an effective floor price for corn and established the government as the purchaser of last resort. In performing this function, the government accumulated and maintained a large inventory. How it managed that inventory deserves some discussion.

Table 4-2. Summary of World Corn Futures Trading: 1969–1975[a]

Year	*Volume (millions of bushels)*	*Value (millions of dollars)*	*Transactions (000, one side only)*	*Average Open Interests (month end, thousands of contracts)*
1969	8,212	9,948	1,642	49,871
1970	10,757	15,301	2,151	54,119
1971	10,422	14,217	2,084	52,354
1972	9,775	13,202	1,955	53,471
1973	20,887	16,747	4,177	81,025
1974	24,067	79,199	4,813	78,393
1975	25,004	73,185	5,637	81,311

[a]Chicago Board of Trade and Mid-America Commodity Exchanges.
Source: USDA, *Agricultural Statistics, 1976.*

The basic instrument of the price-support program was the Commodity Credit Corporation (CCC), created by Congress in 1933. Its function was to stabilize, support, and protect farm income and help maintain and distribute adequate supplies of agricultural commodities. The CCC's major price-support mechanism was its loan program. The CCC would lend a farmer money secured by his crop at a set rate. Later, the farmer could elect to sell his corn and pay off the loan or surrender his grain as full payment. Naturally, when grain prices fell below loan rates, the CCC accumulated grain inventories. By 1960, the CCC had accumulated very large stocks; it needed to reduce excess production and create storage space for the grain it already had.

To reduce excess production, the agency required farmers in the program to remove land from production and paid them a portion of the revenues that land would have produced had it been planted. The major costs of the government's price-support program therefore shifted from inventory carrying costs to land set-aside payments.

To increase domestic consumption and to make U.S. grain more competitive in the world market, the CCC modified its loan rate program to lower domestic grain prices. It declared a target price higher than the loan rate in 1973. It then paid participating farmers the difference between the loan rate or market price and the target price for their production needed for domestic use, whichever was lower. As a result, farmers continued receiving high target prices, with the difference between the market and the target price being paid out of the U.S. Treasury. The market price fell below the target price and caused more grain to flow into the cash market, because it was still above the government loan price. If cash prices fell below the new and lower loan rate, farmers could still avail themselves of the loan system. The set-aside program and the lowering of loan rates reduced both excess production and excess stocks in the face of unusual foreign and domestic demand in 1973. The liquidation of its inventories brought

at least a temporary end to the CCC's function of price and inventory management (see Table 4-29).

In the meantime, the CCC continues to exist and in 1977-78 is called on again to manage corn inventories and prices. The urging of the European Economic Community to discuss a world coarse grain agreement along with an international wheat agreement means that our current U.S. policy must remain flexible to accomodate both market and international agreement changes.

The CCC and the price controls of the early seventies were superimposed on a system strongly influenced by other government programs and policies that have evolved over many years. These programs include health and grading standards, import quotas on livestock products, tax incentives to feedlots and ranchers, subsidies, antitrust regulation, and food stamps. The government also maintains large enterprises for technical, statistical, and economic research; for information gathering and reporting in the United States and abroad; for extension and education; for administration of agricultural credit; and for supplying domestic and international food assistance. Of special importance to all participants in the world feedgrain economy is the fact that the U.S. government retains the authority and ability to support prices and store commodities. The 1977 Farm Act provides for low farm loan values, higher target prices, and set-aside acreage to build reserves and protect consumers and farmers.

Joint Ventures. Joint ventures are another way in which large corporations and farmer cooperatives seek to reduce their risks, develop expertise in new markets, and obtain access to financing not otherwise available to them.

In 1977, American Maize Products and the Amalgamated Sugar Company began a joint operation called Amalgamaize. The former partner's motive in launching the project was its desire to enter the high fructose corn syrup market. Amalgamated Sugar conceived the venture partly as a defensive move, since high fructose corn syrups threaten to reduce sucrose's dominance of the caloric sweetener market. But the company also saw Amalgamaize as an offensive step because it conceived itself as a competitor in the sweetener industry in general, not merely in the sugar industry. Located near major road and river transportation in Alabama, the Amalgamaize facility is now a highly automated, integrated starch and high fructose syrup facility with a daily grind capacity of 35,000 bushels of corn.

Another example of a joint venture, this one in the export segment of the corn industry, is Farmers Export Company (FEC). A federation of regional grain cooperatives, FEC gives its member cooperatives direct access to the export market. Formed in 1968 to market grain for export, it sells mostly corn and soybeans, though it also handles wheat. Its 135,000-ton export terminal in Louisiana is reported to be highly efficient.[20]

Trade Associations. Trade associations perform their coordinating function by informing members of significant factors and developments in the commod-

Table 4-29. Summary of U.S. Government Programs Affecting Corn

Year	Price Support Level: Loan Rate	Price Support Level: Support Payment (cents per bushel)	Price Support Level: Support Price	Put Under Support: Quantity (millions of bushels)	Put Under Support: Percent of Production	Owned by Commodity Credit Corporation 9/30 (millions of bushels)[a]	Land Set Aside of Diverted (millions of acres)	Total Payments to Farmers (millions of dollars
1955	1.58	b	1.58	421	14.7	818	b	b
1956	1.50	b	1.50	477	15.5	932	5.3[c]	180[c]
1957	1.40	b	1.40	369	12.1	1,101	5.2[c]	196[c]
1958	1.36	b	1.36	381	11.4	1,153	6.6[c]	282[c]
1959	1.12	b	1.12	529	13.8	1,286	b	b
1960	1.06	b	1.06	637	16.3	1,327	b	b
1961	1.20	b	1.20	659	18.3	888	19.1	645
1962	1.20	b	1.20	591	16.4	810	20.3	684
1963	1.07	.18	1.25	395	9.8	828	17.2	680
1964	1.10	.15	1.25	216	6.2	540	22.2	927
1965	1.05	.20	1.25	215	5.2	148	24.0	1,094
1966	1.00	.30	1.30	263	6.4	139	23.7	1,028
1967	1.05	.30	1.35	497	10.4	182	16.2	730
1968	1.05	.30	1.35	404	9.2	290[a]	25.4	1,166
1969	1.05	.30	1.35	398	8.7	197[a]	27.2	1,365
1970	1.05	.30	1.35	324	7.9	97[a]	26.1	1,228
1971	1.05	.32	1.35	953	16.9	156[a]	14.1	893
1972	1.05	.0[d]	1.41	420	7.5	4[a]	24.4	1,469
1973	1.05	.0[d]	1.64	261	4.6	0[a]	6.0	910
1974	1.10	.0[d]	1.38	77	1.7	0[a]	.0	244
1975	1.10	.0[d]	1.38	147	2.5	0[a]	.0	90
1976	1.50	.0[d]	1.57	253	4.1	0[a]	.0	181
1977	2.00	–	2.00	–	–	–	.0	221

[a]Uncommitted inventory only.
[b]Not permitted under U.S. farm program.
[c]Soil bank.
[d]Permitted under U.S. farm program—but no payment had to be made due to favorable market conditions.
Source: USDA, *Agricultural Statistics, 1977,* and earlier years.

ity system. The National Corn Growers' Association publishes a regular newsletter for its members. The organization's primary concerns are to increase corn productivity, foster improved market conditions, and present an organized lobby for legislation affecting corn. Elevator operators have associations such as the Northwest Country Elevator Association and the Terminal Grain Elevator Association to deal with and influence governmental and regulatory activities affecting the storage of grains. Processors' products are represented by the Corn Refiners' Association (wet millers), the American Corn Millers' Federation (dry millers), the National Grain and Feed Association, and the American Association of Feed Manufacturers.

International Coordination

Many of the coordinating devices used in the international environment by domestic and foreign participants in the U.S. corn system are similar to those employed within the United States. They include futures markets, cooperatives, vertical integration, and contractual arrangements. However, some of these devices—multinational firms and government-to-government arrangements, for example—have not been discussed so far in this review of coordinating devices. They include proposed international coarse grain agreements modeled on U.S. low price supports, high cost of production target prices with buffer stocks protecting both the consumer in times of shortages and the producer in times of gluts. In between the cash and futures markets are encouraged to do their market allocation tasks. Other unique international arrangements include consortiums for agricultural development and private and public joint ventures as described in cases later on in this study.

Vertical Integration. From within the United States, farmer cooperatives have integrated forward into grain exporting. Fourteen regional cooperatives export grain, although only four have significant direct export volume.

In obtaining a larger share of U.S. corn exports, cooperatives established to export must overcome some significant barriers. The major trading companies have well-developed market intelligence systems; broadly diversified operations; flexibility in terms of types of grains handled, control of transport capacity, and ability to ship from a number of U.S. ports; diversity of interior grain sources; ownership of foreign facilities; foreign sales offices; operating secrecy; and an established reputation for grain quality and (generally) uniform ship loading.

These are significant hurdles to overcome, yet cooperatives do have certain advantages of their own. Local cooperatives produce about 40 percent of the corn eventually exported, and regional cooperatives produce between 25 percent and 30 percent of corn exports. Although exporting cooperatives own only nine port elevators (17 percent of the nation's total), greater use and expansion of these facilities would double their export capacity.[21] These cooperatives are reported to have the available debt capacity such an effort would require. The

cooperatives have an additional advantage in that many international cooperatives are customers for their corn, such as Zen-Noh in Japan and various European cooperatives. Working together, these cooperatives could form a formidable international grain entity.

As U.S. cooperatives have integrated forward, foreign cooperatives have been reaching back. For example, the National Agricultural Cooperative Federation of Japan (Zen-Noh) maintains with Farmers Export Company the contract discussed in Appendix A to Chapter 2 as an important part of its procurement strategy. Some years ago, most Japanese importers purchased corn from the major trading companies c.i.f. Japan, leaving to the trading companies the risks and rewards of arranging ship charters, foreign currency transactions, and the hedging of grain in transit. In the 1960s, Japanese trading firms came to realize how profitable these activities can be and developed their own expertise in them. They began to purchase corn on an f.o.b. basis in the Unites States, and opened offices to handle the details of gathering market intelligence, hedging, and freighting.

From f.o.b. purchasing it is only one more step to outright ownership of port elevator facilities. Four Japanese firms—Mitsubishi, Mitsui, C. Itoh, and Marubeni—have taken this step already. Mitsubishi owns an elevator in Long Beach, California, and Mitsui has facilities in Sacramento, California and Portland, Oregon. Mitsui purchased the Cook Export elevator at the Gulf and Marubeni purchased Cook's Oregon elevator. Given Japan's steadily growing need for corn and other feedgrains, further acquisitions seem likely.

Of course, several of the major grain trading firms have been vertically integrated in the corn system for a number of years. Cargill, Continental, and Bunge have for years maintained trading and milling activities in many countries. In an international commodity system, vertical integration tends to follow growth in volume.

Vertical integration has proceeded as far as the farm. Although data are scanty, non-Americans are buying significant amounts of U.S. grain land. A study of their purchases was made in 1975 in Iowa, the heart of the corn belt. Of 710 real estate brokers polled, 65 reported activity of some kind during 1974 and 1975: 54 reported inquiries and 30 reported transactions. Of the twenty-four transactions studied, seventeen involved German investors, four involved Italians, four involved Japanese, and the remainder were unknown.[22] A more recent study in 1978 indicates that there are six thousand known foreign landholders with holdings of more than 200 acres, holding less than 5 million acres all together. This represents less than 1 percent of all U.S. privately held real estate.[23]

Vertical integration has been and will continue to be an increasingly important means of coordinating activity in the U.S. corn system with that in other national systems, barring some breakdown in the world's legal or political order. Its increasing use is likely to subject it to broader publicity and to greater regula-

tion. Therefore, other forms of integration—particularly contractual agreements—will replace it to avoid disturbing political sensitivities as the use of contracts in coordinating international commodity systems becomes more familiar.

Multinational Firms. U.S. multinational firms are themselves coordinators of many parts of the international corn system. Early entries in the feed-milling industry—Ralston Purina, Archer Daniels Midland, and Central Soya, for example—developed markets for their basic products in the United States. Subsequently, as competition increased from other private firms and cooperatives, these companies diversified their activities within the United States and expanded their basic business overseas. Ralston Purina's formula feeds were the result of a new technology when they first appeared in the United States in the early 1900s. As the technology and the industry matured in the United States, Purina sought new markets overseas, where its technology was still new. Its first foreign operation, established in Canada before 1950, was followed by others in Mexico in 1956 and in Venezuela and Colombia in 1957. It established a subsidiary in Japan in 1970 after setting up one in Thailand in 1969. Today, Purina operates subsidiaries in thirty-four countries outside the United States.

An example of multinational firms from the wet-milling industry is CPC International, which is described in Appendix A to this chapter. These are only two of the most visible examples of the development of U.S. multinational firms. Each company has been followed by others in its industry. In each location where they have established themselves, they have created forward and backward market linkages that have tended to coordinate several segments of local and regional corn systems.

Multinational firms have also acted as agents of technology transfer, trainers of local managers, and stimulants to economic growth. In short, they have done more than merely develop new markets for existing products. In these ancillary activities, multinationals play a coordinating role as important as new market development. They are and will continue to be leaders in the coordination of international markets.

Government-to-Government Agreements. The uncertainties of supply and price in world grain markets in the mid-1970s were heightened by unpredictable purchasing by the Soviet Union and the People's Republic of China. USSR and Chinese purchases in 1972 were largely responsible for the liquidation of U.S. grain stocks in 1973 and 1974. Realizing that the Soviet Union was likely to be a continuing if erratic customer for American grains, the U.S. government obtained the USSR's formal agreement to purchase thirty million tons of U.S. wheat and feed grains over a five-year period. This agreement was a milestone in the evolution of interntional grain trading. United States agriculture depends upon its export markets; the Soviet Union is striving to upgrade the quality of consumer diets. The two governments saw the need to coordinate these vital

parts of their domestic food policies. Similar formal agreements involving other commodities and other countries offer the prospect of coordinating significant segments of the world food economy in the future.

Less formal than the U.S.-USSR agreement is the understanding between the U.S. and Japanese governments described in the previous chapter. Japan will continue to be an important purchaser of U.S. corn and feedgrains, and it will in all likelihood be eager for a renewal of the same or a similar understanding.

SUMMARY

This chapter has examined the trends, structure, and coordinating relations, both domestic and international, of the corn system of the United States. It has shown that participants in this developed segment of the world corn system were able, during the 1970s, to cope with the uncertainties engendered by supply and price fluctuations beyond their previous experience. As noted in this chapter and documented in the cases found in the appendixes, firms responded by creating unique relations for their procurement and marketing functions.

Chapters 3 and 4 have made it obvious that within a commodity system, commercial decisionmaking and government activity interact and influence each other. Government and commercial participants in developed commodity systems do not—indeed, cannot—make decisions without knowledge of each other's needs and constraints. Japan's considerable dependence on imported food supplies forces this realization on participants in that nation's food system. In the United States, the dramatic depletion of grain stocks and the return to freer and more volatile market activity reminded corn-system participants to predict and allow for changes in government policy. The 1977 Farm Act expresses the government's recognition that the producer needs protection during periods of grain surplus and that the consumer needs price protection when shortages occur. At the same time, the price band between price supports and consumer price protection should be wide enough to allow cash and futures markets to facilitate changes in supply, demand, and market structure variables.

In developed commodity systems, as we have seen, practically all participants are in the commercial sector. Extensive differentiation of function exists throughout the system. Decisionmaking may be fairly concentrated at certain functional levels or in some industry segments, but usually significant numbers of commercial participants and new entrants compete at each level.

As the next chapter will show, commercial participants in developing commodity systems are outnumbered by noncommercial and semicommercial participants. The leverage points at which such systems can be influenced are less numerous than in developed systems, and the results of actions taken at these points are less powerful. By building links between their commercial and semi- or noncommercial participants, we can encourage the evolution of developing commodity systems—an essential step in meeting the social, politcal, and eco-

nomic goals of developing nations. The transfer of a commodity system approach to the developing corn countries of Southeast Asia, with appropriate adaptations to fit their national priorities, is one important contribution that the private, cooperative, and public entities of the diversified world can make to the mutual benefit of both parts of the world corn system.

NOTES

1. Economic Research Service, USDA, *Food: Consumption Prices, Expenditures* (AER 138), pp. 59 and 61; Economic Research Service, USDA, *Handbook of Agricultural Charts 1976*, pp. 92 and 106; and Bernard Tobin and Henry Arthur, *Dynamics of Adjustment in the Broiler Industry*, Harvard Graduate School of Business Administration, Division of Research, 1964, p. 11.

2. Based on corn owned by the Commodity Credit Corporation as of 31 December 1966–1971, as reported in *Agricultural Statistics, 1976*, p. 508. See Table 4-2.

3. Under the 1985 assumption of median population and high income growth rates combined with liberalized trade policies in the developed importing countries, total world grain imports are projected to reach 192 million tons, with the United States supplying 116 metric tons. *Alternative Futures for World Food in 1985*, USDA, Foreign Agricultural Service, Report No. 146, April 1978, p. xi.

4. R.A. Anderson, "Corn Wet Milling Industry," in G.E. Inglett, ed., *Corn: Culture, Processing, Products*, Westport, Conn., AVI Publishing Company Inc., 1970, p. 163.

5. *Farm Financial Conditions: Perspectives and Prospects*, USDA, Economies, Statistics and Cooperatives Service, No. 33, p. 24.

6. "A Bumper Crop of Controversy Over Farm Aid," *Business Week*, 18 April 1977.

7. See, for example, Economic Research Service, USDA, *Food Situation*, November 1976, p. 8.

8. John T. Dunlop et al., *The Lessons of Wage and Price Controls - The Food Sector*, Harvard Graduate School of Business Administration, Division of Research, Harvard University Press, Cambridge, 1977, pp. 280–281.

9. Ibid, pp. 258–259.

10. Economic Research Service, USDA, *The Formula Feed Industry, 1969*.

11. *Structure of the Feed Manufacturing Industry 1975*, Economics, Statistics, and Cooperatives Services, USDA, Statistical Bulletin, No. 596, pp. ii–iii.

12. Statement of Mr. Walter B. Saunders, Group Vice President for Marketing and Transportation, Cargill Corporation, before the Senate Subcommittee on Multinational Corporations, Committee on Foreign Relations, Thursday, 24 June 1976.

13. Economic Research Service, USDA, *Feed Manufacturing Costs and Capital Requirements* (AER No. 335), May 1976, p. iii.

14. ConAgra, Inc., *Form 10-K Annual Report to the Securities and Exchange Commission*, 30 May 1976.

15. American Maize Products, *Form 10-K Annual Report to the Securities and Exchange Commission*, 31 December 1975, p. 12.

16. Appendix C, the case of the Indiana Farm Bureau Cooperative Association (B), is but one example of the outstanding and sophisticated positioning of cooperatives in the U.S. and world corn systems. All trends point to their further growth.

17. See Appendix E, the Early & Daniel Industries case, for a closer look at the internationalization of the U.S. corn system.

18. Secretary Bergland and others have encouraged U.S. cooperatives to take a more active role in the international grain trade, using Zen-Noh as a model. One example of the cooperatives' response is Farmers Export Company's recent acquisition of a large grain terminal on the Texas Gulf Coast.

19. Farm Cooperative Service, *Annual Reports* and news releases.

20. Farmer Cooperative Service, USDA, *Improving the Export Capability of Grain Cooperatives* (F.C.S. Research Report No. 34), June 1976, p. 44.

21. Ibid. p. v.

22. Economic Research Service, USDA, *Foreign Investment in U.S. Real Estate*, June 1976, pp. 118 and 131.

23. In March 1967 the average value per acre of U.S. farmland was $168. Total value of farm real estate was $182 billion. In February 1978 the average acre was valued at $450 and total farm real estate was valued at $527 billion. This is a strong incentive for both foreign and U.S. investment. E.S.C.S., USDA, *Foreign Ownership of U.S. Real Estate In Perspective* (Research Report No. 24), 1978.

INTRODUCTION TO APPENDIXES A-E

The CPC case, The Charles Pullin case, the two Indiana Farm Bureau cases, and the Early and Daniels case are included as an Appendix to Chapter 4 to provide the reader with specific decisionmaking perspectives in a changing domestic and world corn system and to show the variety of coordinating arrangements and institutions used by these decisionmakers in relating their operations to the changing structure of the corn system. We hope that these cases will prove useful to private and public decisionmakers in the corn system as they review and analyze their own positions.

CPC International

In the CPC International case the increasing competition of new entrants into the wet-milling business, the high fixed investment of corn sweetener operations, the uncertainties of government corn price, and beet and cane price policies all had to be put into perspective.

Charles Pullin

The Charles Pullin case is typical of farmers in the United States who have seen farm values expand greatly but face cost-price pressures and uncertainties between crops and livestock combinations. The 1977 Farm Act provides more direction and more safety valves to Charles Pullin than were available in 1975 (the time of the case), but the issues and problems remain the same.

Indiana Farm Bureau Cooperative Association, Inc. (B) and The Indiana Farm Bureau Cooperative Association Inc.

The two Indiana Farm Bureau cases provide insight into the growth of farm cooperatives in the U.S. corn system and the unique way the cooperative is extending its activities in farm inputs (fertilizer, oil, feed, etc.); into international grain trade; and into long-term arrangements with its farmer members providing them feed and markets for their livestock and poultry through long-term contracts with processors—who in turn have long-term contracts with retail outlets. These domestic and international arrangements, together with the development of an effective internal cooperative organization, are useful models that can be adapted to many of the problems of the Southeast Asian corn economy.

Early and Daniels Industries, Inc.

The Early and Daniels case provides an analysis of an expanding new entrant in the grain export world. Through this firm's eyes one can better understand the changing global corn economy and the many alternatives available to this firm to relate the U.S. farm economy to the developing farm economies of the world corn system.

APPENDIX A

CPC INTERNATIONAL, INC.*

In late June 1975, Jim Eiszner, president of the Industrial Division of CPC International, Inc., was reviewing the past year and a half to assess the effect of recent corn price fluctuations on his division's performance. Although corn prices during 1974 had doubled, causing a major increase in corn processing costs, sugar prices had sextupled and triggered very strong demand for corn sweeteners. However, weakness in the raw sugar market in the first half of 1975 had lowered the sugar price to a quarter of its high, and some felt that it could fall to the old levels. Recognizing that corn wet-processing was a cyclical industry, Dr. Eiszner knew conditions would continue to change. He was reexamining the elements that affected the profitability of his division: purchasing of raw materials, pricing of finished products, and efficiency of conversion. Eiszner concluded that the efficiency of conversion was fairly stable, but that the volatility of raw-material and finished-product prices might expose the division to some new risks as well as new opportunities. He wondered how those risks might be managed while the new opportunities were developed.

Background of CPC International, Inc.

Formed in 1906, CPC had grown to become the world's largest corn refiner with 1974 sales of $2.57 billion and earnings of $99 million (see Table 4A-1 for CPC's financial details). At one point, it had almost two-thirds of the U.S. market for corn wet-milling products. Although by 1974 its U.S. market share had declined to about 25 percent, it was still the largest worldwide refiner by a significant margin. CPC had so expanded internationally that 50 percent of its sales were from overseas sources (see Figure 4A-1). Sales were also evenly divided between its two major business categories—consumer and industrial. Industrial lines accounted for 48.6 percent of sales and consumer products, 51.4 percent. Food products, however, accounted for more than 80 percent of sales. In the consumer business, these products included convenience and specialty products under leading brand names, such as Hellmann's mayonnaise; Skippy peanut butter, Knorr soups, bouillons, sauces, and gravies; and Mazola corn oil and margarine. On the industrial side, CPC's products included sweeteners and starches supplied to food-processing industries and ingredients for livestock feeds. Nonfood lines included starch for textile and paper manufacture, adhesives and binders, and medicinal and fine chemicals for industrial uses. See Table

*This case was prepared by Richard C. Gartrell, under the supervision of Ray A. Goldberg, Moffett Professor of Agriculture and Business, as a basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Table 4A-1. CPC International, Inc.: Ten-Year Financial Highlights (All figures are in thousands except per share amounts)

Summary of Operations	*1974*	*1973*	*1972*	*1971*
Net Sales				
United States	$1,293,086	$ 856,449	$ 701,765	$ 680,310
International	1,277,187	1,017,853	847,817	756,294
	$2,570,273	$1,874,302	$1,549,582	$1,436,604
Cost of goods sold	$1,986,670	$1,372,792	$1,106,781	$1,056,400
Interest expense	$ 35,289	$ 26,300	$ 25,921	$ 27,370
Provision for taxes on Income	$ 84,347	$ 71,531	$ 60,176	$ 40,754
Income from continuing operations before extraordinary items:				
United States	$ 36,754	$ 29,602	$ 24,736	$ 15,573
International	53,024	45,891	39,538	37,141
	$ 89,778	$ 75,493	$ 64,274	$ 52,714
Income from divested and discontinued operations (net of income taxes)	$ –	$ –	$ 2,114	$ 1,889
Income before extraordinary items	$ 89,778	$ 75,493	$ 66,388	$ 54,603
Extraordinary items (net of income taxes)	9,375	–	20,234	(3,052)
Net income for Year	$ 99,153	$ 75,493	$ 86,622	$ 51,551
Average number of shares outstanding	23,617	23,658	23,688	23,736
Earnings per share based on average shares outstanding:				
Income from continuing operations before extraordinary items:				
United States	$ 1.56	$ 1.25	$ 1.04	$ .66
International	2.24	1.94	1.67	1.56
	3.80	3.19	2.71	2.22
Income from divested and discontinued operations (net of income taxes)	–	–	.09	.08
Income before extraordinary items	3.80	3.19	2.80	2.30
Extraordinary items (net of income taxes)	.39	–	.85	(.13)
Net income for year	$ 4.19	$ 3.19	$ 3.65	$ 2.17
Dividends declared per share	$ 1.39	$ 1.791	$ 1.717	$ 1.70
Balance Sheet Data				
Working capital	$ 274,601	$ 269,177	$ 238,389	$ 202,886
Plants and properties (net)	521,047	478,899	460,705	471,305
Total assets	1,351,088	1,200,821	1,083,563	1,042,719
Long-term debt	164,871	166,914	175,337	204,277
Short-term debt	146,868	111,927	90,104	98,945
Total debt	311,739	278,841	265,441	303,222

Table 4A-1. continued

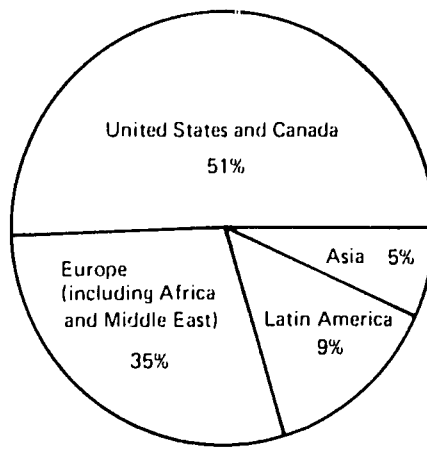
1970	*1969*	*1968*	*1967*	*1966*	*1965*
$ 652,714	$ 579,159	$ 585,410	$ 559,765	$ 568,174	$552,774
674,366	591,522	512,863	486,094	475,363	425,765
$1,327,080	$1,170,681	$1,098,273	$1,045,859	$1,043,537	$978,539
$ 937,112	$ 815,635	$ 763,487	$ 749,585	$ 750,281	$704,059
$ 24,760	$ 20,735	$ 16,814	$ 13,884	$ 10,132	$ 6,640
$ 55,040	$ 57,527	$ 55,182	$ 42,994	$ 47,303	$ 42,854
$ 29,071	$ 26,726	$ 26,964	$ 24,299	$ 29,845	$ 28,259
30,707	26,437	26,071	24,875	27,890	25,931
$ 59,778	$ 53,163	$ 53,035	$ 49,174	$ 57,735	$ 54,190
$ 1,202	$ 2,134	$ 908	$ 472	$ 23	$ (11)
$ 60,980	$ 55,297	$ 53,943	$ 49,646	$ 57,758	$ 54,179
–	–	–	1,129	570	–
$ 60,980	$ 55,297	$ 53,943	$ 50,775	$ 58,328	$ 54,179
23,798	22,840	22,924	22,217	22,242	22,283
$ 1.22	$ 1.17	$ 1.17	$ 1.11	$ 1.35	$ 1.27
1.29	1.16	1.14	1.12	1.25	1.16
2.51	2.33	2.31	2.23	2.60	2.43
.05	.09	.04	–	–	–
2.56	2.42	2.35	2.23	2.60	2.43
–	–	–	.05	.02	–
$ 2.56	$ 2.42	$ 2.35	$ 2.28	$ 2.62	$ 2.43
$ 1.70	$ 1.70	$ 1.70	$ 1.70	$ 1.625	$ 1.525
$ 205,808	$ 196,210	$ 208,945	$ 208,506	$ 152,385	$143,646
457,213	421,808	396,537	369,580	352,578	324,173
1,008,138	931,092	869,191	802,183	703,188	653,087
205,476	191,689	192,018	179,068	112,252	99,949
85,187	74,068	60,966	43,590	40,968	37,797
290,663	265,757	252,984	222,658	153,220	137,746

(continued)

Table 4A-1. continued

Summary of Operations	*1974*	*1973*	*1972*	*1971*
Shareholders' equity	$ 595,565	$ 542,333	$ 509,990	$ 464,596
Shareholders' equity per share	25.23	22.95	21.54	19.60
Shares outstanding, year end	23,605	23,636	23,675	23,703
Statistical Data				
Capital expenditures	$ 92,498	$ 66,230	$ 59,378	$ 54,024
Depreciation	41,076	39,937	40,219	39,656
Marketing (including advertising and promotion)	105,259	92,146	88,215	83,533
Research and development	17,736	16,026	16,350	18,286
Total employee costs	412,347	359,175	325,148	299,815

Source: CPC International, Inc., *1974 Annual Report.*



Source: CPC International, Inc., *1974 Annual Report.*

Figure 4A-1. CPC International, Inc.: Worldwide Sales Geographical Sources

4A-2 for a breakdown of sales by market categories. This wide product range and the broad geographic distribution of its basic businesses provided CPC with flexibility to cushion fluctuations in both raw material prices and demand in any one area.

Best Foods, CPC's American consumer division, purchased most of its corn ingredients from the industrial division at the lowest price the division offered

Table 4A-1. continued

1970	*1969*	*1968*	*1967*	*1966*	*1965*
$ 456,224	$ 424,194	$ 406,928	$ 384,431	$ 378,606	$ 357,872
19.18	18.57	17.82	17.30	17.02	16.06
23,787	22,842	22,830	22,217	22,242	22,283
$ 68,048	$ 48,527	$ 45,955	$ 42,447	$ 54,306	$ 57,651
37,757	34,925	32,571	31,018	29,114	26,567
77,539	78,830	70,896	67,602	62,919	60,450
16,997	16,892	16,629	14,571	10,410	9,000
275,980	235,841	218,173	193,466	178,396	165,000

outside buyers. Among Best Foods' corn products were Argo cornstarch, vegetable oil-based salad dressings, and Rit dyes. Although Best Foods' purchases amount to only 5 to 10 percent of the industrial division's volume, it was the market leader in every consumer product based on wet-milling derivatives.

The industrial division was responsible for the purchase of corn and other processing ingredients, all plant operations, and sales to commercial consumers. It was the industrial division that competed for sales with the other eleven wet millers in the industry.

Industry Background on Corn Wet Milling

Wet milling is a procedure for processing corn to produce starch, syrup, corn sugar, corn oil, and by-products such as steepwater and gluten feed.[1] The process begins when cleaned shelled corn is soaked in warm water containing sulphur dioxide to retard fermentation and aid in the extraction of soluble materials from the corn. These solubles and germ are the first parts to be separated. Since most corn oil is not sold in this crude form, it is refined for use in salad and cooking oils and in margarine. The next step is the removal of the hulls from the gluten and starch. Hulls are dried and added to corn gluten feed. Finally, gluten is separated from the starch; most of it is used in corn gluten feed and meal—ingredients in livestock and poultry rations. Wet starch from the mill can then either be dried for starch or further processed into syrup and dextrose.

Companies based the decision to dry the wet starch or process it into syrup on relative prices and available plant capacity. Most plants were constructed with drying and syrup-producing capacities that exceeded the wet starch-producing capacity so that management could vary the mix of dry starch and syrup pro-

Table 4A-2. CPC International, Inc.: Worldwide Sales by Market Categories

Worldwide Sales by Market Categories

The following categories comprise the company's lines of business:

Industrial Food includes starches, and sweeteners such as dextrose, corn syrups, sucrose and corn and sweetener blends. These are sold to manufacturers of soft drinks, candy, ice cream, baked goods, snacks, beer and fermented beverages, among others.

Industrial Nonfood comprises a variety of starches, starch adhesives, synthetic resins, pharmaceutical materials and emulsion polymers. Customers include paper, pharmaceutical, textile, cosmetics, foundry, furniture, and many other industries.

Consumer Food encompasses branded products such as Hellmann's and Best Foods mayonnaise, Skippy peanut butter, Knorr dehydrated soups, bouillon cubes, sauces and gravies, Maizena corn starches, Alsa instant desserts, Mazola corn oil and margarines, Dextro-Energen dextrose-based tablets, Karo syrups, and Adler cheeses.

Consumer Nonfood includes Niagara spray starch and fabric finish, Nusoft fabric softener, and Rit tints and dyes.

Agribusiness embraces products derived from corn processing operations such as fiber, gluten and steepwater which are sold primarily to the animal and poultry feed industries.

Miscellaneous operations include institutional food supply and restaurant businesses, and specialty contract packaging.

The table below shows the percentage contribution of each category to total corporate sales since 1970:

	1974		*1973*		*1972*		*1971*		*1970*	
	Millions of Dollars	*Percentage*	*Millions of Dollars*	*Percentage*	*Millions of Dollars*	*Percentage*	*Millions of Dollars*	*Percentage*	*Millions of Dollars*	*Percentage*
Industrial Food	704.3	27.4	406.4	21.7	338.4	21.9	327.4	22.8	303.4	22.9
Industrial Nonfood	351.5	13.7	260.2	13.9	218.7	14.1	202.2	14.1	198.1	14.9
Consumer Food	1,100.0	42.8	855.8	45.8	730.3	47.1	675.4	47.0	609.7	46.0
Consumer Non-Food	39.9	1.6	38.1	2.0	43.8	2.8	45.0	3.1	43.1	3.2
Agribusiness	193.8	7.5	175.3	9.4	103.8	6.7	95.4	6.6	93.2	7.0
Miscellaneous	180.8	7.0	138.5	7.4	114.6	7.4	91.2	6.4	79.8	6.0
	2,570.3	100.0	1,874.3	100.0	1,549.6	100.0	1,436.6	100.0	1,327.1	100.0

Since the company's integrated processing operations which convert single raw materials into many consumer and industrial products would require arbitrary cost allocations, any meaningful analysis of profits by market categories is impossible, and is consequently not supplied.

Source: CPC International, Inc., *1974 Annual Report.*

Table 4A-3. Quantity and Value of Selected Corn Products (in millions of pounds and millions of dollars)

	1972		*1967*		*1963*	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Corn syrup, unmixed	4128.1	165.2	2740.5	131.4	2261.3	113.5
Corn sugar, crude and refined	1433.7	99.8	1355.0	92.0	1204.0	80.3
Cornstarch	3588.3	208.8	3119.0	199.5	2565.1	177.3
Dextrin	83.3	11.5	168.7	16.0	118.9	9.9
Wet-process corn by-products	5009.6	180.5	3660.5	110.1	2437.7	78.9

Source: CPC International, Inc.

duced. Across the industry, about 40 percent of wet starch was dried and 60 percent was converted to sweeteners.

Starches were used primarily for further industrial processing. The principal industrial consumers of starch were the paper and textile industries, where starches were used for texture and finish. Although potato starch competed with corn, potatoes had accounted for only about 5 percent of the starch market in the past. Wholesale potato prices had ranged from $2.80 to $19.00 per hundredweight in New York since 1963, but the prevailing prices had been less than $4.80. The 1974 price was about $5.00 A 56-pound bushel of corn currently sold for about $2.95. Since 100 pounds of potatoes yielded only 11 pounds of starch, potato starch was attractive only for specialized uses.

Corn sweeteners were used primarily in bakery and confectionery products, where they competed against sugar. Sweetener products were valued and priced according to the sweetness. Sugar, the sweetest and most expensive, was followed by dextrose and then by corn syrup. In 1972, U.S. sugar refining sales had been 11.4 million tons, compared to less than 3 million tons of corn syrups and dextrose (see Table 4A-3).

Levulose, or high fructose corn syrup, nearly equaled sugar for sweetness. Although markets for this new product were still developing, its prospects were thought to be good; it was estimated that 25 percent to 50 percent of the sugar used industrially might eventually be replaced by high fructose corn syrup. The product could be substituted for liquid sugar in beverages, ice cream, and many other consumer goods. Table 4A-4 traces the per-capita consumption of sugar and corn products in the United States. The recent high price of sugar had accelerated the shift away from sugar to other sweeteners, but this shift had been limited by the available capacity of the corn sweetener industry.

The major raw material required for wet milling was corn. But such a small pecentage (5.5 percent) of the corn crop went to wet milling that changes in demand for wet-milling products had an almost negligible effect on corn prices.

Table 4A-4. U.S. Per-Capita Consumption Sugar and Corn Sweeteners (in pounds)

Year	*Refined Sugar*	*Dextrose*	*Corn Syrup*	*Total Corn Sweeteners*
1960	97.5	4.5	9.4	19.9
1961	97.3	4.6	9.8	14.4
1962	97.6	4.8	10.6	15.4
1963	97.7	5.3	11.2	16.5
1964	95.9	5.2	12.2	17.5
1965	96.8	5.3	12.3	17.6
1966	98.3	5.4	12.5	17.9
1967	97.0	5.0	11.4	16.4
1968	98.7	5.0	12.3	17.3
1969	101.2	5.0	12.5	17.5
1970	102.3	5.4	13.1	18.5
1971	103.7	5.6	13.7	19.3
1972	102.1	5.2	15.4	20.6
1973	103.5	5.7	17.6	23.3
1974 Preliminary	96.5	5.2	20.3	25.6
Projections				
1975	94.5	6.3	21.6	27.9
1976	92.0	See Total		36.0
1977	90.9	See Total		39.1

Source: ESCS, USDA.

Rather, the price of corn was determined almost entirely by the domestic and international demand for corn as feed. However, the events of 1972-74 had driven futures prices as high as $3.96 a bushel the previous December.

If prices for raw materials had been high, however, prices for wet-milling products were even higher. Although corn prices were at $3.50, a world sugar shortage had driven the prices of sugar to over $60 per hundredweight from $15.3 per hundredweight in just one year. Sugar users were trying desperately to find less expensive sugar substitutes, and as a result demand for corn sweeteners and corn sweetener prices had risen significantly. The high corn prices were more than offset by high corn sweetener prices.

Historically, this good fortune was not the rule. In 1970, a corn blight attacked the U.S. corn crop, destroying much of it, and driving 1971 corn prices high. At that time, demand for wet-milling products was not high. The industry was operating below capacity and new plants were coming on line. Competition drove 1972 corn syrup prices to a twenty-five-year low (Table 4A-5).

In contrast with prices for corn sweeteners, corn gluten prices did move in relation to corn (Table 4A-6) because most corn was used for feed. Corn gluten and other milling by-products were sold to the feed-milling industry. Across the United States about nine thousand feed mills bought ingredients for special feeds for poultry, hogs, and cattle. Most of these ingredients were mixed accord-

Table 4A-5. Wholesale Price Quotations for Sugar, Dextrose, and Corn Syrup

Period	Refined Sugar Wholesale Northeast[a]	Dextrose New York[b]		Corn Syrup New York[c]		Dextrose Relative to Refined Sugar		Corn Syrup Relative to Refined Sugar	
		Quoted	Dry Basis[d]	Quoted	Dry Basis[d]	Quoted	Dry Basis	Quoted	Dry Basis
	(Cents per pound)					(Percent)			
1952	8.62	7.29	7.92	7.37	9.18	85	92	85	106
1953	8.72	7.35	7.99	7.32	9.12	84	92	84	105
1954	8.72	7.32	7.96	7.32	9.12	84	91	84	105
1955	8.59	7.22	7.85	7.25	9.03	84	91	84	105
1956	8.77	7.28	7.91	7.15	8.90	83	90	82	101
Average 1952–56	8.68	7.29	7.93	7.28	9.07	84	91	84	104
1957	9.15	7.65	8.32	7.36	9.17	84	91	80	100
1958	9.27	7.66	8.33	7.37	9.18	83	90	80	99
1959	9.33	7.48	8.13	7.31	9.10	80	87	78	98
1960	9.43	7.48	8.13	7.32	9.12	79	86	78	97
1961	9.40	7.45	8.10	7.23	9.00	79	86	77	96
Average 1957–61	9.32	7.54	8.20	7.32	9.11	81	88	79	98
1962	9.60	7.40	8.04	7.01	8.73	77	84	73	91
1963	11.94	8.37	9.10	7.38	9.19	70	76	62	77
1964	10.68	8.14	8.85	6.71	8.36	76	83	63	78
1965	10.22	8.00	8.70	6.64	8.27	78	85	65	81
1966	10.36	8.16	8.87	6.70	8.34	79	86	65	81
Average 1962–66	10.56	8.01	8.71	6.89	8.58	76	82	65	81
1967	10.62	8.37	9.10	6.75	8.40	79	86	64	79
1968	10.84	8.53	9.27	6.31	7.85	79	86	58	72
1969	11.44	8.98	9.77	6.26	7.80	78	85	55	68

(continued)

Table 4A-5. continued

Period	Refined Sugar Wholesale Northeast[a]	Dextrose New York[b]		Corn Syrup New York[c]		Dextrose Relative to Refined Sugar		Corn Syrup Relative to Refined Sugar	
		Quoted	Dry Basis[d]	Quoted	Dry Basis[d]	Quoted	Dry Basis	Quoted	Dry Basis
1970			(Cents per pound)				(Percent)		
January	11.70	9.16	9.96	6.45	8.03	78	85	55	69
February	11.70	9.17	9.97	6.50	8.09	78	85	56	69
March	11.70	9.24	10.04	6.50	8.09	79	86	56	69
April	11.70	9.24	10.04	6.50	8.09	79	86	56	69
May	11.88	9.24	10.04	6.50	8.09	78	85	55	68
June	12.05	9.24	10.04	6.50	8.09	77	83	54	67
July	12.05	9.41	10.23	6.54	8.14	78	85	54	68
August	12.05	9.62	10.35	6.90	8.59	79	86	57	71
September	12.20	9.52	10.35	7.26	9.04	78	85	60	74
October	12.20	9.61	10.45	7.26	9.04	79	86	60	74
November	12.20	9.64	10.48	7.26	9.04	79	86	60	74
December	12.50	9.61	10.45	7.26	9.04	79	86	60	74
Last 12-month average	11.97	9.38	10.20	6.79	8.45	78	85	57	70
1971									
March	12.40	9.77	10.62	7.31	9.10	79	86	59	73
April	12.40	9.91	10.77	7.37	9.18	80	87	59	74
May	12.40	9.91	10.77	7.37	9.18	80	87	59	74
June	12.55	9.91	10.77	7.37	9.18	79	86	59	73
July	12.60	9.91	10.77	7.37	9.18	79	85	58	73
August	12.60	9.91	10.77	7.37	9.18	79	85	58	73
September	12.60	9.91	10.77	7.37	9.18	79	85	58	73
October	12.60	9.91	10.77	7.37	9.18	79	85	58	73
November	12.60	9.91	10.77	7.37	9.18	79	85	58	73
December	12.60	9.91	10.77	7.37	9.18	79	85	58	73
1972									
January	12.81	9.80	10.65	4.15	5.17	77	83	32	40

February	13.00	9.20	10.00	4.15	5.17	71	77	32	40
March	13.00	9.20	10.00	4.15	5.17	71	77	32	40
April	13.20	9.23	10.03	4.15	5.17	70	76	31	39
May	13.20	9.25	10.05	4.15	5.17	70	76	31	39
June	13.20	9.25	10.05	4.68	5.83	70	76	35	44
July	13.20	9.25	10.05	5.13	6.39	70	76	39	48
August	13.20	9.20	10.00	5.13	6.39	70	76	39	48
September	13.20	9.20	10.00	5.13	6.39	70	76	39	48
October	13.13	9.20	10.00	5.13	6.39	70	76	39	49
November	12.95	9.20	10.00	4.92	6.13	71	77	38	47
December	12.95	9.20	10.00	4.78	5.95	71	77	37	46
Last 12-month average	13.09	9.26	10.07	4.64	5.78	71	77	35	44
1973									
January	13.15	9.20	10.00	4.99	6.21	70	76	38	47
February	13.18	9.20	10.00	5.18	6.45	70	76	39	49
March	12.94	9.34	10.15	5.29	6.59	72	78	41	51
April	13.30	9.80	10.65	5.82	7.25	74	80	44	55
May	13.55	9.80	10.65	6.38	7.95	72	79	47	59
June	13.96	9.80	10.65	6.38	7.95	70	76	46	57
July	14.05	9.80	10.65	6.38	7.95	70	76	45	57
August	14.50	9.80	10.65	6.38	7.95	68	73	44	53
September	14.80	10.60	11.52	8.73	10.87	77	78	59	73
October	14.95[a]	10.60	11.52	8.78	10.93	71	78	59	74
November	15.13	10.60	11.52	8.95	11.15	70	76	59	74
December	15.33	10.60	11.52	8.95	11.15	69	75	58	73
Last 12-month average	14.07	9.93	10.79	6.85	8.53	71	77	48	60
1974									
January	15.65	10.60	11.52	8.71	10.85	68	74	56	69
February	18.49	10.60	11.52	8.71	10.85	57	63	47	59
March	20.90	10.60	11.52	8.71	10.85	51	55	42	52
April	23.78	10.60	11.52	8.71	10.85	45	48	37	46
May	27.61	10.60	11.52	8.71	10.85	38	42	32	39
June	31.04	10.60	11.52	8.71	10.85	34	37	28	35
July	32.50	15.25	16.58	10.80	13.45	47	51	33	41

(continued)

Table 4A-5. continued

Period	Refined Sugar Wholesale North-east[a]	Dextrose New York[b]		Corn Syrup New York[c]		Dextrose Relative to Refined Sugar		Corn Syrup Relative to Refined Sugar	
		Quoted	Dry Basis[d]	Quoted	Dry Basis[d]	Quoted	Dry Basis	Quoted	Dry Basis
	(Cents per pound)					(Percent)			
August	36.83	n.a.	n.a.	15.47	19.27	n.a.	n.a.	42	52
September	40.74	n.a.	n.a.	12.05	15.01	n.a.	n.a.	30	37
October	43.59	n.a.	n.a.	12.23	15.23	n.a.	n.a.	23	35
November	60.69	n.a.	n.a.	12.23	15.23	n.a.	n.a.	20	25
December	60.41	n.a.	n.a.	12.23	15.23	n.a.	n.a.	20	25
Last 12-month average	34.35			10.61	13.21			31	38
1975									
January	52.95			14.30	17.81			27	34
February	48.96			14.32	17.83			29	36
March	40.50			14.28	17.78			35	44
May	37.01			14.29	17.80			39	48
Last 12-month average	42.74			12.47	15.53			29	36

[a]Gross basis price in 100-pound bags subject to a 2% cash discount.

[b]Hydrate, commercial bags less than carlots, ex whse., N.Y., N.Y. Beginning April, 1964 price is for 600 bag carload f.o.b. N.Y.

[c]For regular conversion syrup (38–49 D.E.) in tank cars New York, N.Y., except prior to April 1964 price quotation is for corn syrup in drums. Quoted as 40° Baume unmixed, except prior to March 1956 quotation is for 42° Baume unmixed.

[d]Assumes price is for 92% solids for dextrose and 80.3 percent solids for corn syrup. Thus dry basis price is quoted price divided by 0.92 for dextrose and 0.803 for corn syrup.

Source: USDA Sugar Reports.

Table 4A-6. Gluten Feed Prices in Chicago: 1965-1975 (in dollars per ton)

Year	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Average*
1965	44.00	45.00	46.80	47.50	51.50	50.00	45.70	45.40	46.20	47.00	48.40	51.70	47.40
1966	53.00	55.80	59.10	59.00	52.50	49.20	46.00	43.60	46.20	48.00	45.20	44.00	50.10
1967	46.80	49.20	51.00	53.20	48.50	45.70	43.20	42.50	41.70	38.60	38.00	40.00	44.90
1968	42.80	46.00	49.20	50.00	48.50	43.50	42.00	40.00	40.00	40.00	40.00	42.40	43.70
1969	47.00	49.50	51.60	56.75	56.00	45.00	42.00	42.00	42.00	44.00	47.00	50.00	47.80
1970	52.50	54.00	57.00	59.00	50.25	50.00	48.50	48.00	48.00	45.00	41.60	40.00	49.50
1971	40.00	44.00	51.00	50.00	46.00	50.00	50.00	46.00	44.00	46.00	50.00	52.00	
1972	60.00	66.00	74.00	82.00	78.00	76.00	64.00	76.00	78.00	80.00	106.00	95.00	
1973	95.00	96.00	108.00	108.00	84.00	84.00	70.00	72.00	72.00	90.00	115.00	90.00	
1974	110.00	105.00	94.00	90.00	80.00	77.00	88.00	82.00					

Note: Prices subsequent to December 1971, are sample end-of-month prices at Chicago and may not represent the average price for the month.
Sources: USDA and *Feedstuffs* reported prices.

ing to recognized proportions controlled by computers, and they were called formula feeds. Corn gluten feed was a regular component of formula feeds, and as such it competed most directly with wheat bran and soybean meal.

In the past eighteen months, starch prices had seemed least affected by swings in the price of corn and sweeteners. Although prices had climbed from less than six dollars to over seven dollars per hundredweight in 1974, almost the entire starch market was represented by thirty to forty paper companies. As the economy turned down in 1974 and demand for paper products dropped dramatically, demand for starch also fell.

Purchasing

Bob Richards, whose office was in the Chicago Board of Trade building, was responsible for the purchasing of raw material for CPC's Industrial Division, including its four wet-milling plants. He and Dr. Eiszner determined the general buying policy based on the price outlook for corn and the profitability outlook for corn products.

That the functions of Mr. Richards' office were extremely important was vividly demonstrated by the events of 1970–71 when the corn blight caused CPC to buy more corn than normal as a hedge against possible recurrence of the blight in 1971. The blight did not recur. Corn prices tumbled, and CPC's earnings fell significantly as a result of inventory losses (see Table 4A-1).

Corn was purchased in the cash market as follows. Based on annual forecasts, the daily grind for each plant was projected. In the course of the year, forecasts were updated weekly. Each plant had its own buyer who contacted sellers and arranged for a quantity of corn, a delivery date, and a delivery location. The plant buyer also sought to establish a basis price by specifying the difference between delivery price and some reference, such as Chicago futures prices. For instance, the buyer might agree with a trader that the corn to be delivered beginning 1 February 1975 would be priced at three cents per bushel more than March corn futures. At the time that CPC decided that the March price of corn was a good price, CPC would buy March contracts and deliver them to the trader. This established a delivery price.

The trader's side of the transaction developed as follows. At the time he purchased corn from a country elevator, it paid perhaps ten cents less than the March futures price. He sold March corn to offset the cash purchase. When CPC delivered long futures contracts, the trader applied them against his short position in the futures market, closing the open position in the cash market by specifying the price at which CPC would take delivery.

CPC's purchasing process was set up in such a way that the plant buyer made purchasing agreements under the direction of the Chicago office, which itself set the actual price through its purchase of contracts on the exchange. The grain merchant then delivered the grain for the contract price, plus or minus the agreed basis.

The objective of the grain purchasing department was to buy at an average price below the national average spot price that the USDA reported for the year in Chicago. No futures market for corn oil, starch, or sweeteners existed at that time. Since management believed it had no way of hedging on the output side to protect a processing margin, CPC counted on the competitiveness of its conversion efficiency to maintain its market position.

Mr. Richards stated that if processing margins were thin or negative, the timing of pricing for corn under contract for delivery normally tended to approach the actual delivery time. For instance, if margins were poor, CPC might not buy its price-determining contracts on the exchange until five or six days before the corn was due for delivery. If the quoted current cash prices of products provided attractive margins when compared with current corn prices, CPC might price its corn as much as three months in advance. In three months, however, margins could shift significantly.

The Government's Effect on Corn and Sweetener Prices

Prior to 1970, corn prices had been stable. The government's price-support programs had provided an effective floor price for corn near the loan rate. For years, corn prices at Chicago tended to range between $1.10 and $1.40. This relatively predictable price stability reduced some of CPC's risks in purchasing. To some extent, price supports had also protected the corn sweetener market. The Sugar Act of 1934 directed the U.S. Secretary of Agriculture to determine a price objective for sugar high enough to protect U.S. cane and sugar beet growers and low enough to be fair for consumers. From this price objective were calculated volume requirements for sugar, and quotas were allocated to domestic sugar producers and to about thirty foreign exporters of sugar to the United States. As a result of this price protection for U.S. sugar producers, the American price for sugar had consistently been higher than the world price. To the extent that corn sweeteners competed against sugar, corn sweetener prices were also protected by the Sugar Act. In 1974, however, Congress failed to renew the Sugar Act. How future prices of sugar would be affected by the discontinuation of the act was unclear.

Prior to the expiration of the act, the President set new sugar tariffs and a new quota. The new tariffs were to be between 0.6625¢/lb. and 0.428125¢/lb. If the President had not acted, tariffs would have been three times higher. Unlike quotas under the expiring act, which set them on a country-by-country basis, the new quota of seven million short tons was only for the total amount of imports. Countries were to compete for the American sugar market.

Even as Dr. Eiszner reviewed the situation, Congress was holding hearings on a possible new Sugar Act. No one knew what kind of program, if any, Congress would produce; but it was expected that if a program were approved, it would provide for a minimum price to producers, a maximum price to consumers, and

an international allocation for U.S. imports. In the meantime, it appeared to Dr Eiszner that the purchase price of corn and the selling price of corn sweeteners would be more than normally uncertain.

Marketing

The marketing of wet-milled products was fairly complex. Because its products were so numerous, CPC divided its marketing into two major areas: food and industrial. Food was broken into baked goods, beverages (including soft drinks, brewed drinks, and wine), and processed foods. Industrial use also included three areas: feed; corrugated and paper products; and drug, chemical, and other products.

Six sales forces served these six areas. They, in turn, were supported by a single sales and marketing services group that provided market research, technical assistance, field engineering, order processing, and management of advertising and promotion. A business manager with profit responsibility but no line authority integrated the marketing, manufacturing, and other operational activities for each of the major product lines. His management tools were pricing authority, product-line decisions, and complete access to the information systems.

CPC felt that its marketing efforts had done much to expand the primary demand for wet-milled products. Through technological research it had developed many of the uses for starch in the paper industry. Constant efforts were made to develop new products or new applications, and CPC salesmen worked extensively with customers in an effort to improve and perfect new applications as they developed.

Since CPC was the largest wet miller in the industry, it felt that it must continue its leadership in developing new products and applications. Providing these services and products, however, cost money. CPC hoped that its margin would be wide enough to cover the cost of services and product development in a still-competitive price to its customers.

In the early 1970s this hope had not been realized. As new competitors joined the wet-milling industry, they adopted a low-price, small-product-line, high-volume strategy. They targeted a limited number of highly desirable accounts. By offering no services and few product varieties, they had captured an impressive volume of business in a very short time. CPC was informed by several of its large accounts that in the future they would do their own research and development in-house, and that they were more interested in price than in CPC's additional services. And with the new entrants competing primarily on price alone, CPC was finding it increasingly difficult to maintain the margins required to support its research and development.

This situation had temporarily changed in 1973 as the price of sugar rose and demand for corn sweeteners increased. By the end of 1974 demand had risen dramatically, and prices and margins had improved. But now that sugar prices were declining, Dr. Eiszner was uncertain what corn sweetener prices

would be. An answer to this question would be critical given the very expensive cost of additional capacity. Dr. Eiszner had to decide how to take advantage of the present opportunity to maximize returns to CPC.

In the past, as an industry, wet milling was the most concentrated segment of corn processing. The Corn Refiners' Association represented all but one of the significant corn refiners, yet it had only eleven members. In 1967 the four largest companies accounted for 68 percent of shipments by value. The trend toward decreasing concentration in the industry received a boost in the sixties when Grain Processing, Cargill, and Archer-Daniels-Midland began wet-milling operations. The number of plants went down but their value went up (see Table 4A-7). These new entrants were willing to buy market shares by reducing their

Table 4A-7. General Statistics on Corn Processing Plants

Year	*Number of Plants*	*Value Added by Manufacture*	*Cost of Materials, Fuels, etc.*	*Gross Value of Fixed Assets*
		($000,000)	($000,000)	($000,000)
1972	41	331.1	498.7	785.1
1967	45	353.6	401.7	660.9
1963	60	290.9	335.8	489.3
1958	59	249.4	282.0	N.A.

Source: U.S. Bureau of Census.

Table 4A-8. Cents Per Pound of Corn Contained in Various Wet-Milled Products (in U.S. dollars)

Corn Price[a] *Per Bushel*	*Cornstarch*[b] *10% Moisture*	*Dextrose*[c] *Hydrate 8% Moisture*	*Corn Syrup*[d]	*Refined*[e] *Corn Oil*	*Corn*[f] *Feeds*
1.25	3.63	4.17	3.32	78.05	8.38
1.75	5.08	5.83	4.64	109.20	11.73
2.25	6.53	7.49	5.97	140.35	15.07
2.75	8.00	9.18	7.31	171.85	18.46
3.00	8.72	10.00	7.97	187.25	20.11
3.25	9.45	10.84	8.64	203.00	21.80
3.50	10.18	11.68	9.31	218.75	23.50

[a]A bushel of corn contains about 56 lbs of corn.
[b]A pound of corn starch contains 1.63 lbs. of corn.
[c]A pound of dextrose contains 1.87 lbs. of corn.
[d]A pound of corn syrup contains 1.49 lbs. of corn.
[e]A pound of refined corn oil contains 35 lbs. of corn.
[f]A pound of corn feed contains 3.76 lbs. of corn.
Source: CPC International documents.

prices and margins. As industry capacity increased faster than demand for wet-milling products, all companies began to cut their prices in an effort to fill the excess capacity of their plants.

The recently high sugar prices had publicized the opportunities in the wet-milling industry. Seven other companies were producing high fructose corn syrup or had announced their intention to do so. CPC, Clinton, and Staley had producing plants or had already begun their construction. One industry expert estimated that a new "green-field" facility would cost between $1,250 to $1,750 per daily bushel, depending on the product mix. Present corn wet-milling facilities ranged between 14,000 bushels per day to 155,000 per day. Table 4A-8 is a rough analysis of the amount of corn contained in various wet-milling products. A comparison between these raw material costs and the November 1975 sales price of dextrose ($16.50 per hundredweight) and syrup ($12.50 per hundredweight explained the growing interest in corn-wet milling.

NOTE

1. Steepwater is the water in which corn had been soaked in the first stages of processing. In concentrated form it is a rich feed. Corn gluten is a sticky, protein-rich substance in the corn kernel which can be used as a component in feeds or, in a more concentrated form, as corn gluten meal.

APPENDIX B
CHARLES PULLIN*

Charles Pullin was a corn farmer in southeastern Indiana's Shelby County. Early in March of 1975, he was facing three important decisions. He had to decide immediately whether to buy feeder pigs for fattening for the summer market. During April, he had to decide how to allocate his tillable acres between corn and soybeans, the crops that his land was best suited to produce. And by August, when his lease would expire, he had to decide whether to purchase the farm he was working and currently renting.

Mr. Pullin's Farm

Mr. Pullin's farm consisted of 285 acres, 253 of which were tillable, located in the highly productive corn and soybean region of the U.S. Midwest. Pullin had been working the farm since August of 1970, when he had rented it from a major farm machinery manufacturer that had used it previously as a training and testing facility. He had signed the lease in a period when U.S. farm income had been much lower than currently. Consequently, his annual rent per acre (thirty-eight dollars) was much lower than the rates specified in leases signed more recently in the area (sixty dollars to sixty-five dollars); it did not reflect the recent, rapid increase in the value of U.S. farmland.

Like many farms in the area, Pullin's was a one-man operation. Thus, he was heavily dependent on the reliability of his major machines, which included a tractor, harrow and disc plows, a planter, sprayer, combine, portable grain dryer, and grain bin. Since he lacked grain storage capacity on the farm beyond what the portable grain bin provided, he depended on local elevators for his storage needs. He preferred to use the facilities of the local cooperative when storage space there was available.

His work routine through the year followed a fairly predictable pattern. Heavy plowing took place in March and early April following the winter thaw. Ground preparation for specific crops began in mid-April after he had decided how much acreage to allocate to beans and corn. He fertilized at this time, unless he had done it the preceding autumn. Pullin planted corn first, since it took longer than soybeans to mature (about 110 to 120 days in total). Following the old rule of thumb that said "Never plant corn 'til the ground is warm," he sought to have his corn in the ground by mid-May. Then he turned his attention to his soybeans, which he hoped to have planted by early June. Having completed planting, he sprayed for weeds and planned his cultivation programs. In a

*This case was prepared by Richard C. McGinity, Research Associate, under the supervision of Professor Ray A. Goldberg, as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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typical year, he completed these activities by late June. In years when fiel preparation and planting were delayed because of cold or an excessively we spring,[1] Pullin's planting efforts could be delayed to the point where his cor might not have the time to mature before the first frost. In such years, he ha to consider switching his corn acreage to faster-maturing soybeans.

Harvest time was the busiest time of the year for Mr. Pullin. In a typical yea corn was ready for harvest around mid-September. When harvesting corn, Pulli worked steadily from 7:30 A.M. to around 9:30 P.M. combing, drying, an (occasionally)[2] hauling corn to an elevator in his 300-bushel truck. He was abl to pick and dry about ten to twelve acres per day.

When the moisture content of his soybeans dropped below 13 percent (usu ally about the beginning of October), he had to turn his attention to them.[3] During this phase of the harvest, Pullin worked as long as possible, beginnin around noon, when the sun had evaporated the night's dampness from the beans, and finishing just before midnight. When the soybeans were finished he turned again to his corn, ordinarily completing the crop by late October. Pullin preferred to work alone at these tasks, though he could cut his time requirement in half if he hired a man to run his combine or grain drier.

In determining the mix of corn and soybeans that he would plant, Pullin tried to keep track of the national supply, demand, and price situations for these commodities and of the forecasts of future conditions. He obtained this information from numerous farm magazines, from USDA reports, and from talking with various farmers and suppliers in the area.

In marketing his crop, Pullin sought to time the sale to obtain the highest possible price. Once his crops were in the ground, he could estimate his average cost per bushel. Keeping this figure in mind, he followed government and private crop predictions carefully through the summer, eventually reaching his own assessment of the size of the crop, probable price levels, and the best time to sell. If a reasonable profit per bushel was available in midsummer, he might contract with the local cooperative to sell as much as one-third of his crop to cover his investment. If he anticipated higher prices, he might hold off awhile and gamble. Pullin sometimes sold as much as 75 percent of his crop before harvest, though never more because of the risk that disease or bad weather might damage it. Generally, he did not sell before planting, though the option was open to him. He sold all of his grain through the local cooperative if storage was available, since the net return to him was as much as eight to ten cents per bushel higher from it than from competing buyers. Grain that he continued to hold after harvest was stored at the coop. Usually he had disposed of his crop by the end of December. He did not use the futures markets directly.

Pullin, like most Corn Belt farmers, raised pigs from time to time when market conditions made the effort appear attractive.[4] When he did so, he purchased from local dealers as many as three hundred head of feeder pigs weighing about 40 to 45 pounds. He fed them a mixture of corn, soybean meal, and other

ingredients for three to three and one-half months, at which time they weighed 200 or 220 pounds and were ready to be marketed. Pullin would usually truck his hogs to a regional hog market nearby. When Pullin purchased feeder pigs he did so either in early March or in early November, so that they could be marketed around the end of June or in early February. This timing prevented hog-raising from interfering greatly with his field work.

Feeder Pigs: Yes or No?

To determine whether to raise hogs, Pullin had to study hog supply and demand predictions and assess likely prices and margins. He ordinarily desired a good chance for ten dollars per head net margin before he would risk the investment.

Sharply higher hog and retail pork prices appeared to be certain in the year ahead, according to government and industry analysts. The per-capita supply of pork was expected to be the lowest in almost forty years, for the 1974 drought had significantly reduced the U.S. corn crop and had driven feed prices to very high levels, making hog production at best marginally profitable for most farmers and unprofitable for many. (Table 4B-1 shows the recent history of costs and margins for typical Corn Belt hog feeders.) The USDA estimated that 1975 pork production might consequently fall to about 11.7 billion pounds from 1974's 13.6 billion, and per-capita production from over sixty-six pounds to about fifty-seven pounds. In the past, such large reductions in pork production had caused dramatic increases in hog prices. An identical trend seemed to be underway presently (Figure 4B-1).

The USDA reported that, in response to declining pork supplies, retail pork prices had been rising. In December, the average retail price for pork was $1.127 per pound, up from $1.114 in November and $1.09 in October. Many analysts were confident that average retail pork prices would reach $1.20 per pound, and some asserted that they would even top $1.30. Historically, there is a difference of about $0.60 to $0.80 per pound between retail pork prices and live hog prices.

To answer his first question, Pullin had to make assumptions concerning his costs. The prices of feeder pigs and corn were the most important cost components in hog production. Based on his past experience in hog production and on existing market prices, Pullin used the estimates in Table 4B-2 to evaluate the problem. Pullin concluded that he needed to realize about $33.76 per hundredweight to break even on his hogs.

Corn versus Soybeans

In considering how to allocate his 253 tillable acres between corn and soybeans, Pullin had to begin with assumptions regarding his yields and production costs per acre. Because his land was fertile and well cared for, its yields were above national averages; and because his land rent was considerably lower than the local average, his production costs were somewhat below national averages.

Table 4B-1. Costs and Margins for Corn Belt Hog Feeding:[a] February 1974-March 1975 (selected costs at current rates)[b]

Purchased during / *Marketed during*	*Feb.* / *June*	*Mar.* / *July*	*Apr.* / *Aug.*	*May* / *Sept.*	*June* / *Oct.*
	(Dollars per head)	*(Dollars per head)*	*(Dollars per head)*	*(Dollars per head)*	*(Dollars per head)*
Expenses					
40 lb. feeder pig	33.25	32.50	32.19	22.10	17.31
Corn (11 bu.)	30.69	29.37	26.29	27.06	28.60
Protein supplement (130 lb.)	15.60	14.43	13.52	12.42	11.96
Labor & management (1.3 hrs.)	5.88	5.88	5.98	5.98	5.98
Vet medicine[c]	1.29	1.30	1.33	1.34	1.34
Interest on purchase (4 mo.)	1.05	1.03	1.13	.77	.61
Power, equip, fuel, shelter, depreciation[c]	3.14	3.16	3.24	3.25	3.27
Death loss (4% of purchase)	1.33	1.30	1.29	.88	.69
Transportation (100 miles)	.44	.44	.46	.46	.46
Marketing expenses	1.10	1.10	1.10	1.10	1.10
Miscellaneous & indirect costs	.32	.33	.33	.33	.33
Total	94.09	90.84	86.86	75.69	71.65
	(Dollars per cwt.)	*(Dollars per cwt.)*	*(Dollars per cwt.)*	*(Dollars per cwt.)*	*(Dollars per cwt.)*
Selling price/cwt. required to cover feed and feeder costs (220 lbs.)	36.15	34.68	32.73	27.99	26.30
Selling price/cwt. required to cover all costs (220 lbs.)	42.77	41.29	39.48	34.40	32.57
Feed cost per 100 lb. gain	25.72	24.33	22.12	21.93	22.53
Barrows and filts 7 markets/cwt.	27.40	36.31	37.56	35.79	38.86
Net margin/cwt.	-15.37	-4.98	-1.92	+1.39	+6.29
Prices					
40 lb. feeder pig (So. Missouri)	33.25	32.50	32.19	22.10	17.31
Corn[d]/(bu.)	2.79	2.67	2.39	2.46	2.60
29% protein supplement[e]/cwt.	12.00	11.10	10.40	9.55	9.20
Labor and management[f]/hr.	4.52	4.52	4.60	4.60	4.60
Interest (annual)	9.50	9.50	10.50	10.50	10.50
Transportation rate (/cwt. 100 miles)[g]	.20	.20	.21	.21	.21
Marketing expenses[h]	1.10	1.10	1.10	1.10	1.10
Index of prices paid by farmers 1910-14 = 100)	545	549	562	564	568

[a]Although a majority of hog feeding operations in the Corn Belt are from farrow to finish, relative fattening expenses will be similar.

[b]Represents only what expenses would be if all selected items were paid for during the period indicated. The feed rations and expense items do not necessarily coincide with the experience of individual feeders. For individual use, adjust expenses and prices for management production level, and locality of operation.

[c]Adjusted quarterly by the index of prices paid by farmers for commodities, services, interest, taxes and wage rates.

Table 4B-1. continued

July Nov.	*Aug. Dec.*	*Sept. Jan. 75*	*Oct. Feb.*	*Nov. Mar.*	*Dec. Apr.*	*Jan. 75 May*	*Feb. June*	*Mar. July*
(Dollars per head)	*(Dollars per head)*	*(Dollars per head)*	*(Dollars per head)*	*(Dollars per head)*	*(Dollars per head)*	*(Dollars per head)*	*(Dollars per head)*	*(Dollars per head)*
21.50	18.90	18.75	24.10	21.13	25.75	30.10	35.75	39.75
32.78	37.29	36.19	38.39	36.30	36.08	33.66	31.46	29.59
12.48	15.80	13.98	15.60	15.14	14.56	13.84	13.06	12.74
6.14	6.14	6.14	6.38	6.38	6.38	3.22	3.22	3.22
1.36	1.40	1.42	1.43	1.45	1.45	1.46	1.46	1.45
.75	.66	.66	.84	.74	.90	1.05	1.25	1.39
3.30	3.40	3.44	3.47	3.51	3.53	3.55	3.54	3.53
.86	.76	.75	.96	.85	1.03	1.20	1.43	1.59
.46	.46	.46	.48	.48	.48	.48	.48	.48
1.12	1.12	1.12	1.12	1.12	1.12	1.14	1.14	1.14
.34	.35	.35	.36	.36	.36	.36	.36	.36
81.09	86.28	83.26	93.13	87.46	91.64	90.06	93.15	--
(Dollars per cwt.)	*(Dollars per cwt.)*	*(Dollars per cwt.)*	*(Dollars per cwt.)*	*(Dollars per cwt.)*	*(Dollars per cwt.)*	*(Dollars per cwt.)*	*(Dollars per cwt.)*	*(Dollars per cwt.)*
30.35	32.72	31.33	35.50	32.99	34.72	35.28	36.49	37.31
36.86	39.22	37.85	42.33	39.75	41.65	40.94	42.34	43.29
25.14	29.49	27.87	29.99	28.58	28.13	26.39	24.74	23.52
38.34	39.93	38.93	39.61					
+1.48	+0.71	+1.08	-2.72					
21.50	18.90	18.75	24.10	21.13	25.75	30.10	35.75	39.75
2.98	3.39	3.20	3.49	3.30	3.28	3.06	2.86	2.69
9.60	12.15	10.75	12.00	11.65	11.20	10.65	10.05	9.80
4.72	4.72	4.72	4.91	4.91	4.91	2.48	2.48	2.48
10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
.21	.21	.21	.22	.22	.22	.22	.22	.22
1.12	1.12	1.12	1.12	1.12	1.12	1.14	1.14	1.14
573	590	599	603	610	613	617	615	612

[d] Average price received by farmers in Iowa and Illinois.

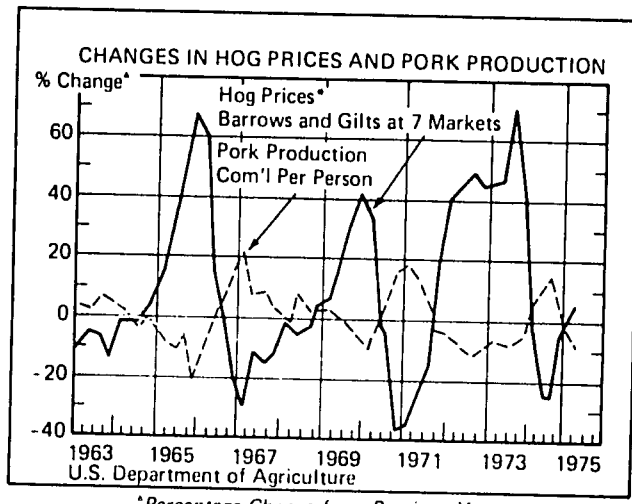
[e] Average prices paid by farmers in Iowa and Illinois.

[f] Assumes an owner-operator receiving twice the farm labor rate.

[g] Converted to cents/cwt. from cents/mile for a 44,000 pound haul.

[h] Yardage plus commission fees at a midwest terminal market.

Source: USDA, *Livestock and Meat Situation*, April 1975.



*Percentage Change from Previous Year
*Barrows and Gilts at 7 Markets

Figure 4B-1.

Table 4B-2. Charles Pullin's Estimate of Hog Production Costs, Per Animal

40 lb. feeder pig	$32.00
10 bushels corn[a]	30.00
100 lb. protein	8.00
Death loss	1.28
Miscellaneous	3.00
	$74.28

[a]About 10 bushels of corn (560 lbs.) were required to bring a feeder pig to market weight.
Source: Charles Pullin's Farm Records.

Based on his past experience, Pullin made the assumptions shown in Table 4B-3. He was quite certain of these assumptions in a typical year. But bad weather, such as 1974's heavy late spring rains and midsummer drought, could increase his production costs and reduce his yields.

Assessing probable market developments for corn and beans was difficult at best. Due to reduced feed demand, corn prices had declined since their October 1974 drought-induced highs, although the crop had been 18 percent below the previous year's and carryover supplies were expected to be minimal. Though exports had continued strong, apprehension existed that they would slow in the spring and summer of 1975 from declining foreign demand and possible cancellations of sales made as a result of panicky overbuying in 1974. Because of these factors, prospects for short supplies just prior to the 1975 harvest did not necessarily mean higher prices between now and then. Cash prices in Chicago were

Table 4B-3. Charles Pullin's Assumptions Concerning Corn and Soybean Yields and Production Costs

Crop	*Yield per Acre*	*Cash Production (dollars per acre[a])*
Corn	115-120 bushels	150-160
Soybeans	45-48 bushels	90-95

[a]Did not include charges for depreication of buildings and equipment, nor for Mr. Pullin's own labor and management time.

Source: Charles Pullin's Farm Records.

Table 4B-4. Corn Supply and Disappearance[a]: 1973-1976

			1975-76[c]	
	1973-74	*1974-75[b]*	*Low*	*High*
Acreage				
Planted (millions of acres)	71.7	77.7	76.1	78.9
Harvested (millions of acres)	61.9	65.2	65.5	67.8
Yield (bushels per acre)	91.2	71.3	90.0	95.0
Supply (millions of bushels)				
Carry-in	709	483	300	300
Production	5647	4651	5895	6440
Imports	1	1	1	1
Total supply	6357	5135	6196	6741
Use (millions of bushels)				
Food and Seed	435	445	455	455
Feed	4196	3440	4100	4300
Exports	1243	950	1000	1200
Total use	5874	4835	5555	5955
Carry-out (millions of bushels)	483	300	641	786

[a]Disappearance is equivalent to use, disposition, or (roughly) consumption.

[b]Estimate.

[c]Estimates. The low estimate assumes a 2% acreage decrease from the previous year combined with low yield. The high estimate assumes a 2% acreage increase and higher yield.

Source: *Doane's Agricultural Report*, 18 March 1975. Reproduced with permission.

expected to stay around their current three dollars per bushel range until indications of the size of the 1975 crop began to develop.

As the spring wore on, 1975 crop size and prospective demand would become increasingly important pricing factors. A well-known private farm management service, reporting that farmers' planting intentions in January 1975 had been about the same as in the previous year, predicted that planted acreage would fall within 2 percent of the previous year's level. Table 4B-4 shows two 1975 crop possibilities based on this prediction—assuming a return to a long-term upward

trend in U.S. corn yields, more normal weather than in 1974, and barely adequate supplies of seed, fertilizer, and other inputs.[5] The expected 5.5 to 5.9 billion bushel crop would permit some recovery in livestock feeding rates and large exports, but it might bring cash prices down to $2.25 to $2.70 by harvest time.

Like corn prices, soybean prices had declined significantly since the 1974 harvest. Declining levels of hog production[6] and declining exports due to deteriorating world economic conditions were the main cause of this slide. Because of these developments and contrary to earlier predictions, a leading farm-management service had lately forecast that the soybean carryout[7] at the end of the current 1974–75 crop year would be somewhat larger than that of 1972–73 despite the fact that the 1974 harvest was smaller than 1972's. Table 4B-5 shows soybean supply and consumption for 1971 through 1975.) The crop in 1975 was expected to be significantly larger than 1974's. Thus, although stocks would decline to levels approaching historical lows, prices for beans were not expected to climb again from their current $5.25 to $5.75 range unless weather were to damage seriously the new crop.

In these circumstances, prices for beans in the coming months would be primarily influenced by the planting intentions of farmers at current price levels. It appeared that soybeans and corn were about equally atractive to farmers,[8] but a slight acreage increase over 1974 was expected for soybeans.[9] Based on current estimates of exports and crushing requirements for the 1975–76 crop year—and assuming normal weather and yields—it appeared that an acreage increase of 2 percent or more would result in carryover of such size that bean prices could be adversely affected (Table 4B-6).

Table 4B-5. Soybean: Supply and Disappearance: 1971–1975

	1971–72	*1972–73*	*1973–74*	*1974–75*
Acreage				
Planted (millions of acres)	43.5	46.9	57.3	53.8
Harvested (millions of acres)	42.7	45.7	56.4	52.5
Yield (bushels per acre)	27.5	27.8	27.8	23.7
Supply (millions of bushels)				
Beginning Stocks	99	72	60	172
Production	1176	1271	1567	1244
Total	1275	1343	1627	1416
Use (millions of bushels)				
Crush	721	722	821	770
Export	417	479	542	480
Feed-seed residual	65	82	92	91
Total	1203	1283	1455	1341
Carry-out (millions of bushels)	72	60	172	75

Source: *Doane's Agriculture Report*, 17 January 1975. Reproduced with permission.

Table 4B-6. Alternative Soybean Supply and Disappearance Forecasts: 1975-1976

Assumed acreage increase over 1974-75		5.2%		3.2%		2.0%
Acreage						
Planted (millions of acres)		56.6		55.5		54.9
Harvested (millions of acres)		55.2		54.2		53.6
Yield (bushels per acre)		27.5		27.5		27.5
Supply (millions of bushels)						
Beginning Stocks		75		75		75
Production		1518		1491		1474
Total		1593		1566		1549
	(a)	(b)	(a)	(b)	(a)	(b)
Use (millions of bushels)						
Food and Seed	810	821	810	821	810	821
Feed	515	542	515	542	515	542
Exports	91	91	91	91	91	91
Total	1416	1454	1416	1454	1416	1454
Carry-out (millions of bushels)	177	139	150	112	133	95

[a]Assumes a 5.6% increase over 1974-1975.

[b]Assumes an 8% increase over 1974-75. Disappearance equivalent to historical highs of 1973-1974.

Source: *Doane's Agricultural Report*, 17 January 1975. Reproduced with permission.

Although Mr. Pullin was never sure about the accuracy of his forecasts until his crop was finally sold, he felt reasonably confident that the coming crop season would be at least profitable. (See Table 4B-7 for an analysis relating corn and soybean prices.)

Buy or Rent?

By midsummer, Mr. Pullin had to decide whether to negotiate a new lease for his farm or to buy it outright. The decision was difficult to make. Pullin was in his mid-fifties and apprehensive about accepting the debt load a large mortgage would thrust upon him. Farm real estate values had climbed rapidly in the last few years, and Pullin believed he might have to pay as much as $1,500 per acre. Although his assets were substantial enough to permit him to make a sizable down payment, the interest rates prevailing on agricultural real estate loans (8 percent-9 percent) meant that his fixed payments would be high. In the event that he chose to sign another lease, he anticipated annual rental payments of at least $65 to $70 per acre.

Mr. Pullin's decision depended heavily on his view of future commodity prices and production costs. These, of course, were impossible to predict with certainty. He was acutely aware of the trends that had been affecting farming

Table 4B-7. Midwest Soybean and Corn Costs and Southern Soybean and Cotton Costs (dollars per acre)

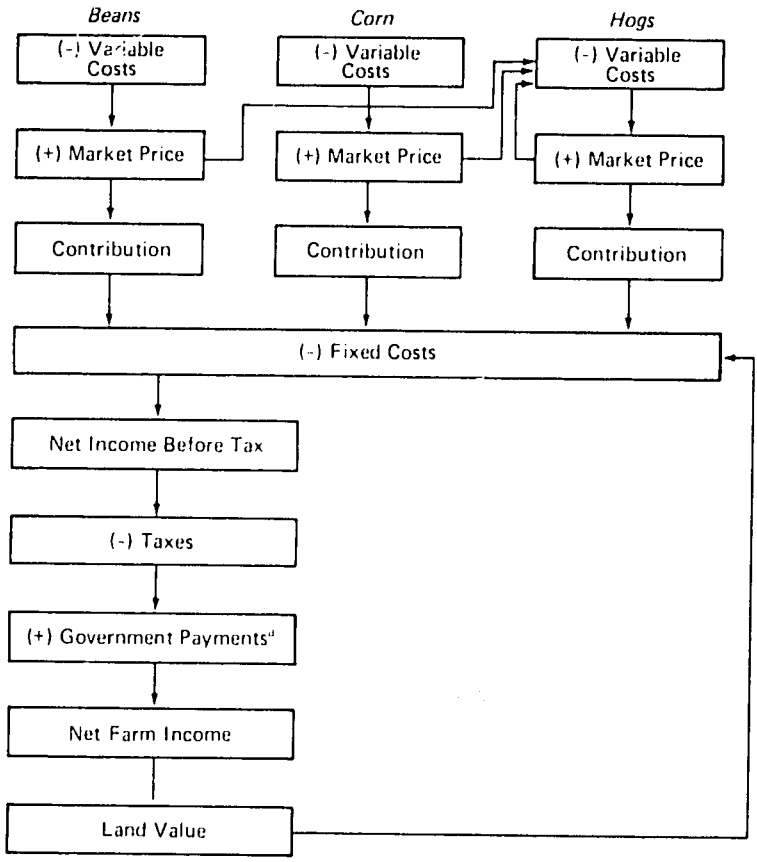
	Soybeans				Corn			
			Estimated				Estimated	
	1974	Percentage	1975	Percentage	1974	Percentage	1975	Percentage
Seed	8.44	6	9.94	6	9.03	5	12.03	5
Fertilizer	8.92	6	8.66	5	39.23	21	51.48	23
Herbicides and other pest control chemicals	8.32	6	10.26	7	9.65	5	11.98	5
Machinery (including depreciation, fuel, repairs, etc.)	20.66	15	24.21	15	23.62	12	27.42	12
Harvesting, drying costs	6.04	4	7.53	5	13.39	7	17.12	8
Hired labor costs	4.29	3	5.79	3	4.53	2	5.60	3
Other variable costs	4.63	3	6.78	4	8.11	4	9.30	4
Total out-of-pocket costs	61.30	49	73.17	47	107.56	37	134.93	34
Land cost (cash rent or 7 1/2 times land value)	70.44	8	75.71	8	70.44	7	75.71	6
Own labor costs	10.92	100	11.83	100	13.05	100	13.95	100
Total costs per acre	142.66		160.71		191.05		224.59	
Expected yields (bushels per acre)	35.00		39.60		118.60		121.70	
Cost per bushel	4.08		4.06		1.61		1.85	

Southern Soybean and Cotton Costs (dollars per acre)

	Soybeans				Cotton	
			Estimated		Estimated	
	1974	Percentage	1975	Percentage	1975	Percentage
Seed	9.22	8	10.11	7	8.75	3
Fertilizer	8.77	7	12.31	9	24.35	10
Herbicides and other pest control chemicals	10.88	9	14.22	10	27.39	11

Machinery (including depreciation, fuel, repairs, etc.)	26.43	22	31.69	23	79.47	32
Harvesting, drying costs	6.48	5	7.98	6	40.25	16
Hired labor costs	10.46	9	11.99	8	14.15	6
Other variable costs	6.75	5	7.64	5	10.56	4
Total out-of-pocket costs	78.99	65	95.94	68	204.92	82
Land cost (cash rent or 7 1/2 times land value)	32.90	27	34.10	24	34.10	14
Own labor costs	10.50	8	10.70	8	10.70	4
Total costs per acre	122.39	100	140.74	100	249.72	100
Expected yields (bushels per acre)	25.30		28.20		60.00	
Cost per bushel (or lb.)	4.84		4.99		.42	

Source: *Soybean Digest* (various issues 1974 and 1975).



[a]When available.

Figure 4B-2. Relationship Between Land Values and Farm Income for a Typical Midwestern Farmer

and farm prices in the recent past, however, and felt that they would continue to have significant influence on farm costs and commodity prices. Most obvious was the continuing growth of capital intensity in U.S. farming. It increased fixed costs and stimulated farmers to enlarge their farms to spread their fixed costs over a larger production volume. Consequently, farms were declining in number but increasing in size. As a result, a small number of large farms had come to account for a disproportionate share of cash receipts and net income. Despite this trend, Mr. Pullin felt that his own farm and others like it could continue to compete with larger units as long as he could withdraw fifty dollars to sixty dollars per acre per year from the operation for his own use.

International developments and their effects were also important but just as difficult to predict. In the early 1970s, increasing world food demands due to

population and income growth had at least temporarily outstripped food production and put great pressure on the productive capacity of U.S. agribusiness. At the same time, liquidation of large U.S. grain reserves in 1972 and 1973 left the world with a short supply and a volatile price situation. Recently higher prices had yielded crop farmers higher incomes. Higher incomes and government encouragement to increase production led U.S. farmers to bring as much land as possible into cultivation in 1974. Higher farm prices and incomes were reflected in higher land values. But it was not clear how long these circumstances would last.

In the 1960s and early seventies, Mr. Pullin had been able to count on commodity price-support programs as a market of last resort if demand for his corn was weak. Commodity prices were relatively low and stable during those years, but at least he was reasonably assured of covering his production costs and of earning a decent sum on which to live. With the government's announced intention of ending price-support programs, however, and with existing support rates well below production costs, the future held more uncertainty for him than it had previously. The "buy or rent" decision was, therefore, a difficult one to evaluate, particularly in view of the relations between land values and income from farming portrayed in Figure 4B-2.

NOTES

1. Pullin could not take his machinery into the fields until the ground was dry enough to support its weight. Heavy winter snows, a late thaw, heavy spring rains, or a combination of all three had occasionally prevented his beginning field work until late April.

2. Pullin could haul it himself or have the elevator do it, for which there was a charge of three to four cents per bushel.

3. The market offered a premium for soybeans graded "#1" that, among other qualities, had a moisture content below 13 percent.

4. The Corn Belt was the leading hog-raising area in the United States.

5. The 1974 seed corn crop had been severely damaged by drought. Seed supplies and quality were expected to be below average. The fertilizer industry had been straining to meet domestic and foreign demand since mid-1973, and some shortages were anticipated.

6. Soybean meal was ordinarily used as the source of protein in hog production. See, for example, the "Protein Supplement" line in Table 4B-1.

7. The supply remaining from the previous harvest.

8. Many farmers employed a "rule of thumb" in choosing between planting corn or soybeans. They would ordinarily plant corn unless the price of beans per bushel was 2.5 times or more the price of corn. This factor was based on analysis of historical production costs and yields of corn and beans.

9. Soybeans were somewhat less risky to grow than corn and required somewhat less labor.

APPENDIX C
INDIANA FARM BUREAU COOPERATIVE ASSOCIATION, INC. (B)*

Early in 1975, the top management of the Indiana Farm Bureau Cooperative Association (IFBCA) was assessing the corn procurement and marketing efforts it was making on behalf of its member cooperatives. IFBCA purchased corn and other grains from county cooperatives and farmers in Indiana. Corn thus procured was converted into feed in IFBCA's own mills, sold domestically to other feed millers, or exported. The association's grain marketing activities were heavily oriented toward the export market. Coop grain sales had increased rapidly in the last few years, primarily due to large foreign purchases. Senior managers wished to assure themselves that the association's strategy with respect to grain procurement, processing, and marketing was successful in making farm supplies available to Indiana farmers at the lowest possible cost and marketing their production at the highest possible price.

The Background of IFBCA

The Indiana Farm Bureau Cooperative Association, Inc. was a federation of all the state's county-cooperatives. The local cooperatives, seventy-seven in number, accomplished purchasing and marketing tasks for over 100,000 member farmers. Compared to other farmer cooperatives, IFBCA was of moderate size: its 1974 sales totaled $633 million, and its net worth was $60 million. (Tables 4C-1 through 4C-3 list detailed financial information.) It was involved in much of the off-farm business of Indiana farmers and engaged in procurement, manufacturing, financial, and research activities.

IFBCA was organized in 1927 to improve the economic standing of Indiana farmers by helping them market their products and by furnishing them low-cost farm supplies and services. In its early years, the association promoted development of local cooperatives and a state wholesaling cooperative. It built up its capital base by paying out 25 percent of its earnings to members in the form of stock.[1] Initially, IFBCA suffered boycotts and other harassment by the manufacturing firms from which it purchased supplies for its members. Consequently, it undertook manufacturing activities of its own. Its first effort was a fertilizer plant, which was so successful that IFBCA's board subsequently approved a variety of agriculturally related activities. In 1975 the association was producing fertilizer, seeds, feed, and petroleum products while breeding and hatching egg-

*This case was prepared by Richard C. McGinity, Research Associate, under the supervision of Professor R.A. Goldberg, as a basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Table 4C-1. Indiana Farm Bureau Cooperation Association, Inc. (B): Balance Sheets, 1970–1974 (years ending December 31)

	1970	*1971*	*1972*	*1973*	*1974*
Assets					
Current assets					
Cash	$ 913,902	392,362	1,458,536	1,100,101	1,260,960
Receivables	13,172,588	12,862,907	24,700,846	37,635,055	52,532,571
Inventories	52,882,437	52,843,072	65,808,617	74,876,785	122,584,909
Other current assets	581,261	645,298	634,379	730,966	761,145
Total current assets	67,550,188	66,743,639	92,602,378	114,342,907	177,139,585
Other assets					
Notes and contracts receivable	1,390,194	1,284,018	1,323,237	1,135,934	394,646
Investments in other cooperatives	5,949,485	5,883,361	6,435,300	7,572,544	11,414,098
Deferred charges	106,187	169,162	283,732	592,453	698,811
Total other assets	7,445,866	7,336,541	8,042,269	9,300,931	12,507,555
Property, plant, and equipment					
Land and improvements	1,791,696	1,826,722	6,784,004	6,777,659	6,903,065
Buildings and other facilities	31,468,024	32,670,643	25,581,525	26,142,908	26,761,797
Storage, pipeline and gathering systems	3,259,285	3,244,000	3,236,685	3,266,658	3,315,618
Machinery and equipment	21,093,389	21,909,744	25,091,088	25,023,669	26,852,841
Construction in progress	373,766	96,217	503,655	1,516,307	9,423,947
Less accumulated depreciation	(28,222,389)	(30,768,834)	(33,046,894)	(35,031,725)	(37,583,399)
Net property, plant, and equipment	29,763,771	28,978,492	28,150,063	27,695,476	35,673,869
Total assets	104,759,828	103,058,668	128,794,710	151,339,314	225,321,009
Liabilities					
Current liabilities					
Notes payable	2[illegible],[illegible]1,000	19,653,257	36,048,000	28,763,000	84,538,000
Current portion of long-term debt	1,772,300	2,193,900	1,605,100	1,652,500	2,482,500
Accounts payable	10,115,219	14,719,232	18,627,537	37,686,205	53,385,277

(continued)

Table 4C-1. continued

	1970	1971	1972	1973	1974
Accrued expenses and losses on open grain contracts	$ 1,995,699	2,326,613	8,482,577	2,150,342	3,510,854
Federal income taxes	143,087	372,021	–	1,232,556	1,223,942
Total current liabilities	39,378,296	39,268,056	64,763,214	71,554,603	145,140,573
Long-term debt, less current portion	17,769,932	16,021,645	14,543,602	14,040,500	19,183,000
Shareholders' and patrons' equities					
Capital stock[a]	37,274,900	37,494,700	37,859,000	39,401,200	41,990,200
Patrons' equities[b]	10,336,700	10,271,267	11,628,894	15,027,543	18,925,316
Total stockholders' and patrons' equities	47,611,600	47,765,967	49,487,894	54,428,743	60,915,516
Total liabilities	104,759,828	103,058,668	128,794,710	151,339,314	225,321,009

[a]Common stock. IFBCA's common stock is a revolving fund, with new stock representing the noncash portion of patronage dividends and the oldest outstanding stock being redeemed at par at the option of the board of directors.

[b]Retained earnings which have not been allocated to patrons as qualified patronage refunds. Earnings so retained are subject to ordinary income taxes. A policy of retaining 10% of earnings before taxes to build permanent capital was started in 1957.

Source: IFBCA.

Table 4C-2. Indiana Farm Bureau Cooperative Association, Inc. (B): Consolidated Statements of Savings, 1970-1974

	1970	*1971*	*1972*	*1973*	*1974*
Net Sales (Supply and Marketing)	$ 256,601,869	279,527,914	317,602,047	523,358,462	633,486,481
Costs and Expenses					
Cost of Products Purchased and Marketed			295,586,923	493,307,741	594,109,475
Procurement and Distribution Expense (net)			9,552,912	11,387,931	14,007,048
General and Corporate Expense (net)			5,037,475	5,677,472	6,910,711
Property Tax			1,099,552	905,105	994,355
Other State and Local Taxes			860,278	1,138,185	1,455,754
Total Costs and Expenses	258,991,569	284,102,398	312,137,140	512,416,434	617,477,343
Savings From Operations	(2,389,700)	(4,574,484)	5,464,907	10,942,028	16,009,138
Other Income	5,906,326	7,779,186	210,112	432,785	117,303
Interest Expense (net)[a]			(1,258,713)	(2,181,601)	(2,768,974)
Savings Before Federal Income Taxes	3,516,626	3,204,702	4,416,306	9,193,212	13,357,467
Federal Income Taxes	114,000	538,500	436,000	1,475,000	2,400,000
Net Savings	3,402,626	2,666,202	3,980,306	7,718,212	10,957,467
Depreciation (Primarily Straight Line) Included Above in Costs and Expenses	2,602,597	2,918,287	3,041,057	3,073,411	3,228,000

[a]For years 1970 and 1971, included in total costs and expenses.

Source: IFBCA.

Table 4C-3. Indiana Farm Bureau Cooperative Association, Inc. (B): Consolidated Statements of Changes in Financial Position, 1970–1974 (in U.S. dollars)

	1970	*1971*	*1972*	*1973*	*1974*
Funds Provided					
Net savings exclusive of extraordinary credit	3,402,626	2,602,702	3,980,306	7,718,212	10,957,467
Charges (credits) not involving funds					
Depreciation, depletion, and amortization	2,616,128	2,928,118	3,070,151	3,177,007	3,332,730
Loss: disposal of assets	118,720	187,037	112,318	–	–
Patronage refunds received in equities	(210,117)	(789,268)	(791,701)	(1,303,135)	(3,463,861)
Additions to deferred income	218,555	328,828	–	–	–
Amortization of deferred charges	20,712	18,775	–	–	–
Funds provided from operations, exclusive of extraordinary credit	6,166,561	5,276,192	6,371,074	9,592,084	10,826,336
Extraordinary credit	–	63,500	–	–	–
Proceeds from disposal of assets	430,616	326,854	236,118	155,765	291,353
Proceeds from redemption of investments in other cooperatives	549,946	1,003,143	415,812	403,194	220,269
Additions to long-term debt	6,930,000	398,500	350,000	1,249,000	7,660,000
Issuance of preferred stock	40,600	–	–	–	–
Payments received on long-term notes and contracts receivable	–	–	479,398	465,324	1,090,703
Other, net	16,682	116,518	–	4,386	51,114
Decrease in working capital	–	696,312	–	–	–
	14,134,438	7,881,019	7,852,402	11,869,753	20,139,775
Funds Applied					
Additions to property, plant, and equipment	5,571,598	2,512,180	2,366,942	2,774,589	11,457,807
Additions to long-term notes and contracts receivable	595,437	96,783	224,742	278,021	349,415

Notes and contracts receivable transferred to long term	–	–	488,000	–	–
Additions to investments in other cooperatives	110,225	150,523	176,085	237,303	597,692
Additions to other assets	–	–	126,758	415,703	302,141
Reduction of long-term debt	1,971,300	2,203,400	1,622,100	1,670,500	2,517,500
Redemption of stock	2,284,200	2,066,700	1,500,065	1,178,000	1,900,400
Dividends paid on preferred stock	141,656	109,140	86,363	77,703	67,320
Patronage refunds payable in cash	651,548	471,398	684,533	1,487,759	2,493,526
Other, net	196,859	270,895	4,290	37,050	6,981
Increase in working capital	2,611,615	–	572,524	3,713,125	446,723
	14,134,438	7,881,019	7,852,402	11,869,753	20,139,775
Increases (Decreases) in Working Capital					
Cash	65,041	(521,540)	1,066,174	(358,435)	160,859
Receivables	(3,068,169)	(309,681)	11,837,939	12,934,209	14,897,516
Inventories	19,438,396	(39,366)	7,039,014	4,073,462	58,964,139
Other current assets	(24,352)	64,035	(10,919)	96,587	30,179
Notes payable	(16,254,000)	5,704,743	(16,391,743)	7,285,000	(55,775,000)
Current portion of long-term debt	104,100	(421,600)	588,800	(47,400)	(830,000)
Advance payments received from patrons	–	–	–	5,680,000)	2,281,836
Accounts payable	2,522,631	(4,604,013)	(3,726,747)	(13,198,668)	(17,980,908)
Accrued expenses	(144,453)	(330,953)	(202,018)	70,926	(1,360,512)
Federal income taxes	(27,579)	(237,937)	372,024	(1,282,556)	58,614
	2,611,615	(696,312)	572,524	3,713,125	446,723

Source: IFBCA Annual Reports.

laying chickens, operating grain export terminal facilities, and providing credit to members. At one point in its history it manufactured light farm machinery.

IFBCA acted as both a supplier and a customer to the farmer members of its associated cooperatives. It provided them with fertilizer, fuel, seed, and other inputs at lower costs than retail while offering an optional market service for their production. In its buying and selling activities, IFBCA set prices at about the same level as leading competitors. Local associations had their own pricing policies, but usually they represented a similar attempt to price with leading competitors in their areas. It was believed that most farmers based their decisions about purchasing supplies or marketing their products on the price and service combinations available at the moment.

To perform these functions IFBCA was organized into five functional departments: plant food, petroleum, livestock and feed, grain marketing, and building supplies. Each of these departments was a profit center. IFBCA was also a member of large cooperative consortiums involved in fertilizer production, energy development, and bartering. CF Industries, a joint venture of IFBCA and other regional cooperatives throughout the United States, was a producer of nitrogen and phosphate and an importer of potash for use in fertilizer. IFBCA was also a member of the International Energy Cooperative (IEC), formed in 1974 by eighteen regional cooperatives that supplied over 30 percent of the petroleum products used by U.S. farmers Through IEC, the association was involved in oil exploration in Egypt and production in Guatemala. IFBCA had been a member of a regional grain exporting cooperative, but had withdrawn when it developed its own port terminal facilities. Figure 4C-1 shows a simplified diagram of IFBCA's grain operations.

IFBCA's operating strategy was based on the needs of its farmer members and defined by the efforts it made to satisfy them. One of its continuing efforts was to coordinate the production and marketing of commodities produced by its members. Such coordination not only resulted in more stable prices for the farmer, but also produced significant economies. Management believed that if it failed to develop innovative coordinating techniques, nonfarm organizations would do so and their economic benefits would accrue at a different point in the commodity system.

Evolution of IFBCA's Grain Marketing

The cooperative had not been involved in grain marketing at its birth. Independently of IFBCA, which had been performing primarily procurement functions following its establishment in 1927, the farmers of Indiana established the Indiana Grain Cooperative in 1938. The new cooperative was organized specifically to market the grain produced in Indiana. It had begun operations with about $50,000 in working capital and 500,000 bushels of leased elevator space in Indianapolis with loan assistance from the newly organized Bank of Cooperatives. The facility had a capacity of 1 million bushels and a 1,000-bushels/hour

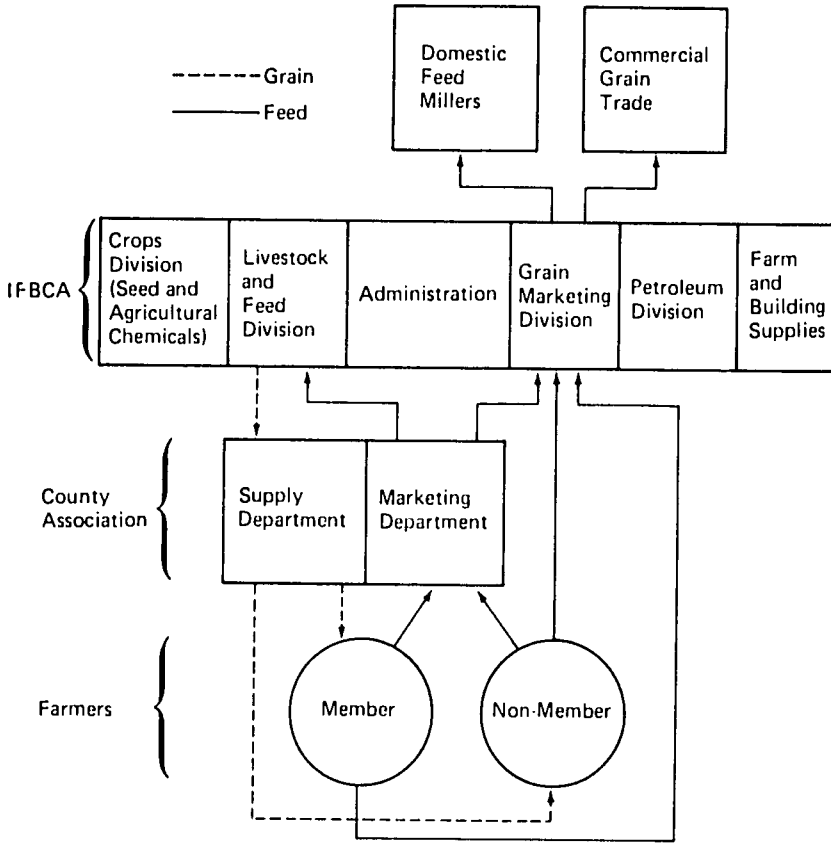

Figure 4C-1. Indiana Farm Bureau Cooperative Association: Flow of Grain and Feed in the Indiana Farm Bureau Cooperative System

drier. Some commercial buyers were initially reluctant to buy from the cooperatives, but it handled 8 million bushels of grain by the end of 1938. Between 1940 and 1950, additional capacity was added at Indianapolis and another facility purchased in Louisville, Kentucky, to serve the needs of southeastern Indiana. In January of 1950, because the membership in both organizations was essentially the same and opportunities existed for economies in management and operations, Indiana Grain was merged into IFBCA.

Following the merger, grain storage and handling capacity grew even more rapidly. In 1950, 1 million bushels of capacity were added to the Louisville facility. In 1957, 2.8 million bushels of capacity with modern ancillary facilities were added at Indianapolis. In 1965, a 3.8-million-bushel addition was completed at Indianapolis, bringing the total capacity of that facility to 9 million bushels. In 1966, the association bought a 500,000-bushel elevator in Princeton, Indiana, to serve the needs of farmers in the southwestern part of the state.

In 1965, IFBCA made its first effort to export grain directly when it rented 1.5 million bushels of elevator space in Baltimore and leased 25 high-volume hopper cars for hauling grain directly from Indianapolis to the facility. It expanded this effort further in 1967 when it signed a long-term lease on a 6.75-million-bushel terminal facility in Chicago. About the same time, after it persuaded the Pennsylvania Railroad to employ unit trains in hauling the cooperative's grain from Indianapolis to Chicago and Baltimore, it leased 100 large hopper cars for this purpose.[2] Later, in 1970, IFBCA purchased a 4-million-bushel terminal at Baltimore, rented 25 additional hopper cars, and terminated the lease on its first Baltimore handling and storage facility.

IFBCA improved its grain gathering capability in 1970 when it completed construction of a 3.25-million-bushel elevator equipped to load unit trains. This facility was constructed at Dunkirk, in northeastern Indiana, where modern high-volume elevator facilities had been lacking and where grain growing was less important than in other areas of the state. Its completion stimulated local grain production and preempted an opportunity for competing grain buyers to absorb the production of some IFBCA member cooperatives in the area. In 1973 the cooperative completed a 4-million-bushel facility at Logansport, in northwestern Indiana. The new elevator was intended to help relieve harvest congestion at the smaller elevators owned by nearby county cooperative associations. It was also equipped to load unit trains. To handle the increased volume of grain it was shipping, IFBCA in 1974 increased the number of rail cars it had under lease to 525. As a result of its recent growth, IFBCA controlled about 40 percent of the terminal elevator capacity in Indiana. Its member associations accounted for about 20 percent of the state's country elevator capacity.

With the expansion of its grain handling and storage facilities, IFBCA became a major force in marketing Indiana grain. Figure 4C-2 shows how the Indiana farmer's disposal of his grain has changed over time. Table 4C-4 breaks the volume of grain handled by the grain division into export and domestic sales for recent years. Table 4C-5 shows the volume of exports handled through each of IFBCA's export terminals for these same years.

Country, Subterminal, and Terminal Elevators

IFBCA's expansion of its grain merchandising efforts reflected important changes occurring in corn harvesting and logistics during the 1960s. Rapidly growing grain production, earlier and shorter harvest periods brought about by more efficient harvesting equipment, and higher moisture content of grain all brought about a need for faster grain-drying and handling equipment and for larger grain-storage capacity on and off the farm. These developments also brought about increased harvest-time demand by farmers and elevator operators for rapid transportation to export and processing points. Railroads, the main movers of grain in the United States, slowly applied the unit-train techniques after considerable pressure from grain handlers and merchants. Gradually seeing

Table 4C-4. Indiana Farm Bureau Cooperative Association, Inc. (B): Grain Division Sales,[a] 1970-1974 (millions of bushels)

Year	*1970*		*1971*		*1972*		*1973*		*1974*	
Commodity	*Domestic*	*Export*	*Domestic*	*Export*	*Domestic*	*Export*	*Domestic*	*Export*	*Domestic*	*Export*
Wheat	3.1	1.9	5.8	1.5	2.3	6.1	3.9	3.5	3.5	6.1
Corn	36.4	17.7	35.1	11.7	32.9	30.8	36.6	38.0	22.7	36.7
Soy Beans	17.6	14.4	19.4	14.6	13.0	18.6	11.4	23.5	13.2	17.5
Other	0	0	0	0	0	0	.8	0	0	.4
Total	57.3	34.0	60.3	27.8	48.1	55.4	52.7	65.1	39.4	60.7

[a]Recorded as sales in the year indicated, though not necessarily handled physically in that year.
Source: IFBCA.

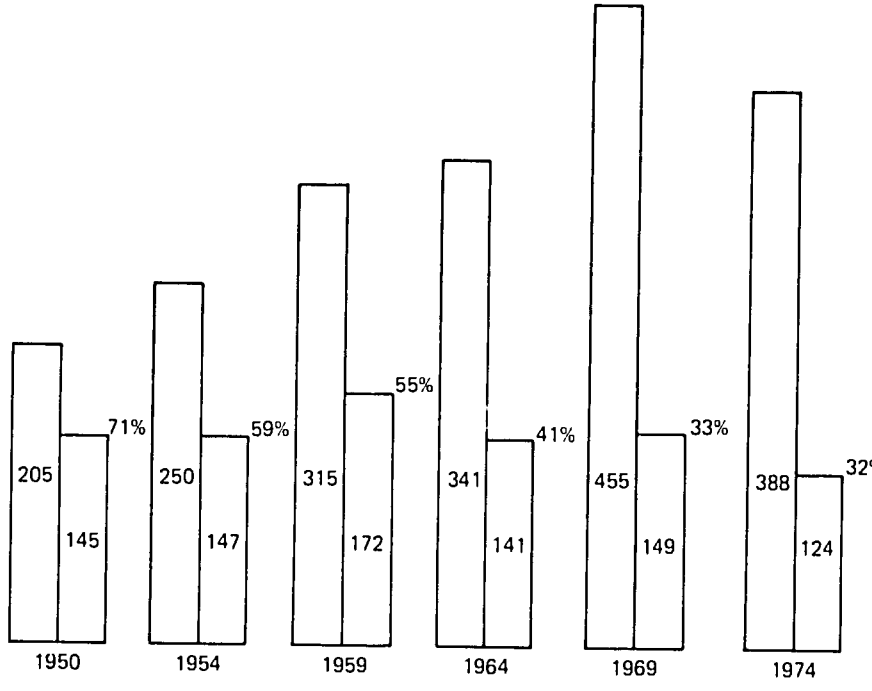

Figure 4C-2. Indiana Corn Production and On-Farm Usage: 1950-1974 (millions of bushels)

the potential for higher volume and fuller use of capacity, the railroads evolved a freight-rate structure for grain that generally became predicated on use of large covered hopper cars in multiple lots. This rate structure did not include provision for storing or milling in transit, stops for inspection, indirect routing, and conventional time allowances for loading and unloading that had been common in the past.

Preferential hauling rates for large-volume shipments had serious consequences for all operators of grain-drying and storage facilities, but especially for the many smaller ones with less than a 50,000-bushel capacity. Through the 1960s it was common practice for these "country elevators" to ship a single 50-ton car to a specific destination with intermediate stops for storage or milling in transit. By early 1975, freight rates were discriminating against this practice, favoring shipment of up to one hundred 100-ton covered hopper cars from a single origin to a single destination without intermediate stops. Railroad management was increasingly committed to moving grain in large volumes and on established schedules from grain elevators or to feed mills located on a main line. Thus, developing grain logistics were working against smaller country elevators that could not ship huge quantities of grain.

As a result, small country elevators were declining in number in Indiana and

Table 4C-5. Indiana Farm Bureau Cooperative Association, Inc. (B): Grain Division Exports by Terminal and Commodity, 1970-1974[a] (millions of bushels)

Year/ Commodity	*Baltimore*	*Facility* *Chicago (IFBCA)*	*Non-IFBCA Facilities*	*Total*
1970				
Wheat	–	1.9	0.2	2.1
Corn	5.7	12.1	0.4	18.2
Beans	2.5	11.9	1.0	15.4
Grains Shipped for Others	1.2	3.7	–	4.9
Total for Year	9.4	29.6	1.6	40.6
1971				
Wheat	1.1	0.4	0.7	1.6
Corn	5.7	6.0	0.9	12.6
Beans	1.4	8.2	7.9	17.5
Grains Shipped for Others	3.9	2.1	–	6.0
Total for Year	12.1	16.7	8.9	37.7
1972				
Wheat	4.7	1.3	–	6.0
Corn	19.2	10.9	0.6	30.7
Beans	11.9	6.1	0.6	18.6
Grains Shipped for Others	2.4	4.1	–	6.5
Total for Year	38.2	22.4	1.2	61.8
1973				
Wheat	1.9	0.9	–	2.8
Corn	25.0	9.3	3.8	38.1
Beans	13.5	10.0	–	23.5
Grains Shipped for Others	1.1	3.6	–	4.7
Total for Year	41.5	23.7	3.8	69.1
1974				
Wheat	6.1	–	–	6.1
Corn	27.8	8.9	–	36.7
Beans	13.5	4.0	–	17.5
Grains Shipped for Others	–	.4	–	.4
Total for Year	47.4	13.3	–	60.7

[a]Bushels physically handled in year indicated.
Source: IFBCA.

other grain-producing areas. Those remaining were generally located in heavy grain-originating areas or on main railroad lines and were large enough to handle multiple car shipments. Simultaneously, higher capacity "subterminal" elevators (500,000-bushel capacity and larger) were being constructed in the country on main railroad lines. They gathered grain from a wide area (often by truck),[3] and were able to bypass country elevators.

As it expanded its grain-handling facilities, IFBCA had employed subter-

Table 4C-6. Indiana Farm Bureau Cooperative Association, Inc. (B): Estimated Investment and Return for New Logansport Elevator (Completion: mid-1975)

	Total Cost	
5 million Bushel Elevator		$ 6,000,000.
Estimated Gross Income[a]		
Long-Term Basis Improvement 4.5 million bushels @ 20¢ bushel	$ 900,000.	
Thruput Margin–3 turns – 15 million bushels @ 5¢ bushel	750,000.	
		1,650,000.
Estimated Expenses		
Employee Costs	130,000.	
Depreciation	278,085.	
Power	42,600.	
Property Taxes	71,000.	
Insurance	30,000.	
Repairs and Maintenance	9,000.	
Supplies	7,000.	
Miscellaneous	7,500.	
Total Expenses		575,185.
Gross Income–Before Interest		1,074,815.
Capital in Use		
Fixed Assets	6,000,000.	
Inventory 4.5 million bushels @ $3.00 per bushel for 7 months.	7,875,000.	
		$13,875,000.
Return on Average Capital in Use .0775		
Rate of Return on Fixed Assets .1791		

[a]Does not include any overall marketing opportunities of the Grain Division.
Source: IFBCA.

minals. Each of its new facilities or additions were constructed to receive, dry, store, and load-out large volumes of grain as efficiently as possible. Management felt that maintaining modern, efficient facilities was critical if IFBCA was to remain competitive with private grain dealers. The financial burden of such an effort was significant, however. For instance, IFBCA's new 5-million-bushel elevator at Logansport involved an investment of $6 million in fixed assets and an additional $7.9 million in inventory (Table 4C-6). Adding capacity at established locations was somewhat less costly (Table 4C-7).

Grain Buying, Pricing, and Marketing

IFBCA purchased grain through its member associations. Corn thus purchased might be handled physically by the country cooperative, or it might be trucked directly from the farmer to one of IFBCA's grain terminals. In either case, the

Table 4C-7. Indiana Farm Bureau Cooperative Association, Inc. (B): Estimated Investment and Returns for Additional Steel Storage Capacity at Gateway and Redkey Elevators (Completion: mid-1975)

Gateway 1,050,000 bushels	$ 850,000.	
Redkey 2,100,000 bushels	1,473,000.	
3,150,000 bushels	2,323,000.	$2,323,000.
Estimated Gross Income[a]		
Long Term Basis Improvement 20¢ per bushel 2,835,000 bushel	$ 567,000.	
Thruput Margin–2 turns @ 5¢ per bushel 6.3 million bushels	315,000.	
		882,000.
Estimated Expenses		
Employee Costs	0.	
Depreciation	129,050.	
Power	18,500.	
Property Taxes	38,600.	
Insurance	15,265.	
Repairs and Maintenance	6,000.	
Supplies	3,000.	
		210,415.
Total Expenses		
Gross Income–Before Interest		671,585
Capital in Use		
Fixed Assets	$2,323,000.	
Inventory 2,835,000 bushels @ $3.00 per bushel for 7 months	4,961,250.	
		$7,284,250.
Return on Average Capital in Use .0922		
Rate of Return on Fixed Assets .2891		

[a]Does not include any overall marketing opportunities of the Grain Division.
Source: IFBCA.

country association was considered to have originated the shipment and therefore received a margin. Through the country associations, IFBCA published a daily list of prices offered to the farmer for corn and other grains. Prices were based on closing Chicago futures prices plus discounts or premiums for quality differentials, delivery date, and delivery point. Prices quoted were fixed until the futures market opened the following day. While the markets were open, IFBCA's offering prices reflected market fluctuations.

A farmer interested in selling grain would contact the elevator manager at the country coop and request a quote. The elevator manager would, in turn, contact the grain marketing division in Indianapolis and determine the prevailing quotation. He would relay this information to the farmer, who would ordinarily compare it to offers from competing grain buyers. If the farmer accepted the

cooperative's offer, he would so notify his local association and arrange for shipment. He might truck it himself to his country association's elevator or to an IFBCA subterminal nearby, or the cooperative might arrange to pick up.

The farmer could determine the price of his grain in one of two ways. He could accept outright the price offered him by the cooperative and receive payment a few days following delivery of his grain to an elevator. Or he could choose the "deferred pricing" method, in which case title to the grain was transferred to the cooperative at the time of delivery but the farmer delayed pricing his grain until the time he chose. This selling arrangement, called a basis contract, specified that grain would be paid for at a certain premium or discount (i.e., basis) from the Chicago futures price. The contract specified the futures option month that would be used and the basis. The farmer could then select any day to price his grain throughout the marketing period specified in the contract. About 3.3 percent of the grain purcased by IFBCA was handled under such deferred pricing arrangements.

IFBCA circulated its net long or short position in each grain daily and maintained such positions fully hedged. Long positions consisted of grain actually owned plus commitments to buy or to take delivery. The short positions consisted of commitments to sell or to deliver. These positions were netted against each other to determine net positions, long or short, for each grain.

Whenever possible, IFBCA sought to export the grain it handled to grain deficit areas. In 1972, a 3 percent decline in world food production had caused a dramatic increase in world demand for U.S. grain and a 250 percent increase in American grain prices. Able to export about half its grain purchased, IFBCA benefited significantly from this situation. Longer-term foreign grain demand was expected to be heavy, although much of this demand would be concentrated in regions and countries whose ability to pay was limited. Nonetheless, IFBCA management believed that some price or marketing mechanisms would be evolved to enable poorer countries to buy U.S. grain. In the coming year the volume of grain exports was expected to decline. Record-breaking corn, wheat, and soybean crops were expected in the United States, and crop conditions elsewhere in the world were promising.

IFBCA was beginning to compete with large grain-trading firms and some other large cooperatives as it integrated forward into grain exporting. In the late 1960s, six major exporting firms operated about half of all the terminal elevators and storage capacity at the twelve leading (Table 4C-8) grain export ports. Cooperatives had historically handled substantial amounts of grain at point of first sale due to the number of country elevators they owned, but they owned only about 10 percent to 15 percent of port elevators and storage capacity. It was estimated within the industry that the six largest trading firms ultimately handled as much as 80 percent of U.S. grain exports, though this percentage was believed to be declining gradually.

IFBCA undertook its forward integration into rail and terminal operations in an effort to reduce its logistical dependence on the large trading firms, to obtain

Table 4C-8. Port Grain Elevators and Capacity by Ownership, Selected Ports: January 1968[a] (number of elevators and capacity[b])

Port	Major Exporters		Cooperative		Other		Total		Major Elevator Capacity as Percentage of Total Capacity
	No. of Elevators	Capacity (million bushels)	No. of Elevators	Capacity (million bushels)	No. of Elevators	Capacity (million bushels)	No. of Elevators	Capacity (million bushels)	
Lakes									
Chicago	7	49.6	1	6.8	5	8.0	13	64.4	77
Duluth-Superior	6	39.5	2	17.7	4	15.3	12	72.5	54
Toledo	2	8.2	1	1.5	4	17.1	7	26.8	31
Atlantic									
Philadelphia	–	–	–	–	2	5.0	2	5.0	0
Baltimore	2	8.9	1	4.0	–	–	3	12.9	69
Norfolk	2	9.6	–	–	–	–	2	9.6	100
Gulf									
Mississippi River	4	26.2	c		1	7.7	5	33.9	77
East Gulf	1	3.0	–	–	1	2.7	2	5.7	53
North Texas Gulf	5	15.9	–	–	9	44.5	14	60.4	26
Pacific									
Columbia River	5	24.7	7	4.1	1	1.2	13	30.0	82
Puget Sound	2	11.1	–	–	1	2.6	3	13.7	81
San Francisco, Oakland and Stockton	–	–	–	–	5	15.0	5	15.0	0
Total, Selected Ports	36	196.7	12	34.1	33	119.1	81	349.9	
Percentage of Elevators	44%		15%		41%		100%		
Percentage of Capacity		56%		10%		34%		100%	

[a]Includes some capacity which may not actually be on the waterfront but is in the immediate vicinity of the port.

[b]Includes some facilities owned by the port authority and leased to major exporters.

[c]A new cooperative elevator with 5 million bushels capacity was placed in operation after January 1968.

Source: USDA, ASCS Approved Warehouse Lists; various state feed and grain dealer directories; *Custom Home Guide* 1968, Budd Publication, New York, 1968; and *Seaway Maritime Directory 1965*, The Fourth Seacoast Publishing Co., Inc., Detroit, 1965, as presented in *Grain Export Industry Organization in the United States*, Research Progress Report 390, August 1971, Agricultural Experiment Station, Purdue University.

the capability of loading-out ocean cargoes, and to earn the margins on such operations for its member cooperatives. IFBCA's largest customer was a Canadian firm that purchased over 20 percent of the association's annual volume. All of the purchases were for overseas export. Major grain-trading firms bought another 30 percent of IFBCA's volume, most of it for export as well. Over 150 customers, primarily feed millers and distillers in the Southeast, purchased the remainder. IFBCA management acknowledged its heavy reliance on its Canadian customer, but felt that use of this channel enabled it to reduce its dependence on the large grain-trading firms.

Feed Milling and Marketing

Feed procurement was one of the first activities undertaken by the organization that evolved into IFBCA. A feed department was organized in 1922. Its initial effort was a formula program based on the experiments of agricultural colleges in the area. From 1922 to 1930 cooperatives in Ohio, Michigan, and Indiana pooled their feed requirements and contracted with an established feed manufacturer for its production. Formulas for various feeds were determined and submitted to the manufacturer, who did the mixing and blending for a specific price per ton. To ensure that the feed was mixed according to order, a supervisor stayed at the mill when it was in operation to check ingredients and mixing operations and to take samples for analysis.

In 1930, the cooperatives in these three states decided to form an organization known as the Farm Bureau Milling Company, whose function would be to contract for feed manufacture. In 1943, the company acquired a large feed mill in northwestern Indiana. The mill was reconditioned, and improvements were added. Production consisted primarily of premixes and concentrates that were converted to complete feeds at local cooperatives.

Because of changes in the feed market, in railroad freight rates, and in feed-distribution patterns, this mill became obsolete and was eventually closed in 1966. IFBCA consequently undertook to build feed mills of its own. In 1966 a new mill was constructed in southern Indiana. A second mill, in Indianapolis, came on stream in 1969, and a third, serving northern Indiana, was opened in 1970. The mills were similar in design, each having a potential annual capacity of about eighty thousand tons. Their locations were determined after substantial research on freight rates, livestock population, highway facilities, and distances from surrounding county cooperative facilities.

The development of the IFBCA Feed Division demonstrated the significant changes occurring in the feed industry. Large terminal, continuous line-mix mills had given way to regional and satellite batch-mix mills like IFBCA's. Shifts in mill location had taken place due to changes in milling-in-transit privileges and other changes in transportation rates and operations. New mills were fully automated; designed to produce complete feeds containing drugs, minerals, and vitamins; and constructed to receive ingredients and ship finished products in

Table 4C-9. Bulk Feed Shipments as a Percentage of Total IFBCA and Industry Feed Shipments in Indiana: 1967-73

	Bulk Feed Shipments	
Year	*IFBCA*	*Industry*
1967	32	N.A.
1968	49	N.A.
1969	48	N.A.
1970	55	49
1971	64	54
1972	65	53
1973	68	56

Source: IFBCA.

bulk. The largest feed companies had diversified into unrelated businesses and integrated forward into livestock and poultry production.

IFBCA stressed efficiency in its feed operations by maintaining high operaing rates in its feed mills. Bulk trucks brought in most ingredients and delivered the finished product either to the local cooperatives or directly to farms, and they hauled freight in both directions on every trip. Bulk shipment of ingredients, large volume production, and bulk distribution of products were emphasized to obtain economies of scale. In its bulk distribution efforts, IFBCA was an industry leader, as shown in Table 4C-9.

Although the feed division offered 164 feed varieties for sale, 10 types accounted for over half its feed volume. Table 4C-10 shows a feed tonnage comparison by type for IFBCA and compares the performance of the feed division in years 1959 through 1974.

Indiana was a major producer of hogs, feeder cattle, and poultry, and feed sales were directly affected by the profitability of raising these animals. Unit sales of livestock and poultry feed (Table 4C-11) fluctuated with the animal population on the state's farms, but IFBCA's close relations with local cooperative associations and their farmer members insulated it somewhat from these fluctuations. Local cooperative associations were the leading distributors of feed to commercial farmers, handling over 20 percent of the feed sold in Indiana. Though they often sold feeds produced by private firms such as Ralston Purina and Cargill, local associations always offered IFBCA's brands. Thus, in 1973, when unit sales of feed declined statewide, IFBCA was still able to maintain growth in feed sales. Its relatively intensive distribution system and the quality of its feeds enabled the feed division to remain profitable over the years.

To meet the competitive threat posed by the large manufacturing firms that had integrated forward into production or contract production of poultry and meat products, IFBCA was seeking to establish long-term production contracts for hogs, turkeys, and eggs with its members. The parties to the contracts were

Table 4C-10. Indiana Farm Bureau Cooperative Association, Inc. (B): Feed Tonnage Comparison by Types, 1959-1974

Year	*Total Tons All Feeds*	*Tons of Mfg. Feeds*	*Tons of Hog Feed*	*Percent of Mfg. Feed*	*Tons of Cattle Feed*	*Percent of Mfg. Feed*	*Tons of Poultry Feed*	*Percent of Mfg. Feed*
1959	168,166	108,609	51,802	47.7	23,260	21.4	33,547	30.9
1960	163,825	97,034	45,866	47.3	22,765	23.4	28,403	29.3
1961	174,155	102,335	50,157	49.0	23,828	23.3	28,350	27.7
1962	179,573	103,243	55,364	53.6	24,577	23.8	23,302	22.6
1963	174,852	100,306	55,282	55.1	24,455	24.4	20,567	20.5
1964	170,965	98,331	52,818	53.7	24,860	25.3	20,654	21.0
1965	155,875	88,999	45,402	51.0	26,662	30.0	16,849	18.9
1966	170,517	97,072	49,508	51.0	28,643	29.5	17,185	17.7
1967	176,993	102,668	52,765	51.4	29,735	29.0	18,033	17.6
1968	182,363	106,461	54,514	51.2	31,429	29.5	18,102	17.0
1969	191,971	114,886	58,789	51.1	38,904	33.0	27,472	23.9
1970	210,921	140,408	66,016	47.0	37,279	26.6	34,355	24.5
1971	224,751	162,598	69,089	42.5	46,322	28.5	43,998	27.1
1972	228,501	171,113	69,638	40.7	43,085	25.2	47,786	27.9
1973	223,719	180,328	76,096	42.2	36,029	20.0	53,524	29.7
1974	250,567	207,819	81,728	39.3	43,875	21.1	71,160	34.2

Feed Division Comparison

	1971	*1972*	*1973*	*1974*
Total Tons Manufactured and Ingredient Feeds	224,751	228,501	223,719	250,567
Sales	$22,399,241	$25,251,213	$39,278,781	$44,163,785
Gross Margins	2,156,284	1,947,540	3,658,934	2,068,879
Expenses	1,157,000	1,190,995	1,352,946	1,748,241
Net Savings (Before General Administrative Expenses)	1,191,548	1,001,144	2,538,649	631,294

Source: IFBCA.

Table 4C-11. Manufactured Livestock and Poultry Feed Purchased by Indiana Farmers and Indiana Farm Bureau Coop Market Share: 1964-1974

	Tons Purchased by Indiana Farmers			*F.B. Coop Market Share*		
Year	*Live-stock*[a]	*Poultry*[b]	*Total*	*Live-stock*	*Poultry*	*Total*
1964	585,261	441,001	1,026,262	23.7%	7.8%	17.7%
1965	552,338	425,961	978,299	22.1	6.5	15.8
1966	636,861	448,630	1,085,491	20.2	6.7	14.8
1967	689,142	461,102	1,150,244	21.8	6.5	15.6
1968	616,469	452,934	1,069,403	25.5	9.1	18.7
1969	675,937	453,823	1,129,760	25.5	9.1	18.7
1970	719,560	388,517	1,108,077	26.4	9.8	19.4
1971	628,552	379,549	1,008,101	28.2	12.7	22.0
1972	617,612	381,600	999,212	28.4	12.9	22.2
1973	747,408	419,311	1,166,719	29.6	15.1	23.9
1974	728,723	467,112	1,195,835	31.1	16.9	25.4
Percent of Change						
1974 versus 1964	24.5%	5.9%	16.5%	31.2%	116.6%	43.5%
1974 versus 1973	-2.5	11.4	2.5	5.1	11.9	6.3

[a]Includes beef, dairy, sheep, and swine feeds.

[b]Includes layer, turkey, and broiler feeds.

Source: Estimates were based on the following data: Statistical Reporting Service, USDA; AFMA Feed Tonnage Reports; Indiana Farm Panel; and IFBCA Feed Tonnage Reports.

IFBCA, county cooperative associations, and farmer members. IFBCA acted as supplier and marketing agent. The county association managed the program locally, and the farmer produced the commodities. The local cooperative purchased livestock (feeder pigs, turkey poults, or laying chicks) from IFBCA at actual cost plus a small fixed fee. The cooperative, in turn, provided the livestock to the farmer at its cost plus a credit fee. It also provided food, medication, and other services required while the farmer fed the hogs or poultry. The farmer provided housing, care, and feeding for the animals until they were finished or (in the case of chickens) their laying cycle was complete. When the hogs or turkeys were complete, they were turned over to IFBCA as marketing agent for sale when it decided market conditions were appropriate. Eggs were sold through IFBCA as they were produced. If the proceeds received by IFBCA exceeded the amount owed by the farmer, the excess was credited to his account. If the proceeds were lower than the farmer's debt, the cooperative absorbed the loss and paid him for his labor on the basis of the efficiency of his operations. To market the commodities produced under these contracts, IFBCA sought long-term selling arrangements with major meat packers and poultry processors. Early in 1974, IFBCA had about 810,000 turkeys, 142,000 hogs, and 930,000 laying chickens under contract in Indiana, about 12.6 percent, 2.2 percent, and

11.6 percent respectively of the turkey, hog, and laying chicken populations in the state.

Feed division personnel believed that the success of these contractual arrangements was vital if IFBCA was to protect its share of the Indiana feed market. Furthermore, such contracts provided the farmer some income security, enabled the feed division to maintain a relatively high operating rate in its feed mills, and offered a model coordinating arrangement to linking successive levels in the commodity system while reducing the risks of participants at each level.

Alternative Strategies with Respect to Corn

IFBCA management was considering what decisions they might make regarding corn. A large feedgrain surplus loomed in the United States over the coming decade, indicating the need for an aggressive export effort to relieve downward pressure on American feedgrain prices. On the other hand, low grain prices would probably mean renewed opportunities for profitable livestock and poultry production, especially if long-term supply arrangements could be made with major processors. Management needed criteria to determine which area offered the most significant opportunities for farmers and what each opportunity would cost to pursue.

In considering its alternatives, IFBCA's management did not have as much financial flexibility as it would have liked. Debt of all kinds had increased from about 33 percent of capitalization in 1965 to about 50 percent in 1971. By 1975 this figure exceeded 70 percent. Management could not rapidly expand IFBCA's equity base without seeking more funds from farmers. This effort would be difficult, however, since IFBCA was already retaining a larger percentage of annual patronage cash refunds and distributing stock instead to member cooperatives and farmers. These noncash allocations were taxable and so were a burden on the association's membership. Given IFBCA's somewhat limited financial resources, management felt that joint arrangements with other cooperatives might be worthy of exploration.

NOTES

1. A cooperative operates under the "conduit" principle for tax purposes. Its income is not taxed to the extent that it is paid to members. Income need not, however, be distributed completely in cash; it may also be paid in the form of a written notice of allocation, or as other property. Written notices may be in the form of equity, debt, or a credit on the books of the organization, provided either that it is convertible to cash within ninety days at face value or that the patron agrees to include it as part of his income. At least 20 percent of a patronage refund allocation must be paid within eight and one-half months after the close of the accounting year involved.

2. Unit trains are freight trains consisting of 100 or more cars of similar design dedicated specifically to the transport of a single commodity between

two (usually) widely separated points. Use of unit trains speeds the movement of commodities, improves the use rate of rail cars (they spend a minimum amount of time in freight yards), and permits reduced freight costs per unit of commodity shipped.

3. As railroads adopted unit trains for handling grain, they abandoned numerous branch lines that served country elevators, either because increasing costs made them uneconomical or because the expanding U.S. Interstate Highway System allowed truckers to offer better service to branch-line shippers.

APPENDIX D
INDIANA FARM BUREAU COOPERATIVE ASSOCIATION, INC.*

Late in 1973, the general manager of the Indiana Farm Bureau Cooperative Association (IFBCA) was seeking to establish new, long-term production and marketing arrangements among the bureau's membership. Specific contracts had been developed for members producing hogs, turkeys, and eggs, and contracts involving additional commodities were being considered. For these commodities, the contracts were unique because they spanned more than one production cycle. The general manager believed that these contracts offered significant benefits to the farmer and his cooperative plus profit opportunities for large-scale purchasers. He wished to develop a program for obtaining broad farmer acceptance of the program.

Long-Term Contracts

IFBCA had been testing innovative programs to assist member farmers in expanding production and marketing larger volumes of their most important products. These programs included such activities as operation of breeding facilities for a variety of livestock, development of production and finishing contracts with farmer members, establishment of marketing programs including long-term contracts and joint ventures with packers and other large customers, construction of the association's own processing facilities, and development of distribution systems. If successful, these activities would provide increased income security to the farmer while allowing him a significant entrepreneurial role.

The association had been attempting to implement long-term (two- to four-year) arrangements for the production and marketing of hogs, turkeys, and eggs. The parties to these contracts were IFBCA, county cooperative associations, and farmer members. IFBCA acted as the supplier and marketing agent, the county associations managed the project locally, and the farmer produced the commodities.

Conceptually, the three arrangements were similar. The local cooperative purchased livestock (feeder pigs, poults, chicks) from IFBCA at actual cost plus a small fixed fee. The cooperative, in turn, provided the livestock to the farmer at its cost plus a fee. It also provided feed, medication, and other services required while the farmer fed the hogs or poultry. The farmer agreed to provide housing, care, and feeding for the animals until they were finished or (in the case of chickens) their laying cycle was complete. The farmer also insured the stock

*This case was prepared by Richard C. McGinity, Research Assistant, under the direction of Professor Ray A. Goldberg, as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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against loss from various causes. When the hogs or turkeys were complete, they were turned over to IFBCA as marketing agent for sale when it decided market conditions were appropriate. Eggs were sold through IFBCA as they were produced. The flocks of spent hens were sold at the completion of their laying cycles.

Although conceptually similar, the contracts differed from one another in terms of complexity, timing, and payment provisions. The hog contract covered a minimum of two years and actually involved two contracts—one providing for delivery to the farmer of feeder pigs of at least forty pounds each at 120-day intervals;[1] the other providing for sale of the hogs through IFBCA. Presently, IFBCA sold the hogs on a best-efforts basis and distributed the proceeds (less a fixed marketing fee per head) so as to pay:

1. the cost of insurance on feeder pigs
2. the cost of transportation to market
3. a percentage (about 6 percent: see Table 4D-1) of gross proceeds to the farmer based on feed-conversion ratio[2]
4. the remaining proceeds to the local cooperative, to be applied in payment toward the cost of pigs, feeds, and other items supplied in the arrangement.

Table 4D-1. Indiana Farm Bureau Cooperative Association, Inc.: Percentage of Net Proceeds from Sale of Hogs or Turkeys Paid to Farmer at Time of Sale

Feed Conversion Ratio[a] *(Turkeys)*	*Percentage of Proceeds* *Hens*	*Toms*
2.84 or less	14.5	11.0
2.94 or less	14.0	10.5
3.04 or less	13.5	10.0
3.14 or less	13.0	9.5
3.24 or less	12.5	9.0
3.34 or less	11.5	8.0
3.44 or less	10.0	6.5
3.54 or less	9.0	5.5
3.64 or less	7.5	4.5
3.74 or less	6.0	4.0
Feed Conversion Ratio[a] *(Hogs)*	*Percentage of Proceeds*	
3.9 or above	5	
3.8 to 3.89	5 1/2	
3.7 to 3.79	6	
3.6 to 3.69	6 1/2	
3.5 or below to 3.59	7	

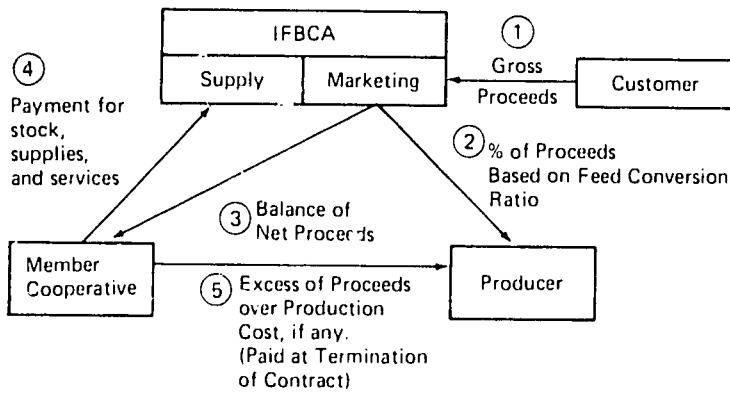
[a]Determined at time of sale, the feed conversion ratio measures the pounds of feed required per pound of weight gain. This figure is computed by dividing the amount of feed consumed by the flock or lot by its aggregate live weight at time of sale. The weight of dead and unmarketable animals is deducted from total weight before the feed conversion ratio is determined.

Source: IFBCA.

The local cooperative agreed that if the proceeds received from IFBCA exceeded the amount owed by the farmer, the excess would be credited to his account.[3] After the last of the pigs had been grown and marketed, the excess would be paid to the farmer. If the proceeds received by the local cooperative from all hogs produced under the contract were not sufficient to pay the farmer's costs, the local cooperative would forgive the unpaid balance. In this way, it absorbed the loss while the farmer still received some income for his labor.

The arrangement for turkeys covered one year at a time. Turkeys were raised during a twenty to twenty-five week period between spring and fall. Two contracts were involved: one providing for delivery of day-old turkey poults, the other for sales of full-grown turkeys. IFBCA sold the turkeys to two major processors on renewable annual contracts. Prices were determined through negotiation, and proceeds from the sale were distributed in a manner similar to that for hogs. Table 4D-1 shows the feed-conversion ratios on which the percentage of proceeds paid to farmers were computed.

The egg production program involved three contracts and spanned a period of three to four years.[4] One contract governed the sale of the local coop of started pullets, another covered the egg production agreement with the farmer, and the third defined the egg-marketing agreement. As in the turkey contract, the price of the eggs when sold was based on Urner-Barry quotations.[5] IFBCA paid the farmer about 18 percent of the gross proceeds of the eggs. The local cooperative was paid the remainder, which it allocated in a manner similar to that for hogs and turkeys. Figure 4D-1 shows schematically the financial operation of these longer-term arrangements.



Source: Indiana Farm Bureau Cooperative Association documents.

Figure 4D-1. Indiana Farm Bureau Cooperative Association, Inc.: Funds Flows Resulting from Sale of Contract Commodities

Potential Obstacles to Implementation

Implementing long-term production and marketing arrangements might be difficult for IFBCA. It faced significant uncertainties of risk management, capital requirements, availability of inputs, and local cooperative autonomy. In each of these areas it had to develop new policies.

IFBCA management was uncertain of the risks it was assuming in proposing the long-term production and marketing contracts. Previously, the farmer had carried substantial risk of loss due to fluctuation in prices for hogs, turkeys, and eggs. Now, however, IFBCA and his local cooperative would assume the risk of fluctuation in commodity prices and guarantee the farmer at least a return on his out-of-pocket costs for production.[6] IFBCA believed, however, that the long-term character of its contracts would at least allow it to break even over the cycles that had characterized hog, egg, and turkey prices historically (Figure 4D-2). During periods of strong prices, proceeds from sales would increase and costs would be more than covered. During periods of weakness, proceeds would be smaller and losses might result, but the farmer would still receive a percentage of the proceeds. Losses, if any, would be borne by the cooperatives, which were certainly better able to endure them.

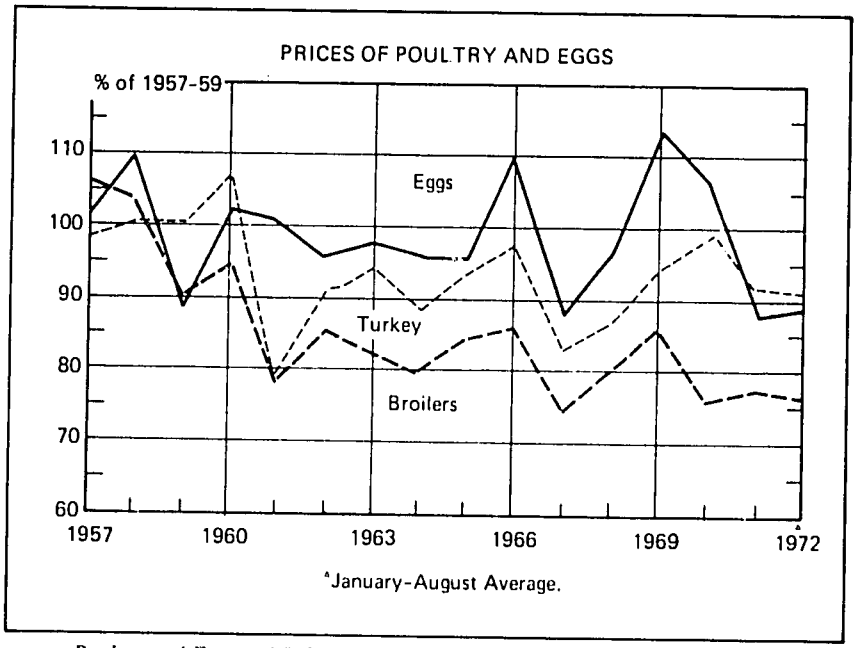
To minimize the effect of the cycles, IFBCA could use the futures markets as a hedging device in conjunction with its contracts for hogs and eggs. Because it would supply the animals to the farmers and market their output, it could keep close track of expected production. Scheduled production represented a "net position" that could be hedged in the futures market. In undertaking this activity, the association would free the farmer from the need for doing so.

The capital requirements of IFBCA's contractual arrangements would be significant. In effect, while a farmer was producing under contract, his working capital needs for producing the contract commodity would be provided by IFBCA. The amount of capital required would vary with the popularity of the new contracts. Table 4D-2 shows working capital requirements for hogs, turkeys, and chickens. Currently IFBCA had about 50,000 hogs, 1 million chickens, and 1 million turkeys under contract. Plans called for increasing hog and turkey

Table 4D-2. Indiana Farm Bureau Cooperative Association, Inc.: Estimated Capital Requirements for IFBCA Long-Term Contracts.

Contract	*Item*	*Cost*
Hog	Feeder Pigs	$40/pig
	Feed (720 lbs./animal, est.)	$140/ton
Turkey	Turkey Poults	$0.85/poult
	Feed (65 lbs./animal, est.)	$140/ton
Egg	Pullet	$2/chick
	Feed (66 lbs./pullet, est.)	$140/ton

Source: Casewriter estimate.

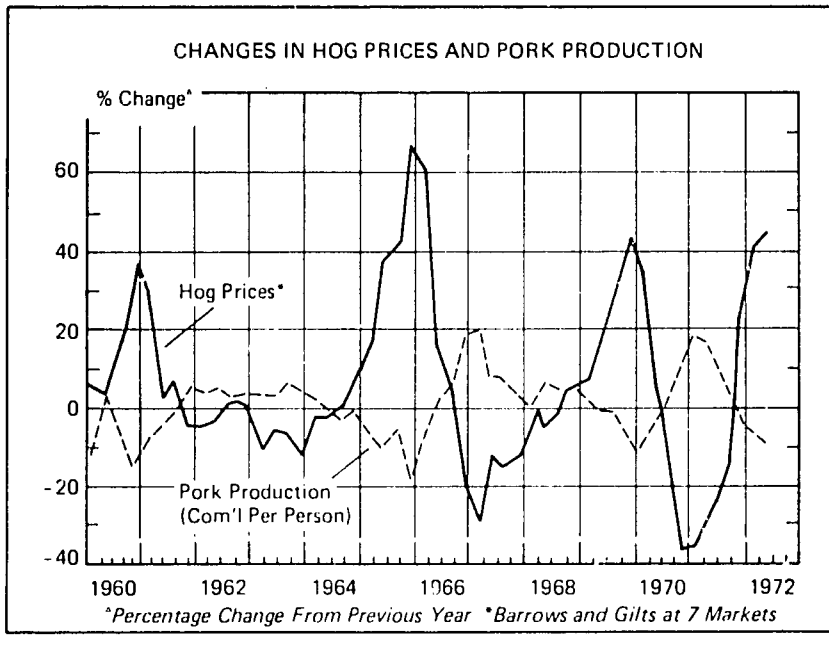


Poultry and Eggs and Related Commodity Groups: Prices Received by Farmers

Year	Reported Price			Index Numbers, 1957-59 = 100					
				Individual Commodities			Commodity Groups		
	Broilers per Pound	Turkeys per Pound	Eggs per Dozen	Broilers	Turkeys	Eggs	Poultry and Eggs	Meat Animals	Dairy Products
	Cents	Cents	Cents						
Average:									
1957-59	17.8	23.7	35.3	100.0	100.0	100.0	100	100	100
1957	18.9	23.4	35.9	106.2	98.7	101.7	103	89	101
1958	18.5	23.9	38.5	103.9	100.8	109.1	108	109	99
1959	16.1	23.9	31.4	90.4	100.8	89.0	91	102	100
1960	16.9	25.4	36.1	94.9	107.2	102.2	101	96	101
1961	13.9	18.9	35.6	78.1	79.7	100.8	92	97	101
1962	15.2	21.6	33.8	85.4	91.1	95.8	92	101	98
1963	14.6	22.3	34.5	82.0	94.1	97.7	92	94	98
1964	14.2	21.0	33.8	79.8	88.6	95.8	90	88	100
1965	15.0	22.2	33.7	84.3	93.7	95.5	92	104	102
1966	15.3	23.1	39.1	86.0	97.5	110.8	102	116	114
1967	13.3	19.6	31.2	74.7	82.7	88.4	84	109	119
1968	14.2	20.5	34.0	79.8	86.5	96.3	90	112	124
1969	15.2	22.4	40.0	85.4	94.5	113.3	103	130	130
1970[a]	13.5	23.6	37.7	75.8	99.6	106.8	96	131	134
1971[a]	13.8	21.9	31.1	77.5	92.4	88.1	84	131	138
Jan.-Aug.									
1971	14.2	21.7	31.2	76.3	90.0	92.0	102	117	116
1972	14.2	22.0	29.2	76.3	91.3	86.2	99	143	120

[a]Prices for 1970 and 1971 are simple averages.

Figure 4D-2. Indiana Farm Bureau Cooperative Association, Inc.: U.S. Prices of Poultry and Eggs 1957-1972 and Hogs 1968-1972



Hog Prices and Commercial Pork Production

Year and Quarter	*Pork Production Per Capita*	*Percentage Change from Previous Year*	*Price of Barrows and Gilts at 7 Markets*[b]	*Percentage Change from Previous Year*
	Pounds	Percent	Dollars	Percent
1968:				
I	16.4	-1.8	18.93	-0.8
II	15.9	+7.4	19.44	-5.5
III	15.3	+2.7	20.50	-2.5
IV	18.0	+3.4	18.32	+4.1
1969:				
I	17.0	+3.7	20.29	+7.2
II	15.9	0	22.89	+17.7
III	15.0	-2.0	26.30	+28.3
IV	16.6	-7.8	26.08	+42.4
1970:				
I	15.3	-10.0	27.20	+34.1
II	15.6	-1.9	23.86	+4.2
III	15.7	+4.7	22.53	-14.3
IV	19.4	+16.9	16.42	-37.0
1971:				
I	18.1	+18.3	17.60	-35.3
II	18.1	+16.0	17.33	-27.4
III	16.9	+7.6	19.27	-14.5
IV	18.7	-3.6	20.06	+22.2
1972:				
I	17.1	-5.5	24.67	+40.2
II	16.5	-8.8	24.98	+44.1

[b]8 markets prior to 1969.

Source: USDA.

Figure 4D-2 continued

numbers to 2 million and chickens to 2.5 million.[7] The timing of cash flows would increase the complexity of the capital problem because IFBCA would have to wait until the animals or eggs were sold before it recovered any of the costs of animals, feed, medications, or services it provided under the contracts. This cash flow gap might impose a burden that IFBCA could not handle with internally generated funds. If so, it would have to seek interim financing, for reliance on members or potential members for capital had not appeared to be a feasible alternative in financing such experimental programs.

IFBCA might find its demand for feeder pigs, pullets, and poults difficult to satisfy if the long-term contract concept became widely accepted. If supply became a problem, the co-op might be forced to expand its breeding facilities. Although this action would ensure a source of supply, it could significantly increase the need for financing.

Convincing farmers to enroll in the long-term programs would not be simple. Coop members might see the contracts as threats to their independence and flexibility. If many did, a serious effort would be required to convince them of the program's value. Although some farmers might be reluctant to participate, others might see the arrangements as primarily benefiting the large farmer. The programs were clearly set up to obtain the economies of large-volume operations. Although management felt the obligation to serve all Indiana farmers, including small and marginal operators, it also believed it must serve the larger and more progressive farmers adequately or risk a decline in IFBCA's importance.

Finally, IFBCA had continually emphasized the concept of local association autonomy. It always tried to maintain the vitality of local organizations and keep decisionmaking authority with the local boards of directors and management staffs. However, the benefits of local autonomy in decisionmaking had to be balanced with some of the obvious benefits of centralized control. Contract hog, egg, and turkey production programs required substantial coordination and control by IFBCA. Trading expected economic benefits for local autonomy might require difficult realignments of decisionmaking authority and responsibility in certain localities.

Expected Benefits

If the long-term contracts were implemented on a large scale, they would produce significant benefits to IFBCA, the farmer, and the customers who purchased hogs, turkeys, and eggs from IFBCA. Member farmers would be largely shielded from the "boom and bust" cycles that had characterized hog, egg, and turkey prices in past years. If they were so shielded and under contract to produce a specified volume periodically, they could concentrate on improving the quality of their production and their reliability as suppliers. Freed from having to expand or decrease production in response to the market, they could obtain the economies available in maintaining steady production levels. (Farmers would be prohibited from raising hogs, turkeys, or eggs on a noncontract basis.) Espe-

cially important, they would be rewarded for concentrating on what they did best—maximizing production efficiency[8]—rather than on guessing the future course of the market.

Shielded from the sharp cycles that had characterized end-product prices, the farmer's risk management problem would be significantly reduced. Because his own capital was not tied up in his inventory of hogs, chickens, and turkeys, he was not exposed to significant loss. Short-term losses would be inconsequential, whereas his profit potential could be considerable. Currently, the farmer had to hedge his own risks through use of the futures market. Under its new contracts, however, IFBCA and the local coops assumed the risk and undertook hedging tactics as part of their management activities.

IFBCA and its federated cooperatives would benefit as well as farmers. They had traditionally carried significant price risks because, although they attempted to guarantee their members a market for their production, they could not control the members' production volumes. Consequently, in declining markets, the coop found that it was often competing for sales against its own members and losing considerably as a result. Longer-term contracts would improve this situation, however, by allowing the farmer to market all of his production through the coop over a period spanning the length of historical cycles in hog, egg, and turkey prices. With full knowledge of its inventories, the association would be able to hedge effectively in the futures market. In addition, if the contracts operated as planned, they would significantly enlarge the array of services IFBCA provided its members. In enhancing the security of the individual farmer, the program would strengthen the farmer's need for his coop and assure him that its marketing arrangements were in his own interest.

Not only were the contracts potentially valuable to IFBCA and its members, but they could be of tremendous benefit to hog and turkey processors and egg retailers. Studies had shown that weekly fluctuations in livestock receipts resulted in higher processing plant costs. It was possible that by contracting with IFBCA for future delivery of hogs and turkeys, a processor could ensure at least a minimally profitable operating rate at all times while reducing procurement costs. To the extent that such cost savings would exceed additional contracting costs, profits would increase. Furthermore, if pricing under the contracts depended on grade and yield payment methods, pricing accuracy could be improved and a major source of processor uncertainty reduced.

In the case of eggs, large retailers sorely needed assured high-quality suppliers on a year-round basis. IFBCA sold to a major national retail chain the entire volume of eggs produced under the coop's long-term production and marketing contracts.

Implications for the Future

The implications of widespread use of contracting arrangements such as IFBCA's are significant. Long-term contractual arrangements linking supplier, producer, assembler, and processor can stabilize the flow of a given commodity

to market and significantly dampen production cycles. As production stabilizes, commodity price cycles in wholesale markets may also even out somewhat. As the price cycles are dampened, uncertainty and risk are reduced at each step in the commodity's progress from supplier through processor. Consumer demand, of course, will always fluctuate for a variety of reasons but more stable supplies can have a moderating effect on consumer prices as well since per-capita consumption of meat, eggs, and poultry does not fluctuate widely from year to year.

An interesting question raised by the development of long-term contracts involves the future role of futures markets. Will they serve as pricing mechanisms in the new contractual arrangements, or will alternative transfer pricing techniques be devised? If new marketing techniques are developed, which effectively reduce the risks of producers in major commodity systems, will futures markets be necessary at all? Will the number of producers who choose not to operate under long-term contracts be large enough to sustain futures markets? Each of these questions must be confronted in analyzing the value and effects of long-term contracts.

If IFBCA is able to gain broad acceptance among its members for long-term production and marketing contracts in hogs, eggs, and turkeys, and if such arrangements are successful, management will wish to consider other areas where long-term contracts might be useful. It is testing only three commodities currently. Could similar techniques be applied in totally different commodity systems, such as grains and vegetables? The success or failure of IFBCA's current efforts may indicate the future of long-term contracts in general.

IFBCA developed the long-term contract concept as a result of its experience at two separate points of several commodity systems. Because it is both a supplier of inputs and a marketer of agricultural products, it could clearly see the advantages of increased vertical coordination not only in its own areas of interest, but in those of the processor and consumer as well. It must now attempt to convince participants in the system of the utility of its concepts.

NOTES

1. The time normally required for a 40-pound feeder pig to reach market weight of about 220 pounds. A farmer must contract for a minimum of six lots.

2. Feed was the largest component in the cost of producing animal protein, and the feed-conversion ratio indicated the producer's efficiency. Feed costs directly affected the farmer's return on his livestock operations and hence his incentives for increasing or decreasing production. The hog-corn price ratio is a classic example of such a relation.

3. For working capital purposes, the farmer also agreed to leave in his account $10 per head from the income of his first lot of hogs.

4. The farmer agreed to keep three laying flocks in succession during their laying cycles. Typically, the laying cycle of a flock lasted twelve to fifteen months.

5. Urner-Barry was a private market service which quoted wholesale prices for a wide variety of agricultural commodities. It was widely used and relied upon.

6. Actually, the farmer ultimately bore the risk to the extent of his patronage retains or equity in the cooperative.

7. Management believed that IFBCA needed to control about 25 percent of Indiana's production of these commodities in order to influence their prices.

8. Their percentage payments at the time of sale were based on the feed/weight conversion ratio they maintained.

APPENDIX E
EARLY & DANIEL INDUSTRIES, INC.*

In August 1976, Mr. Samuel M. Harrell, president and chief executive officer of Early & Daniel Industries, Inc. (EDI), was reviewing the past performance of his company with three subsidiaries: Early and Daniel Company (E&D), Tidewater Grain Company, and General Grain, Inc. E&D operated seven grain elevators in Ohio, Indiana, Kentucky, and Illinois with a total capacity of 16.5 million bushels. Tidewater engaged in the grain export business with its 2.48-million-bushel facility in Philadelphia. General Grain milled and marketed cookie and cracker flour at its soft wheat flour mill in Indianapolis. EDI's revenues increased from $97 million in fiscal 1972 to $456 million in 1976, with net income rising from $275,000 to $5.4 million. Consolidated working capital increased to a record $17.7 million in fiscal 1976, up from $4.1 million in 1972. Tables 4E-1 and 4E-2 show EDI's recent profit performance, and Table 4E-3 is a recent balance sheet. The company had benefited greatly from the substantial increase in U.S. agricultural exports since 1972. In that year, only 15 percent of EDI's grain business dealt with the export market. By May 1976, 69 percent of EDI's grain was marketed as export sales by other exporters. Several questions seemed critical to Mr. Harrell as he planned his company's future. They included the following:

1. What will be the world demand for grains in the future, and will the United States continue to be the dominant supplier?
2. How will grain flow from the farmer to the foreign buyer? For example, where in the United States will grains be grown? What form of transportation will move the product? Which ports will become the major export centers?
3. What structural changes will take place within the United States, and how will they affect EDI? For example, what will be the effects on EDI of increased on-farm storage? of increased competition from cooperatives? of possible government reentry into the grain business?

Mr. Harrell was considering the following alternatives:

1. Expand EDI's internal grain procurement capabilities by increasing E&D's capacity
2. Expand EDI's export capacity by expanding Tidewater's facility, by acquiring another port facility, or by selling directly to overseas buyers

*This case was prepared by Robert Dew, Research Assistant, under the supervision of Professor Ray A. Goldberg, as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Table 4E-1. Early & Daniel Industries, Inc.: Income Statements for Fiscal Years Ending May 31, 1972–75. (in U.S. dollars)

Income	*1972*	*1973*	*1974*	*1975*
Net Sales	96,549,379	185,272,336	346,799,866	400,549,934
Elevator services	647,193	998,933	1,481,364	1,752,018
Interest and other income	100,085	167,623	470,520	518,851
Total	97,296,657	186,438,892	348,751,750	402,820,803
Cost and Expenses				
Cost of goods sold	92,932,406	179,225,266	335,950,072	387,541,742
Selling and administrative expenses	2,605,249	2,808,708	3,182,782	5,759,619
Interest on long-term debt	181,745	128,262	166,629	248,896
Interest on current borrowings	476,[illegible]	914,825	1,493,300	1,295,791
Total	96,195,737	183,007,061	340,792,783	394,846,048
Gross profit	1,100,920	3,361,831	7,958,967	7,974,755
Taxes	546,819	1,721,073	4,072,285	3,812,822
Income from extraordinary items	83,375	(366,473)	0	(129,200)
Minority interest	195,847	689,793	1,439,291	1,100,126
Net income	274,879	1,317,438	2,447,391	3,191,007

Source: Early & Daniel Industries, Annual Reports 1972–1975.

Table 4E-2. Early & Daniel Industries, Inc.: Five-Year Financial Highlights, 1972-76.

	Year Ended				
	29 May 1976	*31 May 1975*	*31 May 1974*	*31 May 1973*	*31 May 1972*
	(amounts in thousands, except per share data.)				
Statistical Data					
Working capital	$17,696	$11,199	$9,345	$6,706	$4,155
Current ratio	1.64 to 1	1.71 to 1	1.46 to 1	1.38 to 1	1.41 to 1
Property and equipment	9,040	7,780	6,990	5,622	6,051
Capital expenditures	2,705	2,888	2,413	587	625
Depreciation	1,270	1,106	735	502	500
Long-term debt	5,746	4,370	3,739	1,819	2,132
Long-term debt to total stockholders' equity ratio	36%	45%	75%	35%	56%
Common stockholders' equity	14,539	8,171	4,955	5,159	3,841
Book value per share of common stock outstanding	203.42	127.37	77.24	12.28	9.15
Cash flow from operations	8,368	6,706	6,260	2,886	973

Source: Early and Daniel Industries Annual Reports 1972-1976.

Table 4E-3. Early & Daniel Industries, Inc.: Balance Sheet, 29 May 1976 (in U.S. dollars)

Assets		
Current Assets		
Cash	5,558,705	
Notes and accounts receivable	6,686,204	
Inventories	25,585,504	
U.S. Government securities	490,310	
Investment in short term notes	7,800,000	
Prepaid expenses	369,520	
Total current assets		45,307,932
Other assets		338,400
Property, plant and equipment		9,040,336
Total Assets		$54,686,668
Liabilities and Shareholders' Equity		
Current Liabilities		
Notes and accounts payable	23,492,796	
Federal income taxes	1,900,205	
Other expenses and payables	2,219,366	
Total Current Liabilities		27,612,367
Long-term debt		5,746,489
Deferred income taxes		5,088,720
Deferred compensation		158,339
Stockholders' equity		16,080,753
Total Liabilities and Stockholders' Equity		54,686,668

Source: Early & Daniel Industries Annual Report 1976.

3. Diversify EDI's activities into other agribusiness activities, such as the corn sweetener market or the marketing of food products.

EDI's Structure

Mr. Harrell owned or controlled about 95 percent of the stock of EDI, with the general public owning the other 5 percent. This ownership structure was a result of a 1975 reorganization in which all of the Harrell family's operations were brought together under the direct control of Mr. Harrell. In the 1950s, Mr. Harrell's father, Samuel R. Harrell, began assembling a variety of agribusiness activities located in Ohio, Indiana, and Illinois. By the early 1960s, the Harrell family owned five feed mills and twenty retail feed outlets, thirty-two country elevators (which also sold a full line of farm supplies), a flour milling operation that was the predecessor of General Grain Company, and a feed mill and layer operation in Tampa, Florida. In 1965, the company acquired the Tidewater facility. In 1967, when Mr. Harrell became chief executive officer, a major

change in strategy resulted in the sale of the feed mills and accompanying retail outlets, the country elevators and farm supply operations, and eventually the Tampa facilities. Mr. Harrell felt that the nature of Midwest agriculture, both at the farm level and the assembling/processing level, was changing in such a way that small feed mills and country grain elevators would become noncompetitive. Therefore, he chose to concentrate the company's managerial and financial resources on the high-volume terminal grain elevators, export elevators, and the port wheat milling business.

E&D. E&D acquired grain from country elevators, farmers, and other suppliers and distributed it to wholesalers, retailers, feeders, processors, and exporters. Table 4E-4 lists E&D's present storage facilities. These facilities were carried on E&D's books at a net value of $7 million. About 28 percent of their capacity had been added during the last four years through acquisition or incremental expansion of existing handling of grain. Sales increased from $68 million in 1971 to $280 million in 1976; contribution to profits soared from $417,000 to $5.5 million. Table 4E-5 summarizes volume sales and contributions for fiscal years 1971-76.

Corn was responsible for the majority of E&D's volume, with wheat and soybeans accounting for most of the remainder. E&D also handled oats, rye, and sorghum. Table 4E-6 shows contribution to profits for each product for the last few years. E&D provided a variety of services. It purchased a large portion of its grain at harvest time from producers who did not have on-farm storage facilities. Much of this grain was dried and cleaned by E&D's drying and cleaning equip-

Table 4E-4. Early & Daniel Company Storage Capacity (in bushels)

Location	*Capacity*
Cincinnati, Ohio (Riverside)	973,000
Cincinnati, Ohio (Fairmount)	2,050,000
Beech Grove, Indiana	6,426,000
Troy, Ohio	1,909,000
Louisville, Kentucky	2,590,000
Sheldon, Illinois	1,200,000
Mansfield, Ohio	1,400,000
Total	16,584,000
Date of Capacity Expansion	
Owned prior to fiscal 1972	11,912,000
Added in fiscal 972	1,200,000
Added in fiscal 1973	3,000,000
Added in fiscal 1975	436,000
Total	16,548,000

Source: Early & Daniel Industries Documents.

Table 4E-5. Early & Daniel Sales and Contribution Data: 1971-76

Year	*Sales (000s)*	*Contribution[a] (000s)*	*Contribution Margin*
1971	$ 68,177	$ 417	.6%
1972	74,966	990	1.3
1973	127,125	1,634	1.2
1974	194,976	3,715	1.9
1975	216,348	3,607	1.6
1976	280,267	5,577	2.0

[a]Contribution equals income before taxes and extraordinary items.
Source: Early & Daniel Company Documents.

Table 4E-6. Early & Daniel Industries—Contribution to Gross Profits by Grain: 1971-75

Fiscal Year Ending May 31	*Wheat*	*Corn*	*Soybeans*	*Total*
1971	16%	58	19	100
1972	9	64	20	100
1973	21	40	35	100
1974	11	64	23	100
1975	22	53	22	100

ment. The company also sorted grain owned by third parties, thereby earning storage and handling fees. Finally, E&D served as an assembler, buying grain from country elevators, subterminals, terminals, and farmers with on-farm storage capacity, then reselling this grain to a variety of consumers. All of the company's positions were hedged in the futures market.

E&D expanded its purchasing methods as farmers became more sophisticated and demanded additional marketing alternatives. It offered the following options:

1. The farmer could deliver grain to be priced at that day's market price
2. He could contract for future delivery at a fixed price
3. He could deliver grain to be priced at any future date he chose
4. He could deliver grain that would be hedged for him so that he could pay the basis and establish a firm price at a later date
5. He could deliver grain as in item (4) and be paid in the next calendar year for tax purposes.

In an effort to improve its logistical efficiency and obtain additional volume, E&D had integrated backward into the trucking business. It owned eighteen

trailers and leased the accompanying tractors. The company also day-leased the services of fifty tractor-trailers from local operators. Although E&D's management felt it was not possible to directly determine the returns from these operations, it believed that the trucking operations ensured critical supplies that would provide profits elsewhere in the commodity chain.

E&D serviced the export market, which accounted for over half of its present volume, through the Atlantic and Gulf ports via 100-car unit trains and with barges to the Gulf. Six of the company's elevators could load unit trains, and the company loaded barges at Cincinnati and Louisville. E&D had 350 railroad cars under lease for varying time periods. These cars comprised a small percentage of E&D's total requirements for railroad cars.

Substantially all of E&D's export sales were made through a wholly owned subsidiary that qualified as a Domestic International Sales Corporation (DISC).[1] E&D's and Tidewater's DISCs provided substantial amounts of financing for EDI. During fiscal years 1973 through 1976, deferred taxes totaled $5,088,720. Bills had been introduced in the U.S. Congress to terminate DISCs, however. If such proposed legislation became law, the accumulated deferred taxes would become payable. Elimination of the DISC law would reduce working capital and, depending upon the period over which the taxes were required to be paid, could require additional borrowings, for both E&D and Tidewater depended upon short-term debt to finance their seasonal inventory needs (see Table 4E-7).

Table 4E-7. Early & Daniel Industries, Inc.: Summary of Working Capital Requirements (thousands of dollars)

	Early & Daniel Industries	*Early & Daniel Company*	*Tidewater Grain*	*General Grain*
	May 31, 1975			
Current assets	$26,916	$12,973	$11,717	$2,852
Current liabilities	15,717	7,377	5,367	1,588
Working capital	11,199	5,596	6,350	1,264
	May 29, 1976			
Current assets	45,307	22,375	18,866	2,993
Current liabilities	27,612	15,390	10,504	1,456
Working capital	17,695	8,362	8,362	1,537
	Fiscal 1975			
Maximum short-term debt		$20,425	$10,510	$4,200
Weighted average interest rate		11.00%	11.32%	11.63%
	Fiscal 1974			
Maximum short-term debt		$14,200	$11,100	$4,880
Weighted average interest rate		9.33%	11.43%	10.36%

Source: Early Daniel Industries Annual Reports.

Tidewater Grain. Tidewater's contribution to EDI's profits increased from $790,000 in fiscal year 1973 to $5.6 million in 1976. The evolution of the 100-car unit train and the increased volume of U.S. grain exports accounted for this change. Tidewater operated more as a grain assembler and storer than as an exporter. The Philadelphia facility's products were sold directly to buyers who provided their own transportation, insurance, and docking arrangements, along with storage and internal distribution at their destinations. About 30 percent of Tidewater's business was with the major grain exporters, another 20 percent with one large European Community (EC) importer, and the remaining 50 percent with twelve independent buyers.

Although the Tidewater export grain elevator was over fifty years old when purchased by the Harrells and required substantial renovations, its book value was only $1.9 million in May 1976. Additional storage space would cost approximately $4.50 per bushel of capacity, if the cost of piling underground were factored in. Table 4E-8 shows Tidewater's recent volume, sales, and contribution information.

Tidewater's product mix was about 65 percent corn, 25 percent soybeans, and 10 percent wheat. It purchased the majority (95 percent) of these grains in the Midwest and transported them in 100-car unit trains. The company had agreements with various railroads for full-time use of nine unit trains, each of which could carry 350,000 bushels of grain between Philadelphia and the Midwest three times per month. The capacities of the ships Tidewater loaded varied between thirty and fifty thousand tons. Thus they required three to five unit trains each.

About 20 percent of Tidewater's purchases were from a large independent grain firm that operated a group of interior elevators, 54 percent from twelve other grain merchandisers, 21 percent from E&D, and the remaining 5 percent from local sources. The procurement of Tidewater's grain had been made much easier as more internal elevators remodeled their facilities to load unit trains. In the early 1970s, only five or six elevators in Tidewater's Midwest procurement

Table 4E-8. Tidewater Grain Sales and Contribution Data: 1973-76

Year	*Sales (thousands of dollars)*	*Contribution[a] (thousands of dollars)*	*Contribution Margin*
1973	$ 78,943	$ 790	1.0%
1974	172,299	2,142	1.2
1975	209,601	5,004	1.2
1976	200,882		

[a]Contribution equals income before taxes and extraordinary items.

Source: Early & Daniel Industries, Company documents.

area could handle unit trains. By 1976, at least thirty-five elevators had unit train loading facilities.

The General Grain Company. General Grain engaged in the milling and sale of soft wheat flour and wheat by-products. It sold its flour both in bulk and in bags to commercial bakers, restaurants, grocery chains, and other industrial users in the Midwest. General Grain's principal product was milled from soft winter wheat and was used primarily in soda crackers, cookies, and cakes. The bulk of the wheat the company purchased was grown in Indiana and Michigan. About 5 percent of its wheat came from E&D at prevailing market prices.

General Grain's processing equipment had a milling capacity of 7,000 per hundredweight of wheat per day, and its facilities operated around the clock six-and-one-half days a week. The Indianapolis operation also had storage facilities for 1.3 million bushels of wheat. In May 1976, General Grain's investment in fixed assets totaled $1.44 million. Table 4E-9 shows General Grain's results over a four year period. General Grain's management believed that this performance was the result of overcapacity in the U.S. flour industry.

EDI's Future

As Mr. Harrell reviewed the factors affecting EDI's future in the grain business, he divided them into two categories: international and domestic. He realized that he would have to consider the interrelations between the two different types of influences. The ability of the U.S. grain system to operate as the residual world supplier and a major factor in international grain trade without alterations in internal flows, prices, and consumption had been destroyed with the liquidation of reserves in 1972. Mr. Harrell viewed the international trends of major importance to include the following:

1. *Production trends.* Greater strains would be put on the capacity of those nations strategically located for efficient production. The ability or inability of nations to expand production would have a profound effect on international flows. In addition, as nations chose to expand agricultural output in certain products, the structure of competition in the world export market would be altered.

Table 4E-9. General Grain's Sales and Contribution Data: 1973-1976

Year	*Sales (thousands of dollars)*	*Contribution (thousands of dollars)*	*Contribution Margin*
1973	$11,841	$204	1.7%
1974	21,788	98	0.4
1975	22,708	96	0.4
1976	21,363	184	0.8

Source: Early and Daniel Industries Company documents.

Table 4E-10. Livestock and Poultry Production in 1950, 1960, and 1970 and Projections for 1985 (in millions)

		1950	*1960*	*1970*	*1985*
World	Beef Cattle	763.3	920.6	1250.7	1936.8
	Sheep and Goats	1012.0	1218.7	1457.3	2155.7
	Swine	227.7	343.1	626.9	1075.4
	Poultry	–	–	5560.2	9668.7
Europe	Beef Cattle	100.6	117.5	124.3	182.3
	Sheep and Goats	144.2	150.9	140.9	196.2
	Swine	69.4	109.8	130.9	177.6
	Poultry	–	–	1226.2	2218.6
Soviet Union	Beef Cattle	56.0	76.0	95.6	154.6
	Sheep and Goats	92.6	140.3	135.8	206.1
	Swine	19.7	58.7	56.0	83.2
	Poultry	–	–	590.3	953.7
North America	Beef Cattle	88.5	106.2	124.1	186.9
	Sheep and Goats	35.4	36.7	23.5	28.8
	Swine	63.7	61.8	63.1	70.9
	Poultry	–	–	541.4	920.5
Oceania	Beef Cattle	19.7	23.5	31.4	46.9
	Sheep and Goats	145.6	201.2	240.6	305.7
	Swine	1.9	2.4	3.3	5.2
	Poultry	–	–	31.5	67.9
Asia	Beef Cattle	275.9	330.2	473.6	814.8
	Sheep and Goats	229.0	295.3	484.6	902.4
	Swine	19.2	38.0	269.4	517.3
	Poultry	–	–	2102.3	5877.3
Latin America	Beef Cattle	162.9	204.0	242.8	373.2
	Sheep and Goats	156.8	163.4	169.9	313.2
	Swine	47.6	77.0	97.5	256.6
	Poultry	–	–	657.0	1427.7
Africa	Beef Cattle	86.2	107.4	158.8	289.9
	Sheep and Goats	193.4	220.8	261.9	491.3
	Swine	4.1	4.8	6.6	12.2
	Poultry	–	–	411.4	792.3

Source: FAO year books and projections.

2. *Consumption trends.* Trends in livestock production gave a good indication of future trends in feedgrain demand. Table 4E-10 displays livestock production by major geographic regions and makes projections for 1985. In many countries, especially those with centrally planned economies, these numbers are a function of national policy and, therefore, are subject to substantial alteration. But demand appeared certain to rise.
3. *World trade.* Table 4E-11 shows the changing pattern of world grain trade, and Table 4E-12 displays this trade of feedgrains by geographic region. Because international trade was the means by which domestic need in excess

Table 4E-11. Changing Pattern of Grain Trade (in millions of metric tons)

Region	*1934-38*	*1948-52*	*1960*	*1970*	*1976*
North America	+ 5	+23	+39	+36	+94
Latin America	+ 9	+ 1	0	+ 4	- 3
Western Europe	-24	-22	-25	-30	-17
Eastern Europe and Soviet Union	+ 5	–	0	0	-27
Africa	+ 1	0	- 2	- 5	-10
Asia	+ 2	- 6	-17	-37	-47
Australia and New Zealand	+ 3	+ 3	+ 6	+12	+ 8

Note: Plus sign indicates net exports, minus sign net imports.
Sources: The United Nations, and USDA.

Table 4E-12. World Imports and Exports of Feedgrains[a] (hundred thousand metric tons)

	1972-73	*1973-74*	*1974-75*	*Estimated 1975-76*
Exports (Net)				
Canada	4.0	2.7	2.6	3.1
Australia	1.6	1.9	2.9	2.2
Argentina	4.2	8.2	8.5	7.1
South Africa	3.3	.5	3.5	3.5
Thailand	1.1	2.3	2.2	2.5
United States	35.4	43.6	34.2	43.3
All Others	3.8	4.7	4.5	5.4
Total	53.4	63.9	58.4	67.1
Imports (Net)				
Western Europe[b]	17.2	21.1	22.0	21.6
Japan	11.9	14.0	13.1	13.2
Soviet Union	5.9	6.1	2.7	13.0
Eastern Europe	5.0	3.5	5.9	6.8
All Others	13.4	19.2	14.7	12.5
Total	53.4	63.9	58.4	67.1

[a]Corn, barley, oats, and sorghum, excluding products.
[b]Excludes intra European Community trade.
Source: ESCS USDA.

of domestic production was met, some projections on future trade flows could be made by analyzing international consumption trends.

To clarify the importance of these factors it is useful to consider one situation of current interest to participants in the international grain system. In the late sixties and early seventies, Brazil began to make a major push to expand its

domestic soybean industry. In 1970 the industry harvested 1.5 million tons from 3.3 million acres; in 1975, 9.7 million tons from 14.2 million acres. The figures projected for 1979 are 13.5 million tons from over 17 million acres. This represents a 500 percent increase in acreage, 50 percent in yield, and 750 percent in volume since 1970. Because the major portion of the Brazilian soybean crop flows into the international export market, and because the United States had traditionally been the only major source of soybeans, the increase in Brazilian production has had a major impact on the structure of international flows. Table 4E-13 displays U.S. and Brazilian exports of soybeans, soybean meal, and soybean oil by recipient areas during this expansion period. In 1975, soybeans equaled or surpassed the traditional exports of sugar and coffee in importance to Brazil's balance of trade. The government has made efforts to protect its new-found source of foreign exchange by seeking long-term trade agreements, and establishing a program to improve the infrastructure through an expansion of storage capacity. Much of the land cultivated for soybeans is also suitable for other crops, primarily wheat. The soybean industry is much more mechanized than other crops in Brazil, so a diversion of acreage is unlikely to occur. This inflexibility could be of major importance to the U.S. industry, where the major areas of production are located in the corn belt and where crop switching is not a difficult task. The problem is complicated, however, by the fact that this is also the area of most efficient production for the U.S. industry.

Other trends were evident within the U.S. domestic grain system that Mr. Harrell felt were important to consider. They included:

1. *Increased export activity of cooperatives.* Farmers already had the nucleus for a successful export company in the interregional farmer cooperative called Farmers Export Company. Farmers Export operated a modern 5-million-bushel export house at New Orleans and sold 175 million bushels of grain in 1975. A recent expansion had increased its capacity to 250 million bushels, and long-range plans called for a Texas Gulf facility and elevators on the east and west coasts.
2. *Increased on-farm storage.* An increased desire by farmers to control the timing of their marketing activities had led to an expansion of on-farm storage. Since 1972 producers as well as private commodity houses had reinvested much of their earnings, with a major portion going to an increase in storage capacity. In March 1976, farm experts had estimated that between 45 percent and 60 percent of the previous year's bumper crop of wheat, corn, and soybean was still in the hands of the producers. The increase in stocks held on-farm had taken place in spite of the fact that farmers were probably unable to store the grain as cheaply as commercial elevators. But farmers were willing to pay the increased costs to gain flexibility of market timing. As prices had ceased to maintain their remarkably stable patterns of preceding years, the expected returns from this flexibility had made the

Table 4E-13. United States and Brazil: Exports of Soybeans and Products

Item	United States Exports 1970	United States Exports 1974	United States Exports 1975 (Jan.-Oct.)	Brazil Exports 1970	Brazil Exports 1974	Brazil Exports 1975 (Jan.-Oct.)[a]	Brazil's Exports as Share of U.S. and Brazil 1970	Brazil's Exports as Share of U.S. and Brazil 1974	Brazil's Exports as Share of U.S. and Brazil 1975 (Jan.-Oct.)
	(1,000 MT)	(1,000 MT)	(1,000 MT)	(1,000 MT)	(1,000 MT)	(1,000 MT)	(Percent)	(Percent)	(Percent)
Soybeans:									
European Community	4,700	6,850	4,365	193	2,253	2,090	4	25	32
Other Western Europe	1,246	1,681	1,153	39	356	657	3	17	36
Eastern Europe	138	127	116	58	–	193[b]	30	0	62
Other	5,870	5,282	3,839	–	121	101	0	2	3
Total	11,954	13,940	9,473[c]	290	2,730	3,041	2	16	24
Soybean meal:									
European Community	2,494	3,134	2,110	412	1,145	1,379	14	27	40
Other Western Europe	123	214	127	27	118	162	18	36	56
Eastern Europe	554	791	472	56	627	860	9	44	65
Other	490	771	366	30	131	118	6	15	24
Total	3,661	4,910	3,075	525	2,021	2,519	13	29	45
Soybean oil:									
Bangladesh	–	14	7	(d)	(d)	12	(d)	(d)	63
People's Republic of China	–	–	–	(d)	(d)	11	(d)	(d)	100
Iran	77	155	63	(d)	(d)	56	(d)	(d)	47
Morocco	32	20	1	(d)	(d)	39	(d)	(d)	98
Peru	33	56	17	(d)	(d)	19	(d)	(d)	53
Tunisia	26	24	10	(d)	(d)	14	(d)	(d)	58
Turkey	3	1	6	(d)	(d)	29	(d)	(d)	83
Other	510	489	198	(d)	(d)	30	(d)	(d)	13
Total	681	759	302	3	2	210	(d)	(d)	41

Brazil: Supply and Distribution, Soybeans and Products, Marketing Years Beginning April 1, 1973–76 (in million metric tons)

Product	*1973*	*1974*	*Forecast Projection*	
			1975	*1976*
Soybeans:				
Production	5.00	7.50	9.72	11.30
8 percent seed and waste	.40	.60	.78	.90
Exports	1.79	2.86	3.80	4.50
Estimated crush	2.60	4.05	5.04	5.90
Estimated stock change	+.21	–.01	+.10	.00
Meal:				
Production 79.5 percent	2.07	3.22	4.01	4.69
Exports	1.37	2.41	3.00	3.50
Apparent domestic disappearance	.70	.81	1.01	1.19
Oil:				
Production 17.7 percent	.46	.72	.89	1.04
Exports	.08	.02	.29	.35
Apparent domestic disappearance	.38	.55	.63	.68
Estimated stock change	.00	+.15	–.03	+.01

[a]Latest period for which destination data are available.
[b]Includes soybean exports to the USSR.
[c]Soybean exports are adjusted via transshipments through Canada.
[d]Not available.
Source: ESCS USDA.

investment worthwhile. Commercial operators currently felt that on-farm storage had not been much of a competitive threat. In the long term, however, overcapacity could affect the volume of commercial elevators.

3. *Price changes.* Since 1972 grain prices have been high, creating a wider basis and allowing grain traders to earn considerably more per bushel. If oversupply were to force prices to decline to their former levels, grain-trading firms might experience substantially reduced profits.
4. *Changes in transportation logistics.* In the Northwest, a number of major grain companies were building or had built major elevator facilities. In addition, the Milwaukee Railroad was reducing rates for grain movements to the Northwest on a unit-train basis in an effort to build revenue rides and effective car use. Could that mean a redirection of Orient-bound export grain from Gulf and Northwest Pacific ports? Such a change would allow better use of ships, since the distance they would travel would be substantially reduced.
5. *Changes in weather patterns.* Climate analysts were predicting major weather changes affecting productive areas.

If Mr. Harrell wanted to expand his grain activities, he had the following alternatives:

1. Expand E&D. E&D could increase its present facilities through incremental expansion by five million bushels at a cost of one dollar per bushel. Any new elevator expansion would cost about two dollars per bushel of capacity. Table 4E-14 shows recent expansion of off-farm storage facilities within E&D's trading area. Table 4E-15 shows on-farm stocks on January 1 for the same area. E&D's management felt that at least a 15 percent return would be necessary to make additional investments on any new capital employed.
2. Expand Tidewater. Expansion of the Philadelphia operation would cost $4.50 per bushel of storage capacity.
3. Expand into the Gulf. EDI's management was uncertain as to where internal

Table 4E-14. January 1 Off-Farm Storage Capacity[a] (hundreds of bushels)

	1973	*1974*	*1975*	*1976*
Illinois	572,670	601,370	627,800	664,600
Indiana	170,640	179,700	186,410	201,050
Ohio	174,000	183,000	193,000	208,000
Kentucky	36,900	38,370	38,230	40,440
Total United States	5,884,410	5,809,760	5,418,230	6,102,880

[a]Capacity data include all elevators, warehouses, terminals, merchant mills, other storages, and oilseed crushers which store grain, soybean, or flaxseed.

Source: Grain Reporting Board, Statistical Reporting Service, USDA.

Table 4E-15. January 1 On- and Off-Farm Stocks: Four State Area (hundred thousand bushels)

	Illinois		*Indiana*		*Kentucky*		*Ohio*	
	On	*Off*	*On*	*Off*	*On*	*Off*	*On*	*Off*
				Corn				
1971	397	232	190	72	27	9	123	70
1975	423	255	202	70	59	12	133	57
				Wheat				
1971	3.6	16.1	2.2	8.3	1.3	2.1	3.6	17.0
1975	5.9	20.7	3.8	10.1	1.8	3.2	5.	26.9
				Soybeans				
1971	84	110	32	30	3.6	6.2	23	28
1975	91	91	32	28	12.0	6.2	32	35

Source: USDA, Statistical Reporting Service, Corp. Reporting Board.

Table 4E-16. U.S. Exports of Soybeans[a] (hundred thousand bushels)

Country of Destination	*1970-71*	*1971-72*	*1972-73*	*1973-74*
Western Europe	239	232	254	324
Soviet Union	–	–	31	–
Japan	102	107	121	106
Other	92	77	74	100
Total	433	416	480	530
Port of Inspection				
Canadian Ports		24	13	24
Great Lakes		61	60	36
Atlantic		23	46	63
Gulf		308	361	407
Total		416	480	530

[a]These figures are for the marketing year and therefore do not agree with earlier exhibits recorded on a calendar year.

Source: ESCS USDA.

grain flows within the United States would occur. Tables 4E-16 and 4E-17 show the ports of inspection for recent exports of soybeans and wheat. A facility of adequate size (5 million bushels) would cost about $35 to $40 million; a 2.4-million-bushel facility would cost $25 million.

4. Expand internationally. E&D and Tidewater did little business in which they arranged the international details. By establishing offices in several key European cities, EDI felt that it could capture a portion of this business. Although Mr. Harrell did not know the exact cost of this option, he felt that it would

Table 4E-17. U.S. Exports of Wheat by Area[a] (hundred thousand metric tons)

	1970-71	*1971-72*	*1972-73*	*1973-74*	*1974-75*
Great Lakes	1.5	1.6	2.8	3.0	2.0
Atlantic	.4	.6	2.4	.8	2.4
Gulf	10.7	9.6	18.6	18.2	14.2
Pacific	5.8	5.1	8.0	9.1	9.4
Total	18.4	16.9	31.8	31.1	28.0

[a]This exhibit is on a marketing year basis and therefore does not agree with earlier exhibits recorded on a calendar year basis.
Source: USDA, ERS.

alter the nature of EDI's present activities and would eventually require substantial capital.

5. Combine E&D and Tidewater. This option would make EDI an integrated grain firm from farm to port, and it might increase the probability of successful international expansion. Mr. Harrell felt that the profit-center approach had aided the development of EDI but that it might be time to combine the operations of these companies.
6. Work more closely with cooperatives as their marketing agent.

Any of these options would have increased EDI's competitive position in the grain business. Mr. Harrell felt, however, that he should consider alternatives outside of EDI's present activities. Although the last four years had been outstanding for the grain business, environmental conditions were in a state of change, and Mr. Harrell was uncertain what profit opportunities for grain traders would be in the future. For this reason, he wanted to consider expansion into other agribusiness activities but had not, as yet, developed any specific alternatives.

NOTE

1. A DISC (Domestic International Sales Corporation) is a domestic corporation with income predominantly (95 percent) derived from export sales. It may defer U.S. income taxes on up to 50 percent of its income, and the other half is taxed directly to the shareholders. The tax-deferred income is never taxed to the DISC; it is taxed to the shareholders only when distributed, when a shareholder sells his stock, or when the corporation no longer qualifies as a DISC. The favorable tax treatment for DISC's is a way to encourage U.S. exports by removing inequalities between U.S. exporters and foreign manufacturers.

Chapter 5

System Response to Growth in Demand: The Case of Southeast Asia

In the last two chapters we analyzed the Japanese and U.S. corn economies, showing how the developed segment of the world corn system responds to growth in demand for corn and corn products and to changes in national policies. Participants at each stage in these systems use various coordinating devices to respond promptly to changing supply and demand factors, technological changes, and the market structure.

The subject of this chapter is the developing corn system in Southeast Asia. Our interests here are the differences between this system and the developed system and the ways in which participants in a developing system can relate their activities to regional and world systems. In other words, we wish to identify the obstacles that slow or prevent the Southeast Asian corn system from responding to growing internal and external demand for corn. At the same time, we wish to identify the transferability and adaptability of a corn systems approach to the problems, opportunities, and priorities in the developing corn system of Southeast Asia.

Some readers will argue, with good reason, that a "corn system" can hardly be said to exist in Southeast Asia. Indeed, most corn producers in the region do raise other crops as well. The merchants who handle the farmers' corn handle all the other grains produced in their market area, and they are in fact primarily rice traders. Although a substantial corn-processing industry now exists in the Philippines, the regional market for manufactured corn products is miniscule. Wholesalers, retailers, and exporters who handle corn and corn-based products all deal in many other commodities as well. And the differing—at times conflicting—policies by which governments seek to manage national food supplies and prices often insulate domestic commodity systems from world markets. In such an environment, the private firm must reach beyond its own traditional

functions and work to create or reinforce the existing elements of a formal commodity system at the request of and in cooperation with national governmental leaders.

DYNAMICS OF THE SOUTHEAST ASIAN CORN SYSTEM

The corn system in Southeast Asia is composed of nine national corn industries of varying sizes, levels of development, and degrees of importance within their economies. The corn industries of Indonesia, the Philippines, and Thailand are significant in terms of the absolute volume of corn they produce as Table 5-1 evinces. That is why we selected them for this study. Indonesia and the Philippines annually consume over one million tons of the corn per year, as Table 5-2 shows.

The domestic markets for corn in these three countries have evolved in different ways in response to differing production, consumption, price, and regulatory factors. Table 5-3, which summarizes their corn consumption and use, reflects these differences. The most striking contrast this table displays involves human consumption and exports: The Philippines and Indonesia consume most of their corn; Thailand exports the bulk of its crop.

Domestic Consumption

Four factors seem of paramount importance in the dynamics of domestic corn consumption in these three countries: the relative availability and price of rice, per-capita income, and the livestock industry's development. The first two factors condition human consumption of corn and corn products. The last two variables determine demand for corn as an animal-feed ingredient.

It is impossible to discuss human corn consumption in Southeast Asia without reference to rice because of its widespread production and consumption and the government programs affecting it. Throughout the region, rice is the most common and—at existing income levels—the favored source of carbohydrates and protein. Where people consume corn heavily, they do so because they do not have enough rice. Only in a few rural corn-growing regions of the Philippines and Indonesia does the per-capita consumption of corn exceed that of rice. For these reasons the national per-capita consumption of corn is much lower than that of rice, as shown in Table 5-4.[1]

Corn's special values to the region's inhabitants are its availability in the event of damage to the rice crop, as in the Philippines during 1972; its use as a food source before the rice harvest when supplies are short, as in Indonesia; and its importance as a source of income for farmers working land that cannot support rice.

The form in which corn is consumed in each country varies. In Indonesia, people boil or steam the whole grain before eating it. In the Philippines, white corn grain, grits, green and sweet corn, and corn flour or meal products are all

Table 5-1. Corn Area and Production in Southeast Asia: 1975

	Area (thousands of hectares)				Production (thousands of metric tons)		
Country	*Arable Land*	*Land in Grain Production*	*Land in Corn Production*	*Corn Land as a Percentage of Grain Land*	*Total Grain Production*	*Corn Production*	*Corn Production as a Percentage of Total Grain Output*
Burma	9,973	5,563	130	2.3	9,531	58	0.6
Cambodia	2,900	760	100	13.2	870	120	13.8
Indonesia	13,300	11,440	2,841	24.8	26,600	3,500	13.2
Laos	960	696	16	2.3	938	28	3.0
Malaysia	3,119	780	2	0.3	2,017	5	0.2
Philippines	7,580	6,780	3,028	44.7	9,162	2,574	28.1
Singapore	2	–	–	–	–	–	–
Thailand	12,500	9,828	1,258	12.8	18,336	3,000	16.4
Vietnam[a]	5,350	5,575	253	4.5	12,332	320	2.6
Total	55,684	41,422	7,628	18.4	79,786	9,605	12.0

[a]Land in grain production exceeds arable land due to difference in years cited by sources.

Sources: Arable land, land in grain production, and total grain production: FAO, *Production Yearbook, 1975*. Land in corn production and corn production: Foreign Agricultural Service, USDA, *Reference Tables on Wheat, Corn, and Total Coarse Grains Supply-Distribution for Individual Countries*, FG 9-76, May 1976; except Laos and Vietnam, for which FAO figures were used.

Table 5-2. Total Consumption of Corn in Southeast Asia: 1960-76 (thousands of metric tons)

Year	*Burma*	*Cambodia*	*Indonesia*	*Malaysia*	*Philippines*	*Singapore*	*Thailand*	*Vietnam*[a]	*Total*
1960	17	–	2,458	127	1,204		10	9	3,825
1961	38	46	2,282	268	1,217		15	30	3,796
1962	35	52	3,243	163	1,275		15	95	4,878
1963	48	118	2,370	103	1,297		20	99	4,055
1964	42	–	3,772	51	1,306		25	93	5,289
1965	47	35	2,327	61	1,345	13	29	74	3,931
1966	40	44	3,601	71	1,405	10	35	75	5,281
1967	58	74	2,261	77	1,484	3	55	34	4,046
1968	52	45	3,056	109	1,691	2	104	75	5,134
1969	58	83	1,909	132	1,889	10	176	162	4,419
1970	55	86	2,541	166	2,050	9	220	111	5,238
1971	60	80	2,446	203	2,160	17	280	124	5,370
1972	59	73	2,248	231	2,115	222	295	122	5,365
1973	61	90	2,441	216	2,320	243	341	96	5,808
1974	74	90	2,314	222	2,530	345	450	100	6,125
1975	71	120	2,508	229	2,655	360	560	95	6,604
1976	85	120	2,557	239	3,015	360	700	95	7,171

[a]South Vietnam only.

Source: Foreign Agricultural Service, USDA, *Reference Tables on Wheat, Corn, and Total Coarse Grains Supply-Distribution for Individual Countries*, FG 9-76, May 1976 and PG 7-77, July 1977.

Table 5-3. Corn Consumption and Use in Indonesia, the Philippines, and Thailand: 1974 (percentage)

	Indonesia	*Philippines*	*Thailand*
Human consumption	82	81	4
Livestock and animal feed	9	13	8
Industrial	.5	3	–
Seed	4	2	.8
Waste	1	1	.2
Export	3.5	0	87
	100.0	100.0	100.0

Sources: Indonesia: Geronimo M. Collado, "The Corn Systems of Thailand, Indonesia and the Philippines: A Comparative Overview," in SEARCA, *Proceedings of the Regional Workshop on Corn*, 9–11 April 1975, p. 29. Philippines: SEARCA, *The Philippines Corn Commodity System* (n.p.) Part 1, Ch. VI, p. 2. Thailand: SEARCA and the Faculty of Economics and Business Administration of Kasetsart University, *The Thailand Corn Commodity System* (n.p.), p. 79.

part of the diet. In Thailand, the population consumes small amounts of corn in the form of baby corn ears for desserts or as a vegetable.

Whether humans consume corn directly as grain and manufactured products or indirectly as animal products depends largely on income level and distribution. Local studies of income and direct corn consumption indicate that increases in income result in lower corn consumption in favor of rice. Consumers in all three countries apparently think of corn grain and grits as "poor man's food."

Although the per-capita consumption of corn directly as grain is likely to decline as real incomes increase, demand for livestock products will probably increase and spur greater use of corn for feed. Fragmentary evidence suggests that higher incomes cause increased demand for meat and poultry products and that consumption of commercial feed is increasing. Tables 5-5 and 5-6 contain evidence of increasing use of corn as a feed ingredient in several Southeast Asian regions.

The use of corn for industrial products like starch, oil, and sugars also tends to increase as income rises. Thus, for example, Japan with its per-capita income of $4200 and population of 110 million consumes about one million tons of starch annually, while the Philippines' 40 million people with per-capita incomes of about $250 consume only about fifty thousand tons annually. Although corn is the most common source of starch, other sources do exist. Table 5-7 shows these ingredients are used to varying degrees in different countries depending upon price, availability, and end use of the starch product. Where markets for the by-products (protein and oil) of starch manufacture based on corn exist, this grain can be the least expensive source of starch. The protein can be sold for animal feed and the oil for cooking oil. If markets for these by-products do not exist, or if tapioca is very abundant and cheap (as in Thailand and Indonesia),

Table 5-4. Comparison of Per-Capita Food Consumption in Indonesia, the Philippines, and Thailand: 1964-66 Averages

	Indonesia			*Philippines*			*Thailand*		
Commodity	*Kilogram Per Year*	*Calories Per Day*	*Grams of Protein Per Day*	*Kilograms Per Year*	*Calories Per Day*	*Grams of Protein Per Day*	*Kilograms Per Year*	*Calories Per Day*	*Grams of Protein Per Day*
Cereals	113.0	1,114	22.5	121.2	1,198	24.6	162.7	1,605	30.0
Wheat	.7	6	.2	10.9	108	3.2	.9	9	.3
Rice	87.9	867	16.1	86.0	849	15.8	161.5	1,593	29.6
Corn	24.4	241	6.2	23.9	237	5.5	.3	3	.1
Other	–	–	–	.4	4	.1	–	–	–
Roots and tubers	118.3	338	2.8	40.2	112	1.0	25.8	66	.5
Sugar	6.7	72	–	15.6	165	.1	17.9	119	.2
Nuts and oilseeds	16.1	122	7.5	13.3	53	1.6	30.2	130	4.5
Fruits and vegetables	34.9	30	1.0	76.6	88	1.7	86.8	93	3.0
Animal products[a]	16.2	44	5.2	56.5	183	14.8	40.0	163	12.3
Fats and oils[b]	2.9	71	–	3.9	93	–	1.8	43	–
Other		7	.2	.3	3	–	.9	7	.4
		1,798	39.3		1,895	43.8		2,226	50.9

[a]Meat, eggs, fish, milk, cheese.

[b]Butter, vegetable oils, animal fat.

Source: FAO, *Agricultural Commodity Projections, 1970-1980*, Vol. II, pp. 121, 123, 124.

Table 5-5. Livestock Numbers on Farms in Indonesia, the Philippines, and Thailand: 1961-75 (thousands)

	1961-65	*1971*	*1972*	*1973*	*1974*	*1975*
Indonesia						
Cattle and calves	6,401	6,245	6,260	6,682	6,687	6,687
Buffalo	2,846	2,916	2,825	2,870	2,786	2,823
Hogs	2,782	3,382	3,300	4,048	4,358	4,378
Sheep and goats	11,046	10,089	9,994	10,675	10,633	10,633
Chickens	62,500	74,033	86,135	96,452	109,679	115,000
Ducks and turkeys	5,640	9,457	13,112	13,810	15,879	16,142
Philippines						
Cattle and calves	1,258	1,795	1,933	2,099	2,200	2,250
Buffalo	3,357	4,556	4,711	4,937	5,000	5,050
Hogs	6,541	7,050	7,742	8,627	9,300	9,700
Sheep and goats	583	953	1,112	1,278	1,331	1,382
Chickens	51,708	56,512	50,103	49,965	51,000	51,000
Ducks and turkeys	1,759	2,482	2,680	3,046	3,160	3,274
Thailand						
Cattle and calves	3,601	4,667	4,377	4,751	4,800	4,939
Buffalo	5,052	5,735	5,829	5,634	5,700	5,784
Hogs	3,329	5,132[a]	3,884	4,573	4,700	4,962
Sheep and goats	50	76	77	78	78	78
Chickens	41,267	53,976	52,882	63,500	64,000	66,000
Ducks and turkeys	6,520	7,194	7,281	7,300	7,400	7,500

[a]Apparent error in source document.

Source: FAO *Production Yearbook, 1975*, except years 1971 and 1972, *Production Yearbook, 1973* and *Production Yearbook, 1974*, respectively.

Table 5-6. Domestic Consumption of Corn for Feed in Southeast Asia: 1960-75 (thousands of metric tons)

Year	*Indonesia*	*Malaysia*	*Philippines*	*Singapore*	*Thailand*	*Total*
1960		66	357		2	425
1961		87	377		4	468
1962		85	415		4	504
1963		54	381		6	441
1964		27	389		10	426
1965		32	396		10	438
1966		37	428		15	480
1967		40	450		25	515
1968		57	546		45	648
1969		69	639		85	793
1970		46	669		105	820
1971		81	658		135	874
1972	154	78	680	207	140	1,259
1973	160	78	750	228	160	1,376
1974	175	70	850	330	250	1,675
1975	181	61	900	345	350	1,837

Source: Foreign Agricultural Service, USDA, *Reference Tables on Wheat, Corn, and Total Coarse Grains Supply-Distribution for Individual Countries*, FG 9-76, May 1976.

Table 5-7. The Market for Starch and Starch Products in Selected Asian Countries: 1974

Country	*Population (millions)*	*Approximate Annual Use (thousands metric tons)*	*Raw Material*
India	600	180	Corn, tapioca
Indonesia	120	n.a.	Tapioca
Japan	110	1,000	Corn, tapioca, potato
Korea	34	60	Corn
Malaysia	12	25	Tapioca
Pakistan	67	65	Corn
Philippines	40	54	Corn, tapioca
Taiwan	16	60	Corn
Thailand	40	35	Tapioca

Source: Malcolm McDonald, "The Asian Market for Corn and Corn Products," in SEARCA, *Proceedings of the Regional Workshop on Corn*, 9–11 April 1975, p. 97.

cornstarch manufacture may be uneconomical. Therefore, increasing per-capita incomes may lead to increased industrial corn use in the Philippines but not necessarily in Thailand or Indonesia.

Supply

The supply of corn as the second most important crop in Indonesia, the Philippines, and Thailand is crucial to their agricultural economies. In many areas it has been considered a poor man's food and therefore its productivity and availability is especially important to the rural development of these selected Southeast Asian countries. Much attention has been given to the development of new varieties and the use of a packaged approach of credit, fertilizer, seed, and irrigation. But in spite of these public and private productivity efforts, supply expansion took place at a more significant rate only in the early 1970s. Market incentives along with increased utilization of appropriate technology, as noted below, is critical in order to improve the supply of and trade in corn in Southeast Asia.

Production. Corn production, as Table 5-8 proves, has increased significantly. However, this growth in production has been due more to increases in land cultivated than to yield increases, as Tables 5-9 and 5-10 demonstrate. Production has increased most dramatically in the Philippines and Thailand. Malaysia, Thailand, Indonesia, and the Philippines have achieved productivity increases modestly larger than those achieved by most other developing countries.[2] In absolute terms, however, yields are still distressingly low.

These low yields reflect, in large part, the persistence of traditional production methods despite government efforts to replace them. In the Philippines and Indonesia, corn grows primarily on relatively small farms with limited resources.

Table 5-8. Corn Production by Country: 1961-76 (thousands of metric tons)

Year	*Burma*	*Cambodia*	*Indonesia*	*Laos*	*Malaysia*	*Philippines*	*Thailand*	*North Vietnam*	*South Vietnam*	*Total*
1961	52	152	2,283		4	1,266	598		32	
1962	65	182	3,243		4	1,273	665		38	
1963	56	204	2,358	15	7	1,293	858	217	37	5,045
1964	53	139	3,769	19	7	1,212	935	274	46	6,555
1965	62	136	2,365	23	8	1,280	1,021	265	44	5,304
1966	54	150	3,717	20	7	1,490	1,122	250	35	6,845
1967	68	154	2,369	22	6	1,619	1,315	220	34	5,807
1968	62	118	3,166	23	6	1,733	1,508	230	32	6,878
1969	68	137	2,293	23	8	2,008	1,700	240	31	6,508
1970	67	122	2,825	25	7	2,005	1,938	250	31	7,270
1971	73	120	2,607	25	5	2,013	1,300	230	34	7,407
1972	55	62	2,016	27	4	1,831	1,320	220	42	5,577
1973	61	120	2,912	29	4	2,289	2,350	250	51	8,066
1974	79	120	3,239	30	5	2,568	2,450	250	50	8,791
1975	82	120	3,600	n.a.	6	2,574	3,000	n.a.	35	–
1976	85	120	2,498	n.a.	6	3,037	2,700	n.a.	35	–

Sources: Laos and North Vietnam: *FAO Production Yearbook, 1974*. All others: USDA, Foreign Agriculture Service, *Reference Tables on Wheat, Corn, and Total Coarse Grains Supply-Distribution for Individual Countries*, FG 9-76, May 1976, and FG 7-77, July 1977.

Table 5-9. Corn Area Harvested by Country: 1961-76 (thousands of hectares)

Year	*Burma*	*Cambodia*	*Indonesia*	*Laos*	*Malaysia*	*Philippines*	*Thailand*	*North Vietnam*	*South Vietnam*	*Total*
1961	68	101	2,462	–	3	2,016	298	–	31	–
1962	128	115	3,175	–	4	1,950	321	–	36	–
1963	131	127	2,559	30	4	1,898	388	236	37	5,410
1964	114	137	3,646	40	4	1,923	541	220	37	6,659
1965	126	89	2,507	40	4	2,106	562	220	36	5,690
1966	143	117	3,778	40	3	2,158	590	200	29	7,058
1967	164	113	2,547	40	4	2,248	598	200	29	5,943
1968	154	102	3,220	42	4	2,256	606	210	29	6,623
1969	142	86	2,435	38	4	2,420	690	210	29	6,054
1970	92	94	2,939	40	3	2,392	749	210	29	6,548
1971	102	100	2,627	40	2	2,432	824	210	31	6,368
1972	107	84	2,254	35	2	2,325	997	200	35	6,039
1973	43	100	3,288	36	2	2,763	1,044	200	40	7,516
1974	100	100	2,648	36	2	3,062	1,082	200	40	7,270
1975	100	100	2,841	–	2	3,256	n.a.	30	–	–
1976	100	100	2,225	n.a.	3	3,445	1,400	n.a.	30	–

Sources: Laos and North Vietnam: FAO *Production Yearbook, 1974*. All others: USDA, Foreign Agricultural Service *Reference Tables on Wheat, Corn, and Total Coarse Grain Supply-Distribution for Individual Countries*, FG 9-76, May 1972, and FG 7-77, July 1977.

Table 5-10. Corn Yield by Country: 1961-76 (metric tons per hectares)

Year	*Burma*	*Cambodia*	*Indonesia*	*Laos*	*Malaysia*	*Philippines*	*Thailand*	*North Vietnam*	*North Vietnam*
1961	.76	1.50	.93	–	2.0	.63	2.01	--	1.03
1962	.51	1.59	1.02	–	2.0	.65	2.07	–	1.06
1963	.43	1.61	.92	.5	2.25	.68	2.21	.92	1.00
1964	.46	1.01	1.03	.48	2.0	.68	1.73	1.24	1.24
1965	.49	1.53	.94	.58	2.0	.66	1.82	1.20	1.22
1966	.38	1.28	.98	.50	2.33	.69	1.90	1.25	1.21
1967	.41	1.36	.93	.55	2.25	.72	2.20	1.10	1.17
1968	.40	1.16	.98	.55	2.25	.77	2.49	1.10	1.10
1969	.48	1.59	.94	.61	2.0	.83	2.46	1.14	1.07
1970	.73	1.30	.96	.63	2.33	.84	2.34	1.19	1.07
1971	.72	1.20	.99	.63	2.5	.83	2.26	1.10	1.10
1972	.55	.74	.89	.76	2.0	.79	1.32	1.1	1.20
1973	1.42	1.20	.89	.81	2.0	.83	2.25	1.25	1.28
1974	.79	1.20	1.13	.83	2.5	.84	2.26	1.25	1.25
1975	.82	1.20	1.12	NA	2.0	.85	2.25	NA	1.17
1976	.85	1.20	1.12	NA	2.0	.88	1.93	NA	1.17

Sources: Laos and North Vietnam: FAO *Production Yearbook, 1974*. All others: USDA, Foreign Agricultural Service *References Tables on Wheat, Corn, and Total Coarse Grains Supply-Distribution for Individual Countries*, FG 9-76, May 1976, and FG 7-77, July 1977.

A large percentage of the farmers in these countries are subsistence operators whose primary objective is to produce enough corn for their own needs. Habit and economic circumstances force them to minimize the risks of crop and financial failure, so they tend to continue using proven (traditional) production methods requiring very small cash investments.

It would be an oversimplification, however, to blame low yields and the continuing dominance of traditional farming methods primarily on the behavior patterns of subsistence farming. Technical, climatic, and economic factors also limit adoption of high yielding varieties and modern technology. The native seed varieties used in the Philippines and Indonesia, and the Guatemalan yellow flint variety used in Thailand, mature in 90 to 100 days instead of the 110 to 120 days most higher yielding varieties require. Their shorter maturation period permits small farmers to reduce their overall risk of crop loss by harvesting three crops per year. In Indonesia, for example, the heaviest plantings occur in October and November, at the beginning of the wet season. Using early maturing varieties, farmers can harvest corn in December and January, when rice supplies are seasonally low.

In addition to shorter maturation periods, many farmers see a number of other technological advantages to the traditional seed varieties. These advantages include:

1. greater resistence to downy mildew disease, a major problem in the Philippines and Indonesia (Relatively few mildew-resistant varieties are available, and farmers have been slow to accept them.)
2. better adaptability to the poor soils of the upland (rainfed) corn-producing areas of the Philippines and Indonesia (Differences in yields between old and new varieties are much smaller in these regions.)
3. higher shelling recovery rates
4. better color and taste (Most of the recommended varieties are yellow, but white varieties are preferred for human consumption.)
5. lower vulnerability to weevil damage and to moisture damage in the rainy season harvest.

Improved high yield varieties are gradually becoming available. In the Philippines, the government is gradually distributing synthetic mildew-resistant white varieties DMR-2 and DMR-4 and yellow varieties DMR-1 and DMR-3. Efforts are also being made to adapt U.S. hybrid varieties to the Philippine environment. In Thailand, the government encourages use of the recently developed "Prabuddabat #5" and DRM-4 varieties. In Indonesia, none of the recommended high yielding varieties (Bharapan, Metro, and Bogor Composite 2) are resistant to downy mildew, but the InterAsian Corn Improvement Program at the International Downy Mildew Nursery in Thailand, CIMMYT in Mexico, and the Indonesian government are cooperating to develop such varieties.

Another major obstacle to the adoption of new varieties is the inadequacy of improved seed production and distribution facilities as highlighted in the Phil Hi-Bred case in Appendix A to this chapter. The case shows how extremely difficult the transfer of technology from U.S. to Philippine seed companies is. The lack of adequate domestic commercial supplies and distribution apparatus is particularly important for corn because the hybrid seeds must be purchased every year. To upgrade seed research and marketing, the Indonesian government has established a National Seed Corporation to manage a 2,450-hectare seed farm and to train specialists in the development and use of the new varieties.

Still, the slow adoption of high yielding varieties is only one part of the problem of modernizing the traditional corn systems of Southeast Asia. Significant changes are also required in farm practices and in the use of other inputs. Among the most critical input requirements still lacking are improved water control and chemicals for fertilization and plant protection. Corn producers in the Philippines and Indonesia use almost no fertilizers, pesticides, insecticides, or herbicides. Use of these inputs in Thailand is very limited. In the Philippines, for example, SEARCA estimates that—despite Board of Trade investment incentives—the nation's twenty-three private agricultural-chemical marketing firms supply only 3.4 percent of the insecticides and pesticides needed for all agricultural purposes.

These countries depend heavily on imports for their fertilizer supplies, and when prices rise—as was the case in the 1973–75 shortage—they have difficulty competing with more affluent buyers. The Philippine government established a Fertilizer Industry Authority in March 1973 to ensure equitable distribution of limited supplies among all agricultural producers. By 1976, supplies had come to exceed demand and one fertilizer firm soon began selling its facilities on a cooperative basis to small-scale farmers. Indonesia imports 50 percent of its nitrogen fertilizers and all of its potassium and phosphate. The nation's current development plan calls for use of its large oil and gas reserves to achieve self-sufficiency in nitrogen by 1979. The Fertilizer Management Board, established in 1972, authorized a 50 percent price increase in September 1973 to stimulate domestic production. At the same time, however, the government continues to subsidize the cost of fertilizer for growers of crops it designates as essential, one of which is corn.

Improved farm-management practices are lacking in phases of corn production in Southeast Asia beyond the application of fertilizer and other chemicals, including land preparation, planting, weeding, cultivating, harvesting, and drying. Inadequate capital for investment in new farm machinery and equipment is only partly responsible for this lack. Of at least equal importance is the need for more training programs and improved extension services throughout agricultural regions. Studies at the International Rice Research Institute indicate that significant yield improvements could be obtained for rice through better farm management, even without large capital investments. The same must also be true

for corn where current practices, even in Thailand, are even more primitive than among rice farmers.

Lack of adequate water control in the corn-production areas is also a major problem in all three countries. Although an increase in the amount of land under irrigation is part of any solution, effective water control also requires improved storage and drainage facilities in rainfed production areas. In 1969, Indonesia ranked sixth in the world in land under irrigation (6.8 million hectares, 38 percent of its total cultivated area), but its irrigated corn-producing areas were relatively small because net farm income was higher for rice and because the government accorded a higher priority to increasing rice production. In Thailand only about one-sixth of the cultivated area is irrigated and the ratio is even lower in the Philippines.

The economic incentives to adopt modern methods of production are, for many farmers in Southeast Asia, insufficient to overcome these obstacles. Even if farmers adopted every aspect of modern corn technology, their potential income from corn would not be significantly higher than current returns from irrigated rice or cassava production. In Indonesia, for example, government data suggest that realizable net farm income from corn under a modernized system might be about 44,200 rupees per hectare. This figure is only moderately attractive, compared with actual returns reported in the January-February 1971 Agricultural Survey of 50,300 rupees per hectare for lowland rice, 43,200 for cassava and 26,100 for upland rice. In the Philippines, it is not clear that the government support price for corn—even at its recently increased level—is sufficient to compensate the farmer for the costs of even moderate improvements over traditional technology. Furthermore, most farmers are unwilling or unable to adopt the full range of modern methods and inputs. As a result, they do not realize expected yield improvements and the actual increase in their net farm income does not justify higher risks.

The pattern of land tenure in the region complicates consideration of the role of economic incentives. In many areas, numerous small subsistence farmers, dependent tenants, and landless laborers live and work on land owned by a small number of middle-income and rich people who are often farmers, lessors, lenders, and traders at the same time. Great disparities in land ownership rarely allow smaller landowners and the landless to be prosperous. To survive, small operators may have to lease some of their own hectarage or work part-time for someone else. Tenants have little security, and they may pay rent exceeding half their entire crop. All risks they take are their own, while gains achieved through additional effort or capital must usually be shared with the landowner. Under these circumstances, tenant farmers are clearly much less eager to undertake the risks of innovation than owners who can enjoy all the fruits of their risk-taking.[3]

Stocks. Figures on regional corn inventories are sparse and difficult to interpret. Table 5-11 shows that, even allowing for a change in reporting for

Table 5-11. Beginning Corn Stocks: 1961-77 (thousands of metric tons: years ending June 30)

	Indonesia		*Malaysia*		*Philippines*		*Thailand*		*Four-Nation Total*
Year	*Stocks*	*Percent of Previous Year's Consumption*[a]	*Stocks*	*Percent of Previous Year's Consumption*[a]	*Stocks*	*Percent of Previous Year's Consumption*[a]	*Stocks*	*Percent of Previous Year's Consumption*[a]	*Stocks*
1961	–		4	3.2	60	5.0	390	390	454
1962	–		4	2.4	109	9.0	384	256	497
1963	–		7	4.3	108	8.5	312	208	427
1964	–		7	6.8	104	8.0	227	114	338
1965	–		8	15.7	113	8.1	241	964	362
1966	–		7	11.5	151	11.2	101	348	259
1967	–		6	8.5	281	20.0	8	22.8	295
1968	–		6	7.8	380	25.7	54	98.1	440
1969	–		8	7.3	400	23.7	168	162	576
1970	182	9.5	8	6.1	519	27.5	190	107	899
1971	220	8.7	18	10.8	504	25.0	245	113	987
1972	226	9.2	17	8.4	523	25.3	154	55	920
1973	5	0.2	23	10.6	355	16.8	135	45	518
1974	331	13.6	21	9.5	414	17.8	13	7.8	279
April 1975[b]	800	31.5	22	9.6	611	24.2	34	7.6	1467
April 1976[b]	879	35.0	23	9.6	777	29.3	88	15.7	1767
April 1977	850	33.2	24	10.0	940	31.2	88	12.6	1902

[a]Calculated from source tables.

[b]For Indonesia, year ending March 31.

Source: USDA, Foreign Agricultural Service *Reference Tables on Wheat, Corn, and Total Coarse Grain Supply–Distribution for Individual Countries*, FG 9-76, May 1976.

Indonesia, corn inventories have increased over the years. This development is hardly surprising, given increased use of corn as an ingredient in feed milling and food manufacturing, traders' and manufacturers' need to maintain an inventory, and improvements in grain inventory reporting. The development of relatively sizable inventories may indicate that the region's corn system is gradually evolving toward a more commercial orientation.

Trade. Because of the dramatic growth in production and exports by Thailand, Southeast Asia is a net exporter of corn. As shown in Table 5-12 Thailand's corn and meal exports now exceed 2 million tons annually; making it the fifth largest corn-exporting nation in the world. Indonesia's corn exports are only a fraction of Thailand's, but they too have grown over time to annual levels exceeding 100,000 tons. But their uncertain production such as in the recent year 1977-78, has meant that sometimes Indonesia becomes an importer of corn. The Philippines exported minimal amounts between 1967 and 1971, but food deficits in succeeding years have forced the nation to import about 8 percent to 10 percent of its corn needs, the bulk of which comes from the United States.

The major external source of demand for Southeast Asian corn has been Japan. Corn trade between Japan and Thailand first began in 1951, when 4,867 metric tons changed hands. By 1960, almost 80 percent of Thai corn exports went to Japan. Subsequently, the importance to Thailand of the Japanese market has declined somewhat. Currently Thailand ships about half of its annual production to Japan, about 20 percent to Taiwan, 10 percent to Singapore, and lesser percentages to Hong Kong, Malaysia, the Philippines, and the Middle East. Singapore is Indonesia's largest customer, accounting for between one-third and one-half of that nation's annual exports. Taiwan has also become an important buyer, accounting for about one-third of Indonesia's exports. Other consistent buyers in varying amounts are Japan, Hong Kong, and Malaysia. Figure 5-1 shows the flow of corn among the countries in this study during 1975.

Chapter 3 showed that Japanese firms and government agencies have attempted to develop or enlarge corn production in several Southeast Asian nations, including Cambodia, Thailand, Indonesia, and Vietnam. Japan's substantial demand for corn and its efforts to diversify its sources promise Southeast Asia a significant market opportunity. But of those nations able to produce feedgrains, only Thailand has taken advantage of this opportunity. Without Thailand, Southeast Asia would have been a net importer of corn since 1971. As the region's population grows, however, internal demand for human and feed-corn supplies will compete with the export market for local corn production.

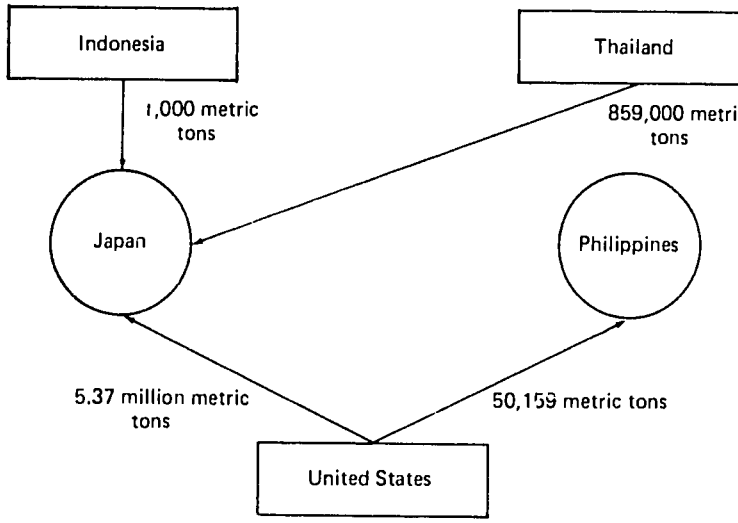
Prices

Regional corn prices tend to reflect U.S. prices. It is much more difficult to generalize about the pricing process within each country due to differences among government programs, market structures, and market efficiency. In Thai-

Table 5-12. Net Trade in Corn by Southeast Asian Nations: 1960-76 (thousands of metric tons, years beginning July 1)

Year	*Burma*	*Cambodia*	*Indonesia*	*Laos*	*Malaysia*	*Philip-pines*	*Singapore*	*Thailand*	*North Vietnam*	*South Vietnam*	*Net Total*
1960	25	140	2	–	-122	–	n.a.	519	–	18	582
1965	15	101	38	–	-52	-3	-13	1,132	-1	-30	1,187
1970	12	36	282	–	-169	1	-9	1,663	–	-80	1,700
1971	13	–	217	–	-197	-74	-17	2,111	–	-90	1,901
1972	–	–	79	–	-235	-116	-222	1,039	–	-80	377
1973	–	30	180	–	-210	-90	-243	2,131	–	-45	1,753
1974	5	30	195	–	-218	-159	-345	1,979	–	-50	1,437
1975	5	–	51	–	-224	-54	-360	2,386	–	-60	1,744
1976		–	30		-234	-141	-360	2,200		-60	1,375

Source: Indonesia: Biro Pusat Statistik, *Ekspor Menurut Jenes Barang, Negeri Tujuan Dan Pelabuhan Ekspor*, quoted in A.J. Nyberg, "Outlook for the Indonesian Maize Industry" in SEARCA, *Proceedings of the Indonesian Corn Commodity System, First National Agribusiness Seminar Workshop* 28-30 December 1975, p. 72. All other nations: Foreign Agricultural Service, USDA, *Reference Tables on Wheat, Corn, and Total Coarse Grain Supply-Distribution for Individual Countries*, PG 7-77.



Source: USDA.

Figure 5-1. Corn Flow Among the United States, Indonesia, the Philippines, and Thailand: 1975

land, for example, domestic corn prices are based on the Bangkok wholesale price, which in turn is closely related to world (Chicago) prices during that part of the year in which the Thai-Japan Maize Trade agreement is in effect. But in Indonesia, which exports relatively small quantities of corn, there is no such correspondence between internal and world prices. There, the government-controlled price of rice influences corn prices, which usually fall significantly below those of other grains. The Philippine government, on the other hand, controls the price of corn at all levels in the system to ensure a reasonable price to consumers, provide corn producers with adequate incentives, and insulate the food system from violent fluctuations in world grain prices. Typical of the difficulties of managing this price-control system is the problem of relating corn and end-product margins to each other and to other crops. The system's consequences for individual firms are highlighted in the Cebu Corn Dry Milling case in Appendix B of this chapter.

Government Activity

With the exception of its *bimas palawija* (credit) program for secondary crop improvement, the Indonesian government has usually left the corn system to fare on its own, but an intensive government program to improve production is underway in the Philippines. Government researchers are working to develop new strains of mildew-resistant corn. The National Grains Authority, the sole importer of corn in the nation, is improving its statistical monitoring of the grain

business. And the Philippine Board of Investment now authorizes tax incentives for certain livestock and feedgrain ventures. Thailand renews its corn trade agreement with Japan each year, and it has long encouraged the growth of the corn industry by providing credit, introducing new varieties, and encouraging cooperatives. The effect of government activity on system participants is discussed more fully in the following analyses of the Philippine, Indonesian, and Thai corn systems.

THE CORN SYSTEM IN INDONESIA[4]

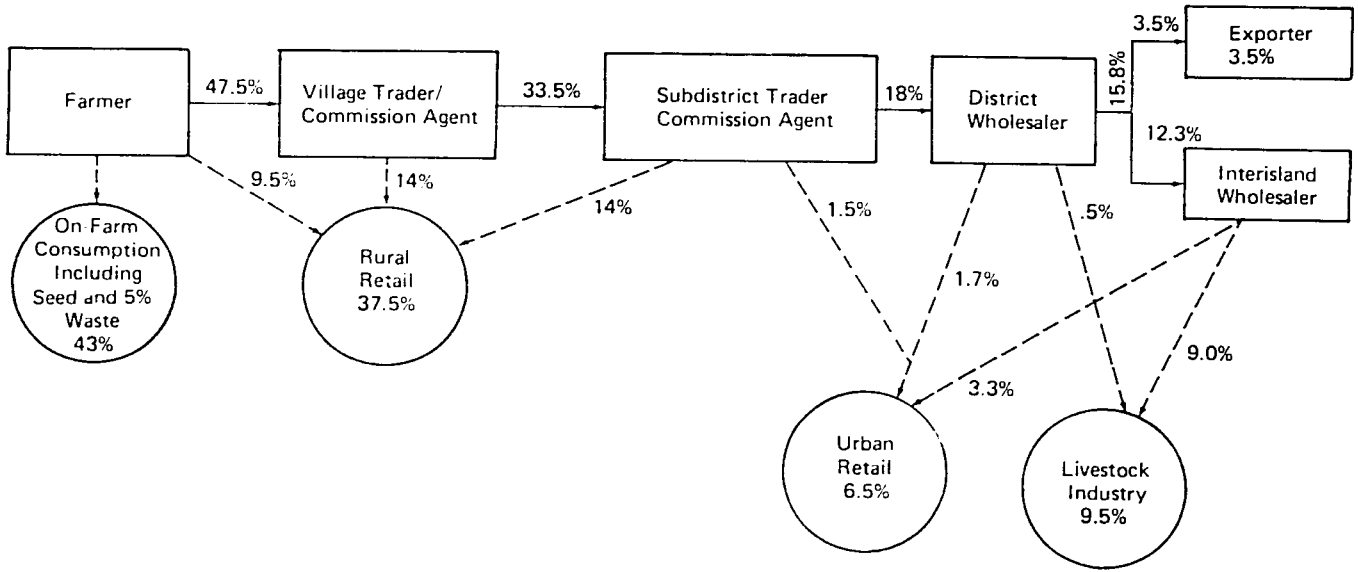
The corn system in Indonesia is primarily centered in the island of Java. Corn is mainly used for human food and over half of it is consumed by the farmers who produce it. This is a classic example of a subsistent corn system and of the difficulties of reaching the many small scale producers with appropriate technology and financial incentives.

Structure

Structure and participation in the Indonesian corn system are difficult to define precisely due to the small size and local orientation of most of its participants. SEARCA reports that four million farmers produce some corn in Indonesia. Slightly less than three million of these producers are located in Java and nearly all of them also produce crops other than corn. About 35 percent of their corn production is of the white variety. Between the producers and the consuming population of over 120 million people are an unknown number of traders, wholesalers, and grain merchants. Three mills established since 1973 are believed to account for practically all of Indonesia's feed milling. One corn-oil processing plant operates in East Java. The Indonesian corn system is therefore the epitome of the developing commodity system: it has many small and subsistence producers; there are few commercial operations of significant size; and we have relatively little data on which to base a conclusive analysis. However, SEARCA's work has defined the broad outlines of the system.

Figure 5-2 traces the production and flow of over 3.6 million metric tons of corn within Indonesia in 1974. A large percentage (43 percent) of this corn remained on farms where it was used for either seed or human food. The remainder is marketed for a variety of uses off the farm.

Indonesian corn farmers have three markets for their production: the local market, the interisland domestic market, and the export market. Several system participants operate between farmers and the final market for their grain. Village traders purchase corn directly from farmers and then sell it to local customers and subdistrict collectors. The collectors in turn sell to retailers in the larger villages, to local feed mills, and to larger district traders. These district traders primarily supply retailers in urban areas, exporters, and interregional wholesalers



Source: The Southeast Asian Center for Graduate Study and Research in Agriculture, *The Indonesian Corn Commodity System* (n.p.), Los Banos, Philippines: 1974. Adapted from Figure G, p. 9.

Figure 5-2. The Indonesian Corn System: 1974

in the interisland and foreign trade. Commission agents operate on a small scale at various market levels, primarily for large traders.

The market system for corn is most highly developed on the island of Java, which accounts for about three-quarters of the entire Indonesian corn crop. East Java alone produces just under half the total corn crop. Most of the corn sold there is in the form of grain. Husking and shelling are usually done by hand, although some farmers sell corn on the cob and leave these operations to traders. Farmers dry their retained corn by either suspending small quantities over the cooking area or by shelling and sun drying. A few traders in rural areas have mechanical dryers.

The marketing of corn by farmers depends upon corn's importance as a staple and upon the price of rice. Three patterns of corn consumption and thus of corn marketing are prevalent.

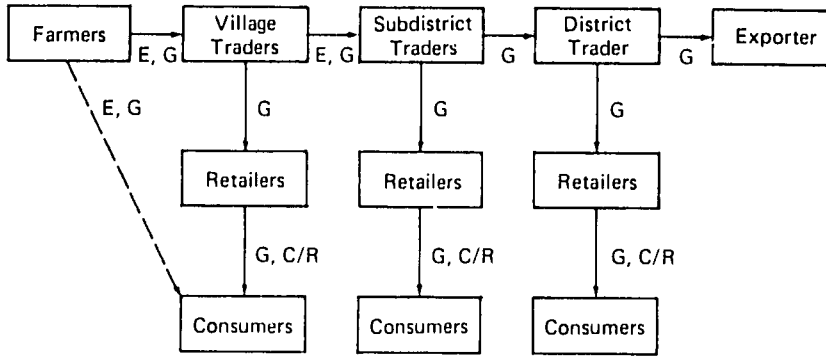
1. Corn is consumed as the main staple only during particular months. As the price of rice begins to drop seasonally, the importance of corn decreases; more rice is consumed, and more corn is marketed.
2. Corn is mixed with rice all year long as a staple food, and only moderate amounts are marketed.
3. Corn is the only staple food throughout the year, and farmers market relatively small amounts.

In East Java, where the per-capita corn consumption is highest, farmers market a lower percentage of their corn crop than those in other areas. Conversely, in South Sulawesi and Lampung (South Sumatra), where dependence on corn as a staple is lower, the surplus marketed by farmers is higher.

Although corn can be planted any time during the year in Indonesia, it is usually planted at the onset of the wet season in October and November. Due to use of early maturing varieties the largest harvest occurs in December or January, the period of heaviest rainfall and leanest rice supply. Lacking adequate drying and storage capacity and usually faced with substantial demand for a rice substitute, most farmers sell whatever corn they can immediately after harvest.

Village traders purchase two forms of corn from farmers: ears and shelled grain. In the season of largest harvests, the sales quantities of both products are about equal: but in the dry season the quantity of corn sold as grain is about 60 percent of the total corn purchased by traders. Almost all corn ears are processed into grain by village traders. Beyond the village trader level, less than 10 percent is marketed in the form of ears that are finally processed by district traders. Figure 5-3 depicts the flow of corn through the system by type of product.

Cow-drawn carts capable of hauling loads of up to two tons are the principal means of transporting corn in villages, although bicycles are also used. Typically, corn is transported a distance of four to five kilometers. Beyond the village level, trucks are the main means of transportation.



Note:
E = Ears.
G = Shelled corn grain.
C/R = Corn rice mixtures in different forms and proportions.
Source: SEARCA, *The Indonesian Corn Commodity System*, (n.p.), 1974, p. 153.

Figure 5-3. The Flow of Corn through the Indonesian System, by Type of Product

Corn grain at the village trader level has a moisture content of about 16 percent to 18 percent. It is further dried by subdistrict and district traders. When they have completed their work, the grain has a moisture content of about 15 percent. Despite its expense compared to sun drying, machine drying is preferred by many traders because of its independence of weather conditions. During the wet season, sun drying may take as many as seven days instead of three. Such a delay can compel traders to operate at uneconomically low volumes.

At all stages of the commodity system, grain is the most common form of stored corn. At the village and subdistrict levels, corn ears are almost immediately processed into grain after drying; grain is converted into corn/rice products only when there is demand, since such products spoil more quickly than separate grains.

Most village traders prefer to keep no more than one week's inventory because their storage facilities are generally limited to covered godowns with capacities of ten to fifty tons. District traders own larger storage facilities, ranging in size from one hundred to five hundred tons in capacity, but their facilities are also covered godowns in which corn is stored in sacks. Of all participants in the Indonesian corn system, exporters employ the most adequate storage facilities. Although most of their facilities are also covered godowns with corn stored in sacks, weight loss is estimated to be only 1 percent, instead of the 1.5 percent and 2 percent for district and village traders. Exporters also fumigate their grains.

A 1971 study by Weitz-Hettelsater engineers of warehouse space in Indonesia estimated a total warehouse capacity of 1.6 million metric tons. About half of

this capacity was general warehouse space; a quarter was owned by rice millers and hullers; and the remainder was retail and godown storage.[5] Although this capacity has undoubtedly expanded since 1971, a severe shortage remains. Indonesia produces in excess of 25 million tons of grain annually (of which less than 4 million is corn), and yet it apparently has storage capacity for less than 8 percent of this amount.

No reliable statistical data profile the interisland trade in corn. In an effort to describe this trade, however, the Central Institute of Agriculture at Bogor has combined data on production in various regions for 1972, population in 1971, and consumption estimates for 1967 to obtain estimates of surplus and deficit regions. Table 5-13 lists the results. According to the institute, the Sumatran corn deficit is questionable because there is no record of corn imports to that island. The other deficit area, Kalimantan, obtains its corn primarily from South Sulawasi. Transportation of corn from Nusa Tenggara, an unlisted surplus area in the eastern part of the archipelago, is so difficult that the area is not considered.

Transportation problems—especially the inferior quality of the country's road network—are among the main obstacles to effective coordination of the Indonesian corn system. Much of the road system dates from 1939; and, even if maintained properly, it is inadequate for modern needs and motor vehicles. In 1966 the nation had only 84,000 kilometers of highway. In 1968, only 18 percent of the system was paved; only 5 percent was in good condition; and only 2 percent could handle axle loads of five metric tons. Over 75 percent of Indonesia's roads are limited to loads of less than two tons. And of the estimated half million motor vehicles in Indonesia, 20 percent to 40 percent are variously reported to be inoperative due to obsolescence or lack of tires and spare parts.

Many problems also exist in vital interisland shipping. With over one-fifth of its vessels inoperative, the nation's fleet is in poor physical condition. Less than one-third of Indonesia's three hundred ports can be used in inter-insular trade, and only about twenty are capable of receiving ships of any size alongside a quay or pier. The situation is further complicated by the lack of port services, lack of maintenance and repair of channels, harbors, and port facilities, and the slowness of ship-clearance facilities.

The 7,000 kilometers of railroads have similarly suffered from lack of maintenance for many years. Most tracks, roadbeds, and bridges are in poor condition. Rolling stock is very old and idle much of the time. Many diesels and electric locomotives lack spare parts and are inoperative. No wonder the use of railroads for moving grain is declining in the face of lost shipments, extended transit times, and uncertain delivery dates. In North Sumatra, for example, the railroad carried about 250,000 tons of rice in 1960 but only about 48,000 in 1969.

Transport problems also constitute obstacles to expansion of corn exports, as demonstrated in the Mitsui & Co., Ltd. case study in Appendix C of Chapter 3. Exports flow through the ports of Surabaya in East Java, Semarang in Central

Table 5-13. Indonesian Corn Production, Consumption, and Surplus by Region: 1972

Region	*Production (thousands of metric tons)*	*Population (thousands)*	*Annual Per-Capita Consumption (kilograms)*	*Total Consumption (thousands of metric tons)*	*Surplus (thousands of metric tons)*
Jakarta	n.a.	4,576	0.5408	2.4	-2.4
West Java	104	21,633	0.9256	20.0	84.0
Central Java	576	24,367	17.1444	417.8	158.2
East Java	969	25,527	25.7348	656.9	312.1
Sumatra	150	20,813	16.2240	337.7	-187.7
Kalimantan	10	5,152	16.2240	83.6	-73.6
Sulawesi	224	8,535	16.2240	138.5	85.5
Other Islands	221	7,857	16.2240	127.5	93.5
Total	2,254	118,460		1,784.4	469.6

Note: Production figures do not agree with Table 5-8 because they are from a different source and apply to the fiscal year.
Source: SEARCA, The Indonesian Corn Commodity System (n.p.), 1974, p. 177.

Table 5-14. Indonesian Corn Exports by Island: 1966-74

Year	*Total Exports (metric tons)*	*Percentage from*			*Percentage from Other Islands*
		Sumatra	*Java*	*Sulawesi*	
1966	85,087	39	43	10	8
1967	155,609	20	51	13	16
1968	65,308	47	13	39	1
1969	153,760	29	58	12	1
1970	281,842	21	64	8	7
1971	217,138	37	53	2	8
1972	78,533	72	15	1	12
1973	180,271	39	38	18	5
1974	195,496	39	55	1	5

Note: The 1968 and 1972 export seasons followed periods of reduced corn production in Indonesia. Java's ability to export was consequently reduced due to local need for corn. In Sumatra, where corn is less important in the daily diet, exports were much less affected. In those years Sumatra's share of all Indonesian exports increased substantially.

Source: Based on Biro Pusat Statistik, *Ekspor Menurut Jenes Barang, Negeri Jujuan Dan Pelabuhan Ekspor*, quoted in A.J. Nyberg, "Outlook for the Indonesian Maize Industry," in SEARCA, *Proceedings of the Indonesian Corn Commodity System, First National Agribusiness Seminar Workshop*, 28-30 December 1975, p. 72.

Java, Cheribon in West Java, Panjang in Lampung, and Makassar in South Sulawesi. Table 5-14 reveals that Java is the source of about half of Indonesia's exports. In recent years, over four-fifths of Java's exports have passed through Surabaya. Indonesia's second largest corn-exporting port, Panjang in South Sumatra, handles about one-third of Indonesia's exports. Shipments from the Sumatran port of Belawan (390 miles northwest of Singapore) have been rising since the mid-1960's, and it is now the third largest point of corn export. Belawan has grown in importance as Singapore has evolved into the leading buyer of Indonesian corn, as shown in Table 5-15.

The use of corn for livestock feeding and in large-scale milling of feed and industrial products, only now beginning in Indonesia, consumes about 10 percent of annual corn production. Nine percent is fed to animals, a small part of which is processed by the formula-feed industry.

The nation's three modern feed mills all began operation since 1973, and all are joint ventures between Indonesian and foreign grain firms: Cargill, Mitsui and Company, and the Thai firm Charoen Pokphand. Aggregate monthly output is estimated at one thousand tons, consisting of about 80 percent poultry feed, 15 percent swine feed, and the remainder miscellaneous.[6] The poultry industry, which produces eggs and meat for upper-income residents of the Jakarta area, is the major market for compound feed. Currently it mixes its own, and the new feed milling industry is seeking to persuade poultry-products producers to purchase complete feeds rather than do so.

Table 5-15. Indonesian Corn Exports by Destination: 1965-74 (thousands of metric tons)

Destination	*1965*	*1966*	*1967*	*1968*	*1969*	*1970*	*1971*	*1972*	*1973*	*1974*
Japan	3,930	70,892	87,502	13,465	31,991	68,372	46,347	16,539	43,305	6,900
Hong Kong	1,200	13,718	46,131	1,650	22,316	48,633	35,803	15,918	14,300	14,375
Singapore		–	21,691	49,425	85,910	146,744	113,177	33,987	63,113	80,863
Malaysia		–	–	768	13,522	15,246	21,711	11,955	8,660	17,497
Taiwan	–		–	–	–	–	–	–	47,591	74,856
Other		477	285	–	21	2,847	100	134	3,302	1,005
Total	5,130	85,087	155,609	65,308	153,760	281,842	217,138	78,533	180,271	195,496

Note: – = Inconsequential.

Source: Biro Pusat Statistik, *Ekspor Menurut Jenes Barang, Negeri Jujuan Dan Pelabuhan Ekspor*, quoted in A.J. Nyberg, "Outlook for the Indonesian Maize Industry" in SEARCA, *Proceedings of the Indonesian Corn Commodity System, First National Agribusiness Seminar Workshop*, 28-30 December 1975, p. 68.

Behavior and Performance

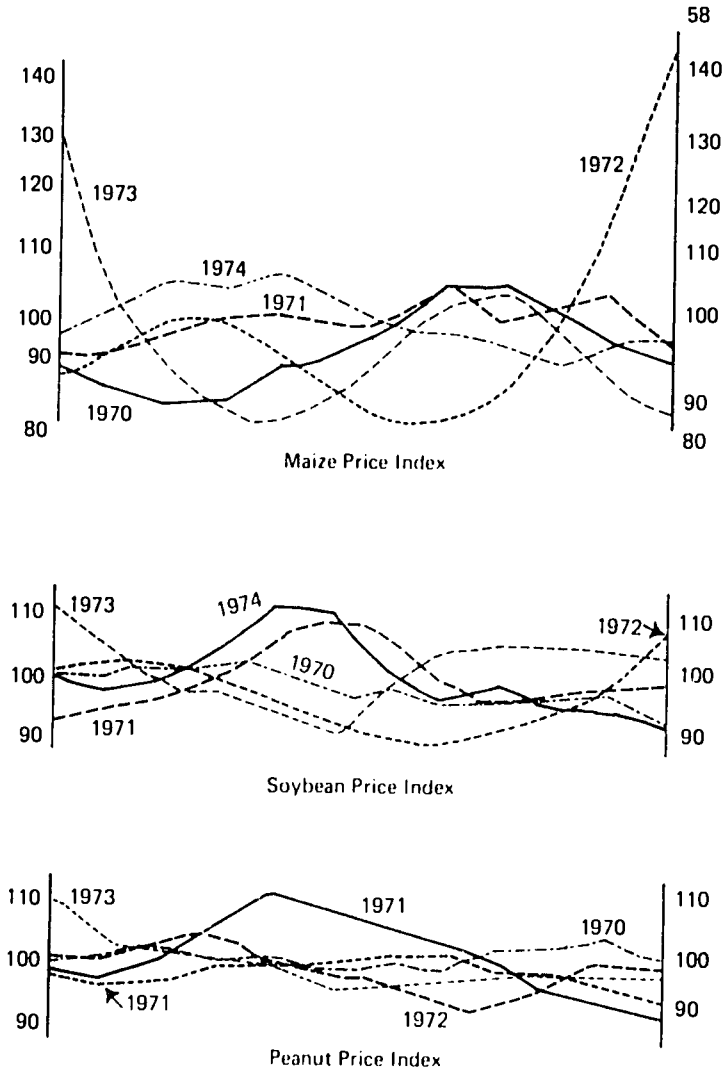
The behavior of the Indonesian corn system is different in several respects from that of either the Philippines or Thailand. Most corn farmers plant their main crop at the beginning of the rainy season in September. Some follow it with a crop of soybeans and then a second corn crop at the end of the rainy season. They plant varieties of relatively short maturity (one hundred days) to fit this cropping pattern. Thus, the two main periods when corn moves off-farm in quantity are December-January and June-July. Traders are most active during these periods and accumulate significant amounts of the corn flowing through commercial channels. During the rest of the year their corn inventories are low and their trading activities involve other commodities.

Although data on inventory holdings by various sytem participants at different times of the year is lacking, it is probably safe to draw three conclusions. First, there is practically no local carryover of corn from year to year. Second, farmers lack the storage capacity, financial ability, or market sensitivity to withhold their production from traders and consumers in order to obtain higher prices. Third, expanded storage facilities and active year-round trading of corn will eventually occur with or without significant export incentives because of an increase in local food and industrial demand.

Figure 5-4 compares seasonal price indexes of corn, peanuts, and soybeans from 1970 to 1974. Note the dramatic runup in corn prices in 1972, caused by reduced Indonesian and worldwide grain harvests, and the tendency toward early and midyear lows when corn harvests are being taken in. The relative volatility of the price of corn in Indonesia has made it a more risky commodity for farmers than several other alternatives.

Table 5-10 showed that Indonesian corn yields, although they have improved, have been lower than in several other Southeast Asian nations. The use of low yielding, quickly maturing varieties that fit local cropping patterns and the use of native varieties having some resistance to downy mildew disease help explain this performance. An important additional reason, however, is that pure corn production is uncommon. Other crops are often interplanted with corn to reduce risk (or merely out of custom) and when the corn plant density is less than some normal level, yields fall.[7] As the Indonesian corn system becomes increasingly market-oriented, the planting of corn in pure stands will probably increase and yields will grow.

At existing price and yield levels, corn production is profitable. But it is less profitable than several alternatives, as Table 5-16 shows. And over time, corn has declined in profitability relative to peanuts and soybeans. Soil conditions, cropping patterns, the taste preferences of local consumers, and the relatively small cash outlay it requires not profit seem to be the reasons for growing corn. All in all, price instability and corn's relatively low profitability suggest that the production of corn can be quite risky for the small Indonesian farmer wishing to market a portion of his crop.



Source: A.J. Nyberg, "Outlook for the Indonesian Maize Industry," in SEARCA, *Proceedings of the Indonesian Corn Commodity System First National Agribusiness Seminar Workshop*, 28-30 December 1975, p. 58.

Figure 5-4. Seasonal Price Indexes—Corn, Soybeans, and Peanuts: 1970-74

Profitability beyond the farm level is difficult to define precisely, but the results of the several studies that have been made of marketing margins are summarized in Table 5-17. The margin between the farm and wholesale price appears to be in the range of 40 percent to 50 percent, and the margin between wholesaler and export (in terms of the farm price) is about the same. High trans-

Table 5-16. Costs and Returns of Selected Crops in East Java: 1973 (rupiah per hectare)

	Rice	*Cassava*	*Sweet Potatoes*	*Peanuts*	*Soybeans*	*Maize*
Production value	92,875	56,490	57,784	55,717	43,987	27,608
Costs	26,858	7,122	12,116	18,365	12,323	9,789
Net profit	66,017	49,352	45,668	37,352	31,664	17,819

Note: 414 rupiahs = $1.00.

Source: Biro Pusat Statistik, *Survey Pertanian 1973*, quoted in A.J. Nyberg, "Outlook for the Indonesian Maize Industry," in SEARCA, *Proceedings of the Indonesian Corn Commodity System First National Agribusiness Seminar Workshop*, 28-30 December 1975, p. 54.

Table 5-17. Summary of Corn Marketing Margin Studies in Indonesia (percentage)

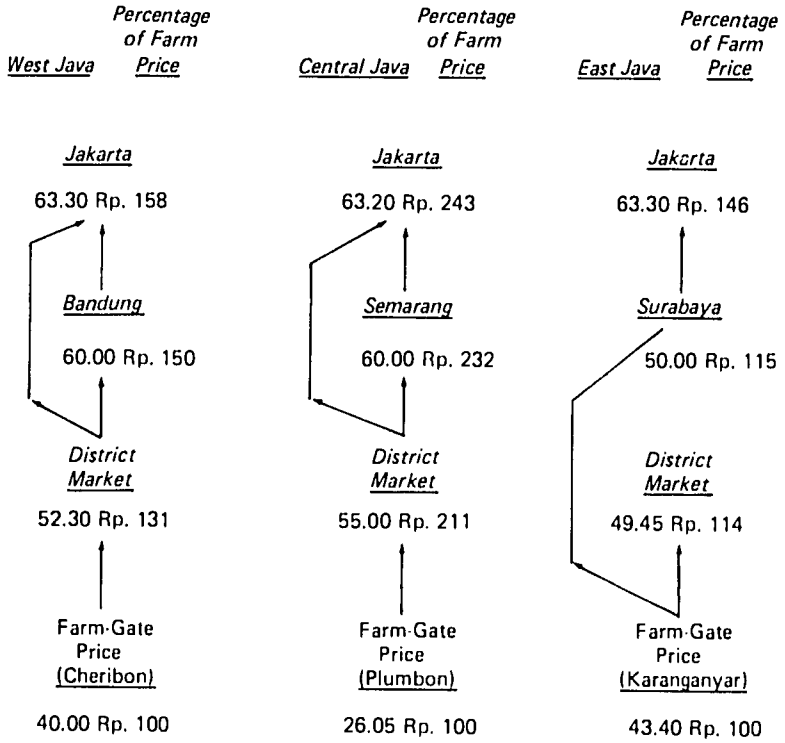
	South Sulawesi (1970)	*East Java (1971)*	*East Java (1966)*	*South Sulawesi (1972)*	*South Sulawesi, Lampung, East Java (1972)*	*East Java (1971)*
Farm price	100	100	100	100	100	100
Middleman price	160	131	133	NA	151	NA
Export price	189	188	250	180	206	189

Note: Figure are percentages of farm prices.

Source: A.J. Nyberg,"Outlook for the Indonesian Maize Industry," in SEARCA, *Proceedings of the Indonesian Corn Commodity System First National Agribusiness Seminar Workshop*, 28-30 December 1975, p. 62.

portation costs, poor storage and drying facilities, and labor costs for sacking and handling inflate these margins. According to Nyberg, no significant evidence shows that middlemen's profits are excessive. Rather, the great number of middlemen causes these wide margins. In many cases, three or four middlemen operate between the producer and final purchaser, and each of them tries to make some profit. The effects their efforts have on actual prices is shown in Figure 5-5. Note the large spread between the Jakarta and central Java farm-gate price. The date on which these prices were sampled (15 April 1974) probably coincided with harvest time in the area around the Plumbon producer's market, with consequent depressing effects on the farm price.

One researcher has found rather wide spreads between Indonesian export prices and recipient import prices. Nyberg found average import prices to be 30 percent to 50 percent higher than Indonesia's average export prices. Available data do not explain whether this differential is due to quality differences, trans-



Note: Rp. = Rupiah

Source: Directorat Ekonomi, Ditjentan, "Catatan Harga Palawija . . ." 1974. Jakarta Price: Central Bureau of Statistics. Quoted in SEARCA, *The Indonesian Corn Commodity System*, (n.p.), 1975, p. 182.

Figure 5-5. Price Formation of Corn in Java: 15 April 1974

port costs, or other factors such as seasonal harvest price pressures for the export crop or seasonal shortages for the imported crop.

Note how skipping a marketing step in Figure 5-5 offers the opportunity of eliminating some handling costs and either increasing profit or reducing the difference between the farm-gate and the terminal-market price. A variety of coordinating linkages might accomplish this end: vertical integration (forward through farmer cooperatives, or backward by terminal-market traders), contractual arrangements, a government marketing program, or perhaps something as simple as broadcasting the Jakarta corn price to producers in Cheribon, Plumbon, and Karanganyar.

Coordination in the Indonesian System

About half the corn marketed at the farm level in Indonesia is sold on a cash-and-carry basis. The other half, however, is traded under arrangements involving

varying degrees of coordination between buyer and seller. These arrangements are basically four: cash before delivery, cash after delivery, *tebasa* transactions, and contracts.

The cash-before-delivery method is used primarily between traders at different levels and probably represents an extension of credit through the sytem. For example, a subdistrict trader wanting to buy grain from a village trader may advance the purchase to the village trader, who in turn will use the money (less his operating margin) to purchase grain from farmers. The subdistrict trader may be party to a similar arrangement with a district trader or exporter for whom he acts as buyer. In *tebasa* transactions, the purchaser pays harvesting and transportation costs. Such transactions involve village traders and farmers, and they involve cash payment in advance.

Though information on their numbers and importance is lacking, commission agents apparently play a significant role in coordinating the system at and below the district level. Usually acting on behalf of district traders—but occasionally for larger interisland traders—these agents buy from farmers, village traders, and subdistrict traders. They probably constitute an important communication link at the local levels of the system and may play key roles in implementing cash-before-delivery arrangements.

Table 5-18 summarizes the various types of purchase/sale arrangements in the Indonesian corn system. Clearly, the most significant degree of coordinating presently occurs at the district level or below. Some contract buying involving exporters does occur, but the export volume of corn from Indonesia is so small that these contracts do not yet have a major coordinating effect on the system. If Indonesia's exports expand as much as they may, however, exporter contracts may become a major coordinating device in the system.

Coordination by multinational firms is occurring. One example of such activity, the Mitsugoro joint venture involving Mitsui in South Sumatra, was discussed in Appendix C of Chapter 3. Mitsui also participates in the feed-milling industry. Cargill and the Thai milling firm Charoen Pokphand are also involved in feed-

Table 5-18. Buying Practices in the Marketing of Corn in East Java: 1974 (percentage)

	Method of Payment				
Buyer	*Cash*	*Cash before Delivery*	*Cash after Delivery*	*Contract*	*Tebasa*
Village trader	45	22	11	NA	22
Subdistrict trader	50	50	NA	NA	NA
District trader	43	57	NA	NA	NA
Exporter	60	30	NA	10	NA

Note: Figures are percentage of total transactions.

Source: SEARCA, *The Indonesian Corn Commodity System*, (n.p.), 1975, p. 154.

milling joint ventures. Pokphand, primarily a feed miller based in Thailand with contracts throughout Asia and the United States, is changing its product line to meet new needs and markets in Southeast Asia. Its activities in the region generally and in Indonesia specifically are the archetype of an emerging trend: increasing internationalism of firms based in developing countries.

Late in the 1960s the Indonesian government undertook a corn improvement and export project in East Java in cooperation with certain Japanese government agencies. Signed in December of 1967 and renewed in 1971 for three additional years, the project's aims were ambitious:

1. to increase production of corn through improved cultivation, fertilizer application, and plant protection
2. to improve corn quality by developing new drying, processing, fumigation, grading, and storing facilities and practices
3. to rationalize the marketing system for export
4. to expand the trade in corn between Japan and Indonesia
5. to improve the skills of corn farmers
6. to encourage the development of agricultural cooperatives in East Java.

The Indonesian government provided funds for the project and the International Technical Cooperation Agency of Japan provided technical expertise, machinery, and equipment. Appendix C of this chapter describes the organization of the project in some detail. Of particular interest is the fact that the intended buyer of the expanded corn production was Zen-Noh, the National Federation of Japanese agricultural cooperatives discussed in the text and appendix A of Chapter 2. The East Java project is an excellent example of the dilemma faced by developing-country government eager to expand exports but concerned with the food security of its population. If Indonesia's corn export capacity increases as some studies predict, however, the East Java project may be instructive in organizing and promoting that flow.

Government Policy and Activity

Any government's food policies must pursue seven broad objectives:

1. maintain an adequate domestic supply of food
2. maintain or improve rural incomes
3. reduce food imports or increase food exports
4. provide food access to the poor
5. improve nutritional levels
6. generate employment
7. develop new agricultural industries.

In connection with each of these objectives, the Indonesian government has developed several policies that affect the corn system.

Encouraging rice production and stabilizing rice prices have been concerns of the Indonesian government since the 1960s. Even so rice production and supply remain insufficient in Indonesia. To increase overall production, including that of corn, the government mounted the bimas palawija program for secondary crop improvement in 1974. The production-intensification aspect of this program involves supervised credit and noncredit provisions. Credit provided to farmers consists of small operating loans and HYV seeds, fertilizers, and pesticides at subsidized prices. Noncredit arrangements provide for cash sales of subsidized fertilizer and pesticides. Also, farmers receive advice and guidance on new technology; credit is extended at low interest rates; and market facilities are being improved. The target areas of the intensification effort are Java, North Sumatra, Lampung in South Sumatra, South Sulawesi, and East Nusa Tenggara.

The effort has encountered a variety of problems common in projects of this kind. The availability of high yielding varieties is limited: service agencies still put top priority on the ongoing rice intensification effort. And the instability of the corn market discourages many farmers. Price supports for corn have been discussed and rejected. The result of all these difficulties is that only about 75 percent of the area targeted for the corn improvement program has been covered.

The influence of the rice price stabilization policy on the corn system is significant. Table 5-19 compares average deflated retail prices for rice and corn in rural Java for three different periods from 1962 through 1973. In a recent unpublished study, C. Peter Timmer analyzes the factors affecting food consumption in Indonesia.[8] Corn is consumed primarily by the rural poor and is usually mixed with rice and consumed as a single staple. As Timmer notes:

> Corn and cassava prices do not seem to influence rice consumption in the rural areas but they are important in urban areas where a much larger proportion of consumers must buy their rice and alternative staples. The cross-price elasticity of demand for rice with respect to corn and cassava

Table 5-19. Comparison of Real Retail Rice and Corn Prices in Rural Java and of Corn Production and Hectarage in Indonesia: Selected Periods, 1962-73

Period	*Rice Price*[a] *(rupiah/ kilogram)*	*Corn Price*[b] *(rupiah/ kilogram)*	*Corn Production (thousands of tons)*	*Corn Hectarage (thousands of tons)*
1962–64	5.93	2.99	3110	3127
1966–68	5.48	2.63	3084	3182
1969–73	5.25	2.66	2578	2690

[a]For pounded rice, Bulu No. 1.

[b]For mixed corn.

Source: Central Bureau of Statistics, quoted in Indonesia University *Supply of, Demand for, and Trade in Selected Agricultural Commodities; Indonesia: 1975, 1980 and 1985*, pp. 140–41.

prices is approximately 0.1 for urban Java and about -0.1 for urban off-Java. According to the coefficients corn and/or cassava are *substitutes* in urban Java and *complements* in urban off-Java.[9]

The implication of the figures in Table 5-19 and Timmer's paper and his previously cited paper on the impact of price policy on protein-calories intake[10] is that pricing of commodities in Indonesia must take into consideration both production incentives for the farmer and nutritional needs of the consumer.

Government policy appears to discourage export for the purpose of earning foreign exchange—understandably, given the importance of corn as a staple food. The export price per ton is increased 13 percent by various taxes and duties (10 percent export duty, 2 percent sales tax, 1 percent stamp duty, and certain other expenses).[11] In periods of grain shortage such as 1972, an outright ban on corn exports is declared.

Nor does the government give the corn system priority as an area for job creation or development. The simple fashion in which corn is currently consumed tends to limit the corn system's ability to provide new agricultural industry development. Similarly, studies of five crops in Indonesia indicate that corn production has a relatively low rate of labor absorption compared to rice, tobacco, peanuts, and soybeans (when off-farm soybean processing facilities are included).[12] In other words, the present corn system can do less to further government objectives in rural employment and agricultural industries than other systems.

Outlook

A study made by Indonesia University for the U.S. Department of Agriculture has sought to define the probable extent of Indonesian corn consumption and production in 1980 and 1985. The study is based on a host of assumptions regarding incomes, yields, government policy, climate, prices, improvements in infrastructure, and other factors. Its results are shown in Tables 5-20 and 5-21. The study predicts an internal consumption of about 2.6 million metric tons for 1985, over 90 percent of which will be for human food. While this internal consumption remains at approximately current levels, production will rise and enable Indonesia to export 1 to 1.5 million tons of corn by 1985. The projections are certainly arguable, but nonetheless they do put some dimension on the likely course of corn supply and demand in Indonesia. Participants in the system should consider these projections in making decisions about their own activities. Expanding foreign markets provide considerable opportunity for domestic corn producers if their own food needs can be satisfied and demand and production can be effectively coordinated.

CORN SYSTEM IN THE PHILIPPINES

The Philippine corn system has had more attention given to it than has the corn system in any other developing country in Southeast Asia. There have been

Table 5-20. 1972 Indonesian Corn Consumption and Projected Corn Consumption for Human and Animal Food in Indonesia, 1975-85

Year	*Per Capita Private Consumption Expenditures (rupiah 1972 prices)*	*Midyear Population (000s)*	*Human Corn Consumption (thousand metric tons)*		*Livestock Animal Consumption (thousand metric tons)*		*Total*	
			Low	*High*	*Low*	*High*	*Low*	*High*
1972	27,703	121,632	2,323	2,371				
1975	30,666	130,597	2,390	2,442	48	50	2,438	2,492
1980	35,817	145,631	2,478	2,537	82	90	2,560	2,627
1985	44,461	164,895	2,407	2,473	154	172	2,562	2,645

Note: 414 rupiahs = $1.00.

Source: Table III-2-12 in Indonesia University, *Supply of, Demand for, and Trade in Selected Agricultural Commodities; Indonesia: 1975, 1980, and 1985*, (prepared for the Economic Research Service, USDA, October 1975), p. 139.

Table 5-21. Projected Production, Local Consumption, and Corn Export Potentials in Indonesia, 1980-85 (thousand metric tons)

Item	*1980*		*1985*	
	Low	*High*	*Low*	*High*
Production	3,111	3,531	3,721	4,292
Estimates for seed	70	80	72	83
Available for consumption and export	3 041	3,451	3,649	4,209
Local consumption	2,560	2,627	2,562	2,645
Export potential				
Low production Low consumption	480		1087	
Low production High consumption	414		1004	
High production Low consumption	891		1647	
High production High consumption	824		1564	

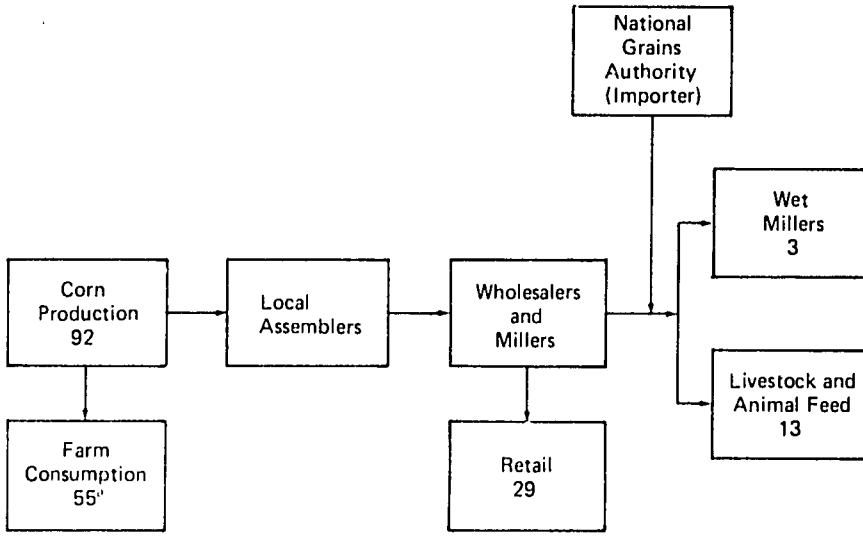
Source: Table III 2-18 in Indonesia University, *Supply of, Demand for, and Trade in Selected Agricultural Commodities; Indonesia: 1975, 1980, and 1985* (prepared for the Economic Research Service, USDA, October 1975), p. 144.

government price programs and incentives to increase production and investment at the farm and off-farm levels resulting in improved productivity and distribution gains. Yet in spite of these programs and incentives much remains to be done to improve the corn system of the Philippines.

Structure

The production and consumption of 3 million metric tons of corn in the Philippines is represented by the diagram in Figure 5-6. As in Indonesia, less than half of total farm production moves from the farm into various marketing channels because the grain is an important human staple in certain areas. About 90 percent of the corn produced in the Philippines is white corn, the type preferred for human consumption. The 55 percent of total corn supply remaining on the farm is mostly of this variety, and it is a major food source for the many small and subsistence farmers who grow it.

Most commercial corn farmers sell their grain immediately after harvesting; its collection, handling, and preparation are accomplished primarily by assemblers. Marketing of corn at farm level is done in the fields, by roadsides, or at the local buyers' and assemblers' warehouses. Fresh or dried corn on the cob is sold husked and unhusked by the basket or cartload. Husked corn on the cob is sold in kilos, or *cavans.*[13] Shelled and milled corn are both sold by the kilo or cavan, while green corn is sold by the ear. The farmers' lack of adequate storage and drying facilities and their need for immediate cash force them to sell their prod-



Note: Figures are percentages of total corn supply. Figures are adapted from data contained in SEARCA, *The Philippine Corn Commodity System* (n.p.), 1974, p. 114, which did not include imports.

[a]Includes seed and waste of 3 percent.

Figure 5-6. Flow of Grain in the Philippine Corn System

uce outright without any deliberate marketing strategy to take advantage of price movements.

Local assemblers and millers, retailers, and consumers buy corn on the farm. They provide the farmers with transportation, container, storage, handling, and oftentimes shelling facilities. These services help develop the good buyer-farmer relations that are so important at this very competitive level. Competition is so intense that most farm sales are made for cash. In fact, agent buyers, wholesalers, and millers often offer cash advances of as much as 20 percent or 25 percent of the estimated crop sales well before harvest time.

Wholesale buyers employ agents, subagents, country buyers, commission agents, and local wholesaler-millers to procure corn supplies. They often undertake the bulk of assembling, transporting, handling, and packaging of corn production for shipment to terminal markets and millers. Locally assembled grains are moved to the wholesale trading terminal centers from the farms with assemblers incurring all costs.

Feed millers use various methods of corn procurement. Figure 5-6 shows they depend heavily on imported supplies because of a domestic undersupply of yellow corn. To make foreign purchases, the millers must buy through the government's National Grains Authority, which regulates all aspects of the nation's grain business. In buying locally, millers must rely most heavily on

traders who are able to buy directly from farmers or from local assemblers and wholesalers at trading centers. Feed millers commonly send their agents to main trading centers in Mindanao and the Visayas during the corn harvest to purchase their quarterly requirements. Most feed millers carry stock for about three to four months to maintain direct control over spoilage, storage, and handling costs, and to ensure availability. Two of the larger millers recently set up permanent buying stations in Mindanao, the major corn-producing area. Wet millers are owned by trading firms and thus have assured access to whatever supplies are available for wet processing.

Retail distribution flows through both government-approved retailers and nonlicensed retailers. The former group gets its corn stocks from wholesaler-millers and processors designated by the National Grains Authority. Retailing in the local markets is handled by local millers and ordinary retailers. Farmers also retail their production in limited scale.

In major markets, corn is retailed in the form of corn grits, meal, and by-products that come from local millers, wholesaler-millers, local grit dealers, and also directly from farmers. Retailers sell directly to the final consumers and sometimes to other retailers in public markets. Corn retailers have been observed to be more predominant in the Visayan region because of a higher concentration of corn-eating Filipinos there.

The corn surpluses of Mindanao are shipped to Cebu and Manila, while corn coming from Leyte is channeled mainly to Cebu. In Luzon, corn from the north is transported to Pangasinan and Manila, and again the wholesalers absorb the costs of handling and transportation. Processed corn grits are often shipped back to Mindanao from Cebu for livestock feed and human consumption.

Cebu has become the main wholesale market for corn because of its shipping facilities and the prevalence of corn consumption in its general area. Furthermore, the city has good banking facilities and an adequate communication system to facilitate transactions and dissemination of demand and price information. Most shipping companies operate between the Visayas and Mindanao, and therefore they have their bases in Cebu City.

Corn wholesaling, not only in Cebu but throughout the Philippines, is dominated by a group of strategically located wholesaler-millers who perform a key role in the trade and pricing of corn.[14] Most businessmen engaged in the corn trade maintain agents in Cebu to keep track of ever-changing prices and market trends. These changes are promptly relayed to different shipping terminals in Mindanao, where about 50 percent of total Philippine corn production originates. The cities of Cebu, Davao, and Dadiangas in this region are the main transshipment points for corn being sent to the corn-deficit areas to the north. The flow of corn grain from the various production regions of the country is depicted in Figure 5-7.

More so even than in Indonesia, the corn industry of the Philippines is dependent on interisland shipping. But the Filipino shipping industry shares many of

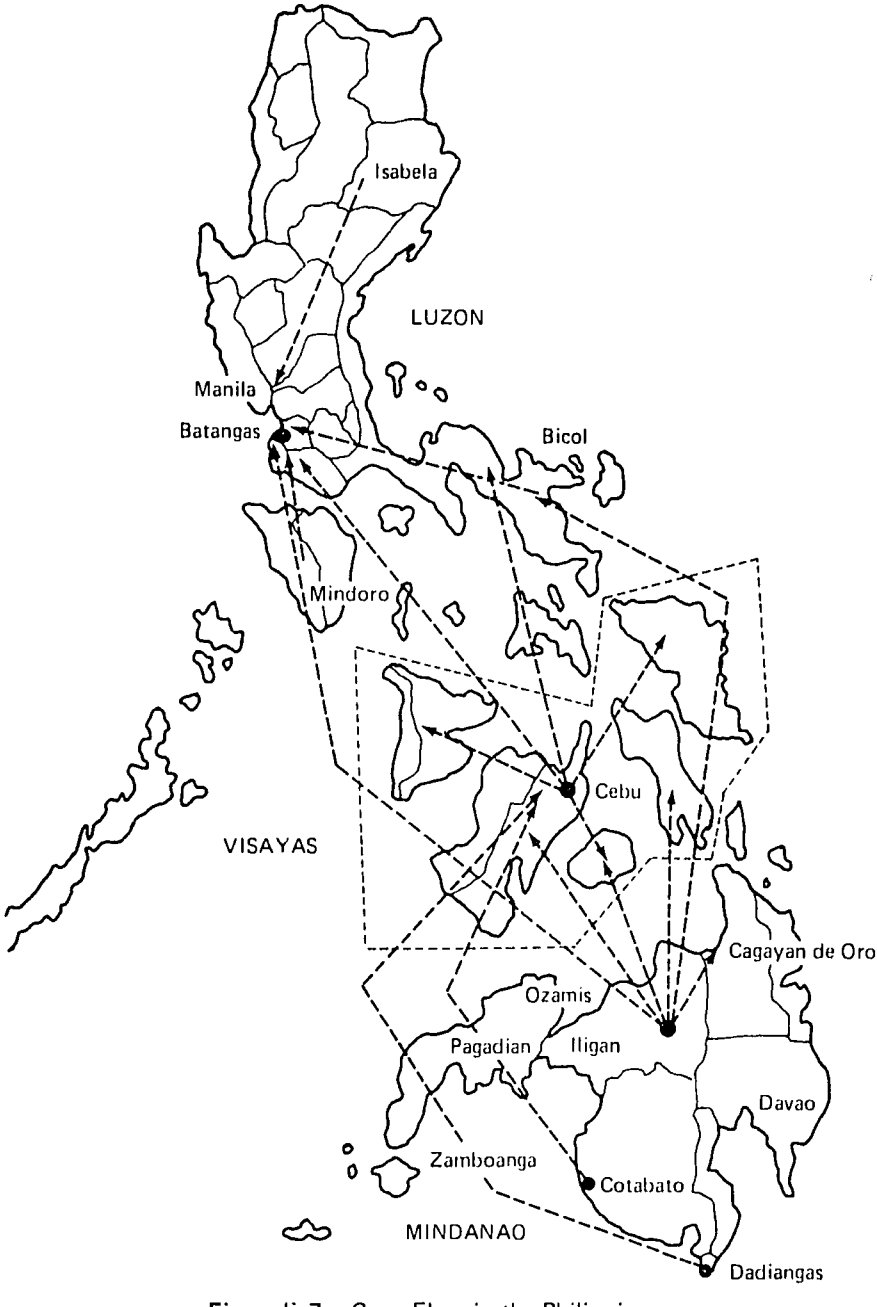


Figure 5-7. Corn Flow in the Philippines

Source: Hegino Ma. Orticio, *Marketing of Corn and Corn Products by Selected Provinces* (unpublished M.A. thesis), Department of Agricultural Economics, University of the Philippines, Los Banos, 1973. Reproduced with permission.

the problems of Indonesia's. The domestic merchant fleet is obsolescent: about 52 percent of its ships exceed twenty years of age, and 44 percent are over twenty-five years old.[15] Lacking a substantial shipbuilding industry, shipping lines must purcase new bottoms abroad. Yet the customs duties levied on ships purchased abroad are high, and so are taxes on spare parts. Ship owners claim these policies are serious disincentives to additional capital investment. Poorly developed harbors in most places other than Manila, Cebu, Iloilo, Davao, Zamboanga, and San Fernando cause very slow docking, unloading, and loading. Shipping companies thus charge very high rates for service to ports other than these six.

Land transportation is more developed in the Philippines than in Indonesia. In Luzon, relatively well-developed road networks traverse the main valleys and coastal regions. Cebu, Mindanao, and the Visayas all major corn-production or trading regions also have rather extensive road systems. Still, more feeder roads leading to villages and barrios would be desirable. The Pan-Philippine Highway links several of the larger islands by road.

Grain shipments on the Philippines' rather limited rail network are less than five thousand tons annually and corn shipments in particular have always been small. Important corn production, trading, and consumption areas are not linked by rail.

Estimates of the number of participants in this corn system can be based on several sources. Using the information of the National Economic and Development Authority, SEARCA estimates that the number of corn farmers in the Philippines increased from 378,000 in 1960 to over 514,000 in 1970. Over this period, it estimates the average corn farm grew from 2.5 to 2.9 hectares.

It is also difficult to determine the number of participants at the assembly level. Although grain traders are supposed to be licensed by the government, the many who are apparently able to operate informally make an accurate count difficult. The licensing enforcement and statistical collection of the National Grains Authority are improving, however. Table 5-22 gives some indication of the numbers of grain assemblers, traders, processors, and retailers. The majority of the wholesalers are located in the central and southern areas, and the majority of the retailers are in the larger urban centers of the Visayas and Luzon. Not all grain handlers and processors are corn dealers, however. Of the nearly sixteen thousand Philippine grain mills operating in 1974, 82 percent were rice mills; and of the 4,230 grain warehouses licensed in the Philippines in 1974, less than 4 percent were strictly for handling corn.[16]

The existence of a highly developed corn-processing industry distinguishes the corn economy of the Philippines from that of Thailand and Indonesia. As suggested by Figure 5-6, almost half the Philippine corn supply is processed to some extent for food, feed, or industrial products. The processing industry consists of food and industrial-product manufacturers (producers of grits, oil, starch, and various consumer products) and animal-feed manufacturers.

Table 5-22. Number of Grain Postharvest Businessmen Per Line of Activity and Facility, in the Grains Industry[a] in the Philippines, 1974 (private sector only)

	Businessmen	*Units*	*Capacity*[a]
Retailers	59,536	60,014	
Wholesalers	24,221	24,387	
Millers (mills)	14,610	15,884	950,808
Warehousemen (warehouse)	3,772	4,230	48,218,767
Corn shellers	859	866	106,679
Dryers	96	116	22,338
Transporters	3,287	3,488	346,242
Processors/manufacturers	641	677	
Exporting	2	0	
Importing	2	0	

[a]Daily milling capacity in bags of 50 kilos per twelve hours for mills. Storage capacity in bags of 50 kilos for warehouses. Shellers same as millers.

Sources: Grain Economics Division, National Grains Authority.

Table 5-23 lists the five wet millers who were processing in 1975. Three of these mills were constructed between 1958 and 1963; two more were added between 1968 and 1971. Wet millers prefer yellow to white corn for starch production, and due to the general domestic preference for white corn they have had to depend on imports for much of their raw materials. Because of this dependence, the low priority placed on domestic cornstarch production, and the government's desire to minimize corn imports, wet millers have found it difficult to maintain efficient operations. The five wet millers have a combined annual capacity of just over 160,000 metric tons of starch, but they often find themselves operating at about one-third capacity.

Of the eighty-six feed mills in the Philippines, seventy-one operate in Luzon, nine in the Visayas, and six in Mindanao. Members of the Philippine Association of Feed-millers, Inc. (PAFMI), number ten and account for 45 percent of industry capacity.[17] Integrated livestock operations and extensive distribution systems have enabled PAFMI members to obtain 56 percent of the livestock feed market. Annual industry production is approximately 1 million tons per year, of which three-quarters is poultry feed and the remainder is hog feed. Over 90 percent of PAFMI-member sales are concentrated in Luzon. The industry has been growing rapidly, its output increasing from 247,000 metric tons in 1965 to about 1 million tons in 1975. The industry's one-shift capacity of 831,000 metric tons per year suggests there is ample opportunity for continuing expansion of output. That companies in Luzon were operating on a two- or three-shift basis in 1975 indicates the existence of significant under-capacity in the rest of the Philippines.

Feed manufactures in Luzon compete with manufacturers in other islands.

Table 5-23. Major Corn Wet-Milling and Feed-Manufacturing Firms in the Philippines: 1975

Wet Milling		*Feed Milling*	
Firm	*Percent of Industry Starch Capacity (industry totals: 163,390 metric tons/year)*	*Firm*	*Percent of Industry Capacity (industry total capacity: 831,000 metric tons/year)*[a]
Universal Corn Products, Inc.	25	Champion Feed Mills	1.4
Lamsan Trading Company, Inc.	18	Far East Agricultural Supply	3.0
Philippine Trade Center, Inc.	18	General Milling Corporation	3.0
Philippine Corn Products, Inc.	27	Liberty Flour Mills	.5
General Milling Corporation	12	Philippine Feed Milling Company	1.8
		Republic Flour Mills Corporation	5.9
		San Miguel Poultry and Livestock Feed Plant	11.3
		Universal Robina Corporation	7.2
		Virginia, Incorporated	1.4
		Vitarich Corporation	9.0
		Seventy-six Other Firms	55.5
	100		100.0

[a]Based on eight-hour day, twenty-six-day month labor year.

Sources: Philippines Board of Investment. Center for Research and Communication, *Study of the Feed Milling Industry in the Philippines, 1975*, p. III-5.

For example, of the 85,580 bags of feed marketed in the northern Mindanao region around Cagayan de Oro City in 1975-76, 88 percent was "imported" from the mills of San Miguel, Vitarich, General Milling, and other manufacturers near Manila and in Cebu. The retail prices of such feed in Cagayan de Oro City were about 7 percent higher than those of feed produced in Cagayan's own two small mills.

This price difference seems to promise a considerable opportunity for increased feed production in Cagayan. Furthermore, a recent study by the Department of Agriculture of the Philippines indicates that only about 7 percent of the area's chicken population and less than 1 percent of its hogs were fed mixed feed in 1975-76. If such circumstances are common throughout the nation, the feed industry promises remarkable market potential.[18]

PAFMI members have integrated forward into poultry and hog production. They now account for most commercial poultry production, but hog production has been slower to develop into large-scale integrated operations. The one hundred to two hundred active commercial hog producers each have an annual output of about 6,000 to 10,000 head. Six or seven operators produce between 10,000 and 40,000 head per year. Two firms are considering operations that would each be capable of producing 500,000 hogs annually, but they are hesitant to undertake such projects given the inadequacy of local feedgrain supplies. Because of consumer preference for white corn and the competition for land suited to feedgrain production from other commercial crops, it is not certain that production can ever be great enough to ensure adequate supplies for such operations.

Behavior and Performance

As with most agribusiness commodity structures, the corn system in the Philippines is characterized by differences in consumption and production patterns. Consumption of corn products occurs year round. Corn production takes place year-round in various places too, but seasonal peaks occur between August and October (about 35 percent to 40 percent of the total annual crop) and between February and March (25 percent to 30 percent). Thus, various participants must store corn at different times and in different places.

Inventory Management. Because statistical collection by the National Grains Authority is improving, it is possible to estimate corn stocks in several positions within the system since 1974. Table 5-24 shows selected positions only; it does not represent the total estimated stocks reported in Table 5-11. Comparison of the two tables forces one to conclude that farmers hold a smaller percentage of corn inventories in the Philippines than in the United States, where they hold more than half the entire national inventory throughout the year. These tables dramatically indicate the weak bargaining position that most Philippine farmers are in at harvest time because they lack the capital and facilities to withhold

Table 5-24. Inventories of Corn in Selected Positions in the Philippines: 1971-76 (thousand metric tons in storage at beginning of crop year beginning July 1)[a]

Position	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*
Households				179.0	158.8	91.8
Farm	58.2	132.9	174.4	61.1	105.8	65.6
Nonfarm	n.a.	n.a.	n.a.	31.0	36.0	10.0
Urban	n.a.	n.a.	n.a.	85.9	17.0	16.2
Commercial warehouses	114.0[b]	14.0	45.9	20.8	66.3	47.8
National Grains Authority	n.a.	n.a.	78.3	36.3	48.6	4.3
Total shown				236.1	273.7	143.9

[a]Selected positions only. Does not equal total estimated stocks as shown in Table 5-11.
[b]Includes government-owned stocks.
Source: Statistics Division, National Grains Authority.

grain from market. A few more substantial producers do have bodegas or silos for storage, however.

Local assemblers and wholesaler-millers dominate the flow of commercially traded corn from producer to consumer. They own a large part of the warehouse space employed in grain storage, which in 1974 was about 2.4 million metric tons of sacked commodities.[19] This figure does not include the capacity owned by the government, which might add another 250 thousand metric tons. Existing information does not allow us to say with certainty how the corn stock of traders and wholesaler-millers varies through the year. It is known, however, that in Luzon corn production moves especially rapidly out of the storage-poor Cagayan Valley to the provinces of Nueva Ecija and Bulacan in Central Luzon, where warehouse space is greater. Corn is stored here until milled and transported to wholesalers in the greater Manila area. Thus, the graders and millers in this area play an essential inventory management role in relating production and consumption patterns.

Feed millers procure about 97 percent of their domestic purchases from assemblers and dry millers, and they buy the balance directly from producers. Bulk purchases from large grain wholesalers are the norm. It appears that the feed-milling industry maintains inventories of white and yellow corn grain averaging 255,000 metric tons throughout the year, and corn grit inventories of about 68,000 metric tons. Availability and price effect considerable variations around these means during the year.

Although the inventories maintained by industrial processors are not known, their procurement and inventory-management practices are probably similar to those of the feed millers. The warehousing facilities maintained by the five large starch manufacturers give them the capability to handle substantial inventories.

The implication of this brief summary of inventory management in the Philip-

pine corn sysetem is that assemblers and wholesaler-millers determine the flow of commercially traded corn. Their bargaining power is far greater than that of producers and industrial corn users because of their strategic position in the commodity system and the vital nature of the coordinating role they perform. Remember also that with an output of 9.2 million metric tons of grain, the nation's storage capacity of 2.4 million metric tons is very inadequate.

Prices. Retail corn and corn produce prices are set by a price control council. The corn procurement program managed by the National Grains Authority maintains throughout the system a corn pricing structure intended to stabilize prices for both producers and consumers. Under this program, the farm-gate price of shelled corn cannot be below the government support rate of 0.90 pesos per kilo.[20] If the corn is delivered by the farmer to the buyer, the farmer charges the buyer the cost of transporting the stocks over and above the minimum support price. Processed corn in the form of grits must not be sold above 1.47 peso per kilo to the retailer nor above 1.59 peso per kilo to the final consumer. From the margin between 0.90 peso per kilo and 1.08 peso per kilo the farmer must deduct his costs of transporting, packaging, and handling. Conversely, the middleman, agent buyer, and wholesaler who buys from the farm at 0.90 peso per kilo derives his profit margin between the support and ceiling price after deducting transport, collection, and handling costs.

Millers' and processors' margins are based on their ability to sell corn byproducts in addition to processed corn at 1.47 peso per kilo. At a 1.59 peso per kilo selling price to the consumer, the retailer usually earns a margin of 0.12 peso. Table 5-25 shows the price ceiling computation for white corn grits during 1976 as well as support prices since their establishment in 1972. The trend in support prices reflects the serious inflation with which the Philippines has been coping in the last decade.

Price Stability. It is interesting to compare the trend in corn prices in the Philippines to world (U.S.) prices. In Figure 5-8, note the relative stability in Philippine corn prices during the 1960s, which is comparable to the stability indicated for U.S. prices in Figure 4-1 of the last chapter. Philippine corn prices began a sharp increase in 1969 and 1970, a period of rapid inflation and devaluation of the peso, despite efforts to control them through the price stabilization program. This inflation coupled with the selling off of U.S. corn surpluses in 1972-73 helped to fuel price increases of corn throughout the world. The United States in essence reinforced the stabilization activities of other corn producing nations with its corn surpluses.

Profitability. It is difficult to obtain precise measures of profitability in the various levels of the Philippine corn industry. At the farm level, recently increased government support prices appear to provide an attractive incentive to

Table 5-25. Price Ceiling Computation for White Corn Grits, 1976, and Trend in Corn Price Supports (pesos)

	Cavan[a]	*Kilo*
Farm gate price	45.00	0.90
Wholesale price	54.00	1.08
Dry miller cost structure		
Cost including procurement	55.22	1.10
Equivalent cost at 65% milling recovery rate	84.95	1.70
Milling costs	3.50	.07
Credit from by-product sale	(21.90)	(0.44)
Selling expense	5.16	.10
Profit	2.00	.04
Price to retailer	73.71	1.47
Retailer cost structure		
Retail distribution expense	.99	.02
Retailer profit	5.00	.10
Cost to consumer	79.70	1.59
Corn Price Supports		
1972 November	20.00	0.40
1973 February	25.00	.50
1974 February	31.00	.62
1974 September	40.00	.80
1976 July	45.00	.90

[a]Sack of 50 kilos.

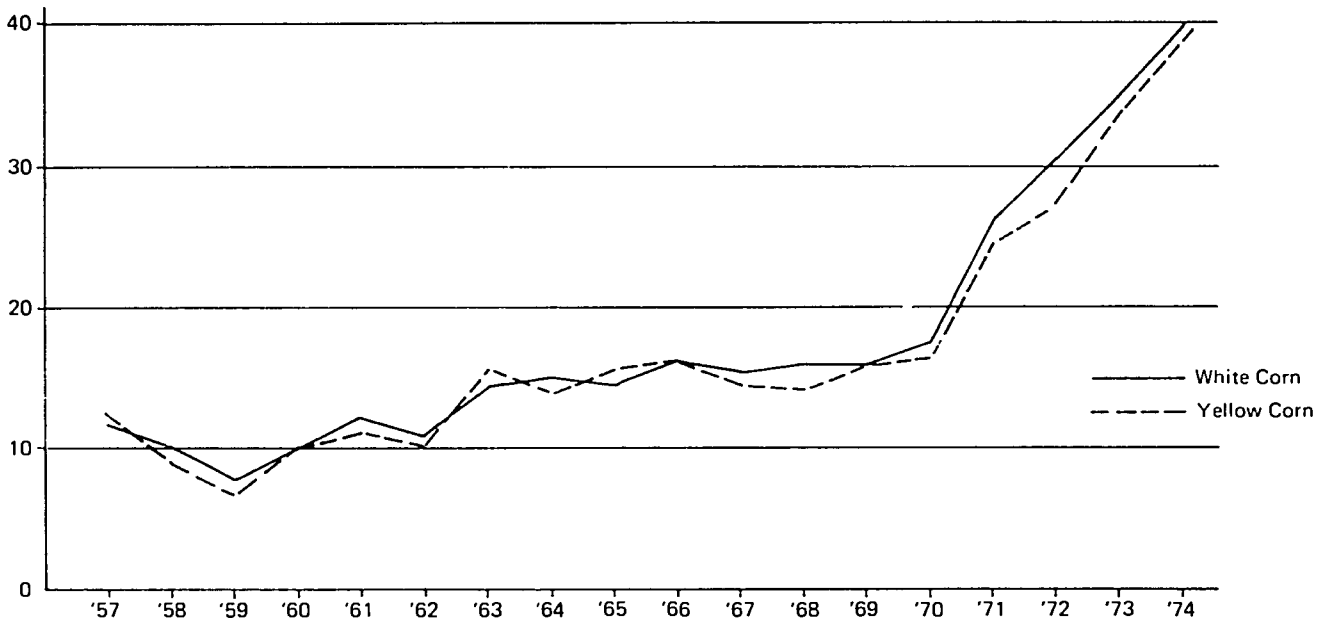
Note: One U.S. dollar equals 7.50 pesos.

Source: Statistics Division, National Grains Authority.

the producer, if corn yields are 30 cavans (1.5 metric tons) per hectare of better (see Table 5-26). The return to the farmer's own labor can be low or negative, however, as Table 5-27 shows. Note there that cash costs are less than 25 percent of total production costs per kilo, and that the support price adequately covers such costs. Nevertheless, low yields and large noncash costs make corn production unprofitable.

Of course, production costs and yields do vary among farmers. The Small-Scale Corn Farmer case in Appendix D represents the situation of a farmer for whom corn production is profitable in both cash and noncash terms. Although he is a small operator, however, the central figure in this case is atypical of small farmers in that he is a high-school graduate who makes ready use of technical and marketing support. The case graphically shows the need for the small farmer to be "tied in" to the commercial system for his operation to be economically successful.

Few wet-milling and feed-manufacturing operations are separate entities, and those that are separate are privately held. Dry milling is carried on by firms that are either small and privately held or larger and integrated across several grain-



Note: One U.S. dollar equals 7.50 pesos.

Source: SEARCA, *The Philippine Corn Commodity System* (n.p.), 1974, p. 193.

Figure 5-8. Average Price Trends of Corn in the Philippines: 1957-74 (pesos per cavan of 50 kilos)

Table 5-26. Cost of Production of Corn: 1976 (per hectare, per crop)

Item	*Man-days*	*Man- and animal-days*	*Amount*	*Cost and Return Analysis at 45 Pesos/ Bag Support Price*	*Cost and Return Analysis at 40 Pesos/ Bag Support Price*
I. *Labor*[a]				411.00	411.00
Land preparation:		18	180.00		
First plowing		6			
First harrowing		3			
Second plowing		5			
Second harrowing		3			
Furrowing		1			
Planting	4		28.00		
Basal application (fertilization)	2		14.00		
Cultivation					
First cultivation (off-baring)		3	36.00		
Second cultivation (hilling-up)		3	36.00		
Side dressing (fertilization)	2		14.00		
Spraying (two times)	3		21.00		
Harvesting, husking, drying, shelling, and hauling	10	1	82.00		
II. *Material inputs*				483.80	483.80
Seed			25.50[b]		
Fertilizer			308.30[c]		
Pesticides and chemicals			150.00		
III. *Fixed costs*				289.00	289.00
Depreciation			25.00		
Interest on loan			28.80[d]		
Land amortization			165.00[e]		
Samahang Nayon fees					
Barrio Guarantee Fund (1 cavan)			45.00		
Barrio Savings (5% of loan)			18.00		
Land tax (18.00 pesos/annum)			7.20		
Total cost per hectare				1,183.80	1,183.80
Yield per hectare in bags of 50 kilos				30	30
Cost per bag of 50 kilos				39.46	39.46
Gross income				1,350.00	1,200.00
Net income				166.20	16.20
ROI				14%	1.4%

[a]7.00 pesos per man-day; 12.00 pesos per man-animal day.

[b]17 kilos at 1.50 pesos/kilo.

[c]Two bags complete at 69.50 pesos each and two bags urea at 84.65 pesos each.

[d]4.8 percent of 600.00 pesos.

[e]Based on 10.29 cavans of 50 kils per annum valued at 40.00 pesos/cavan.

Note: One U.S. dollar equals 7.50 pesos.

Source: Philippine Department of Agriculture and Natural Resources.

Table 5-27. Expenses and Net Profit from Corn Production, Ilocos Region: 1976 (pesos)

Item	*Cost*
Cash	
Labor (hired)	18.95
Food (hired; exchange labor)	13.33
Seed	15.49
Animal rent	3.45
Interest on loan	17.07
Irrigation fee	16.84
Fuel	26.56
Fertilizer	191.63
Insecticide	46.49
Tax	7.38
Repair, delivery (hired)	9.26
Containers, pump rent	1.63
Subtotal, cash	368.08
Noncash	
Labor (operator, family, exchange)	475.09
Depreciation	30.85
Interest on investment	576.64
Seed	10.23
Landlord	111.07
Harvester	22.52
Subtotal, noncash	1,226.40
Total expenses per hectare	1,594.48
Average yield (kilos): 809.4	
Cost per kilo	
Cash	.455
Noncash	1.515
Total	1.970
Potential cash profit per kilo at 0.90 peso support rate:	0.455
Net profit per kilo including all costs:	-1.07

Note: One U.S. dollar equals 7.50 pesos.

Source: Costs and yields from Special Studies Division, Department of Agriculture, *Comparative Input, Output, and Financial Data for Palay, Corn, Mango, Virginia Tobacco and Cotton, Ilocos Region*, 1976, p. 26.

milling activities. Thus, informatin on the profitability of dry milling is difficult to obtain. A 1976 study by the Center for Research and Communication did indicate that profitability in the feed-milling industry had declined during the 1970s. The study of PAFMI-member companies showed that, between 1972 and 1975, poultry feed margins declined from 14.1 percent to 11 percent. When weighted according to the respective hog/poultry feed sales, these proportions suggest an average profit margin decline from 12.6 percent to 6.3 percent, a drop of about 50 percent. During that period operating costs increased at the annual rate of 18 percent to 19 percent, and the government allowed price increases of only about 15.5 percent.

Many of the pressures affecting corn system participants in the United States and Japan obviously also affected the Philippines, despite government efforts to control prices. The farm price of corn increased, but so too did input costs. Higher input and ingredient costs hurt all participants who could not immediately pass on their cost increases to consumers. Price increases for consumers had to come eventually to relieve some of the pressure on the operating margins of producers and processors.

Coordination in the Philippine Corn System

The Philippine corn system is more complex than those of Indonesia and Thailand. It employs a wide spectrum of coordinating devices, from traditional to innovative, from ineffective to highly effective. Many of these devices are common to other developing commodity systems.

Local Coordination. Some of the coordinating devices used at the local level in the Philippine corn system include financial institutions and arrangements, cooperatives, and vertical and contractual integration.

Trade Credit. Very closely related to the functioning of local corn markets in the Philippines (and, for that matter, throughout Southeast Asia) is the credit-extension process. In most rural parts of the Philippines the credit mechanism is the most important relation between producers and the rest of the commodity system. Most Thai and Filipino farmers, for instance, live on credit provided by middlemen, primarily local assemblers. They receive loans of food and other necessities to get through the growing season and to produce their crop. In return for these loans, producers deliver varying percentages of each year's crop. Effective interest rates on extensions of credit to producers may approximate 50 percent or 60 percent, and they are sometimes much higher. This system ties the producer to the merchant and assures prompt delivery of grain at harvest time.

Cooperatives. Cooperatives have developed to some extent in the Philippines, but they are still quite weak. Cooperative marketing associations for corn and other grains are relatively numerous, though many have failed. In 1974, SEARCA reported 726 cooperative associations engaged in the production and marketing of such crops as grains, tobacco, livestock, sugar, fruits and vegetables, onions, coffee, and peanuts. However, only 323 of these organizations were reported to be active, while the rest were nonoperational due to various operational and management problems. The majority of these nonoperational organizations (217, or 30 percent) dealt in rice and corn. One hundred eighty-five cooperatives with a membership of about 76,845 farmers were active in the rice and corn production and processing business. So although they are fairly numerous, cooperatives can hardly be said to represent a substantial portion of Filipino corn farmers.

Where they exist, farmers' cooperative marketing associations (FACOMAs) are usually composed of a minimum of 200 members with at least one share of stock each. Law requires that they begin with an authorized capitalization of not less than fifty-thousand pesos with at least 20 percent of the subscribed capital paid up. FACOMAs are organized and operated under their own articles of incorporation and by-laws, operated by their own elected officers and boards of directors, and registered with the government or Securities and Exchange Commission. They are supervised and governed by the policies of the Agricultural Credit Administration (ACA). Only one cooperative association can be organized or authorized to operate in a municipality. These cooperative institutions pursue four major fields of business activities:

1. warehousing
2. processing and milling
3. commodity procurement and merchandising from cooperative members and other organizations
4. marketing of commodities, involving handling, transport, packaging, and obtaining the best prices for the members production.

At the end of 1973, FACOMAs had warehousing space for 171,000 metric tons of grain and a total milling capacity of 670 tons per twelve-hour period.[21]

Vertical Integration. Although the extent of this form of commodity-system coordination within Southeast Asian nations cannot be quantified, it is known to exist to a significant degree in the Philippines. There, as noted earlier, major grain millers have integrated forward into poultry and hog production. One operator, Liberty Flour Mills, Inc., is fully integrated from feed manufacture through meat packaging and distribution by virtue of its Maya Farms subsidiary.[22] The San Miguel Corporation is vertically integrated in a wide range of commodity systems. In fact, of all Southeast Asian nations, corn-system coordination by means of vertical integration is most advanced in the Philippines. It exists to a lesser degree in Thailand and to only a slight degree in Indonesia.

Contractual Integration. As firms in the corn-processing industry (especially feed manufacturing and wet milling) attempt to maintain stable operations in an environment of unstable yellow corn supplies, contractual integration has become a common coordinating device in the Philippines. The development of such arrangements has been further stimulated by General Order 47, which requires that businesses of any significant size take steps to produce or procure the rice and/or corn requirements of their employees, either domestically or in the world market. Firms must distribute this grain to their employees as part of their wages, or else sell it to them at a price no higher than the government-mandated retail price ceiling. To comply with this order, businesses in all industries have sought contractual arrangements to procure corn. Even so, contractual

procurement arrangements probably account for less than 5 percent of the movement of the Philippine corn crop.

National Coordination. The major coordinating device in the Philippine corn system at the national level is the government, with trade associations also playing an important role.

Government Activities. Due to the importance of corn as a staple food in the Philippines, the government has undertaken numerous activities that directly affect the corn system. We have already discussed the system of price controls; here we will review several of the government institutions that play important coordinating roles.

In addition to its operation of the price-control system, the National Grains Authority (NGA) also attempts to:

1. upgrade and develop existing grain facilities and encourage the development of new facilities
2. develop more responsible and effective manpower in the grain industry
3. coordinate the activities of the various components of the industry
4. promote local and foreign investments
5. adopt other measures as may be necessary for the integrated growth and development of the industry.

In grain procurement , private traders, millers, and warehousemen are encouraged to participate as NGA-accredited agents. Also, agreements between NGA and lending institutions are worked out to enable farmers, through NGA funding, to pay their obligations to the latter in kind. In addition, in areas where procurement operations by private traders are inadequate, NGA buys directly. Knowing that large grain losses that contribute to the yearly cereal shortage are caused by improper handling and processing, NGA is launching a program to rehabilitate, upgrade, and further develop grain-processing facilities.

The Philippine government has mounted a variety of other programs for agricultural development since the end of World War II, including projects for:

1. production and productivity
2. development of agricultural credit and marketing systems
3. land reform, including social development
4. infrastructural development
5. effective program implementation.

In spite of the past emphasis on agriculture, major roadblocks to national economic development persist. Among them are the uneven distribution of land, high tenancy rates, low farm productivity and income, untapped foreign markets for agricultural products, and rapid forest denudation.

To resolve these problems, the recent four-year (1974-77) development plan for agriculture established the following major objectives:

1. acceleration of land transfer and distribution
2. self-sufficiency in food and food products
3. expansion of agricultural exports and production of import-substitute crops
4. conservation and development of forest resources.

The acceleration of land transfer and distribution ranks high in the national development plan for agriculture. This major objective is embodied in Presidential Decree No. 77, which provides for the gradual transfer of rice and corn lands to tenants. The tenant farmer is deemed owner of a family-size farm of 5 hectares if it is not irrigated, and of 3 hectares if it is irrigated. The landowner may retain an area of not more than 7 hectares if he is or will soon be cultivating it.

The granting of land titles to the tenant farmer is subject to his membership in a duly recognized farmer's cooperative. Landowners, on the other hand, have been assured just compensation by requiring cooperatives to pay amortizations on the value of the land. The government guarantees such amortizations with bonds and shares of stock in government-owned and government-controlled corporations.

Land-transfer activities are being undertaken by the Bureau of Lands. In such operations, the bureau identifies tenant farmers, farm holdings, and landowners; collects production data on the lands involved for the last three years; parcel-maps with the aid of aerial photographs; determines land values; and issues land-transfer certificates. The land-distribution program is emphasized particularly in Mindanao, where social disorders are partly caused by land disputes.

In pursuit of food self-sufficiency, the government emphasizes grain production. Government programs[23] attempt integrated action to:

1. expand irrigated areas
2. encourage farmers to employ technological inputs and modern production practices
3. enlarge the supply of credit available to small farmers and supervise them in its use
4. maintain price support at levels sufficient to encourage greater production
5. assure producers of markets for their grain
6. develop higher yielding seed varieties and distribute them to producers.

Credit and farm management technicians are being employed in the massive, sustained educational campaign ("Masaganang Maisan") to bring modern technologies to the farmers. Since many small farmers in the country lack the financial resources for the "HYV technology," rural banks, Philippine National Bank, Agricultural Credit Administration, and other credit institutions offer credit

support. All loans from these institutions are administered on a supervised basi by extension agents of the Department of Agriculture.

The price-support and marketing arrangements are implemented through ar rangements between the NGA and authorized farmer-producers cooperatives o private warehousemen-millers. In areas where the private sector may not be per forming efficiently in procurement, the NGA supports prices to the producer a official levels.

Limited quantities of high-yielding seed varieties and their high price bese the production of white corn and feedgrains. Desiring to improve seed process ing centers, the government has launched an intensive campaign to produ e high-quality foundation seeds. The seeds are made available to seed cooperative who produce certified seeds for the farmers. In addition, government assistance in seed processing and storage is being extended.

Specific goals and target growth rates have been set for grain production. The target annual growth rates for white corn and feedgrains are as follows: white corn, 1.8 percent; yellow corn, 1.1 percent; sorghum, 32.9 percent; and soybeans, 20.9 percent. Table 5-28 shows the production targets and total requirements for rice, corn, sorghum, and soybeans from 1974 through 1977.

In the production of pork, poultry, and table eggs, the country has attained near self-sufficiency. Accordingly, the goal from 1974-77 is primarily to meet

Table 5-28. Production Targets and Total Requirements for Rice, Corn, Sorghum, and Soybeans: Fiscal Years 1974-77

Item	*1974*	*1975*	*1976*	*1977*
Rough rice (in million cavans)				
Production	130.6	139.9	148.5	159.7
Requirement	134.4	147.9	152.5	157.2
Surplus (deficit)	(12.8)	(8.0)	(4.0)	(2.5)
Corn and sorghum (in thousand cavans of 50 kilograms each)				
Production	40,202	41,454	42,922	44,388
White corn	35,136	35,916	36,674	37,134
Yellow corn	4,400	4,730	5,420	5,700
Sorghum	952	1,155	1,440	2,200
Requirement	39,108	40,032	40,968	41,931
Surplus (deficit)	84	1,422	1,954	2,457
Soybeans (in thousand metric tons)				
Production	8	24	42	64
Requirement	364	397	445	493
Surplus (deficit)	(356)	(373)	(403)	(429)

Source: Four Year Development Plan FY 1974-77, National Economic and Development Authority, Manila, 1973.

domestic requirements for beef and "carabeef."[24] The specific annual growth targets in production for livestock and poultry products are: pork, 8 percent; beef, 6 percent; carabeef, 6.9 percent; poultry, 8.2 percent; and eggs, 7.3 percent.

In beef and carabeef production, the emphasis is on forage improvement, feedlot operations, and upgrading native herds by artificial insemination. Several leguminous grasses for cattle and carabao recommended for pasture improvement are now being multiplied at the Bureau of Animal Industry for distribution to interested ranchers. Meanwhile, feedlot operations have been programmed for the provinces of Tarlac, Pampanga, Zambales,Bataan, Batangas, Laguna, Panay, Negros Oriental, and Negros Occidental. The latter operation will use sugar by-products for feed purposes.

Poultry and swine producers will continue to receive some encouragement from the government, although perhaps not as much as other sectors; this sector is, after all, relatively well-organized even now. The government plans the following support services to the poultry and livestock industries:

1. improvement of veterinary services
2. training of more artificial insemination technicians
3. farmers' training on improved poultry and livestock management
4. provision of liberal credit to livestock and poultry raisers
5. improvement of the marketing system.

A loan of $14.5 million, secured from the World Bank in 1972, finances integrated coconut/beef cattle farms, hill beef cattle breeding ranches, pig breeding/fattening farms, and poultry/broiler and egg farms. In line with Presidential Decree No. 7, which prescribes the orderly marketing of livestock and animal products, auction markets are being established in various towns and provinces. The auction markets are expected to feed into the meat processing, wholesaling, and retailing operations in the metropolitan Manila market.

The Masaganang Maisan program is an example of the comprehensive approach to agricultural development followed by the Philippine government. A large-scale white corn and feedgrain program, Masaganang Maisan's main objectives are:

1. satisfaction of increasing demand for human consumption of white corn
2. production of sufficient yellow corn, sorghum, and soybeans to satisfy the feed requirements of the poultry and livestock industries
3. production of corn for export in the form of starch and other by-products
4. establishment of joint feedgrain projects with foreign investors.

The program is modeled after Masagana 99, an earlier government effort to increase rice production by providing farmers with production technology, inputs, supervised credit, and marketing arrangements.

Table 5-29. Masaganang Maisan Corn and Feedgrain Program—Financing Targets: 1974-75

Commodity	*Target Area (hectares)*	*Financing Target (hectares)*	*Loan Rate (pesos per hectare)*	*Amount Needed (pesos)*
White corn	500,000	300,000	500	150,000,000
Yellow corn	200,000	150,000	500	75,000,000
Sorghum	30,000	30,000	500	15,000,000
Soybeans	20,000	20,000	650	13,000,000
Total	750,000	500,000		253,000,000

Note: One U.S. dollar equals 7.50 pesos
Source: National Food and Agricultural Council.

To achieve the objectives of Masaganang Maisan, credit is made available to farmer-participants so they may purchase a recommended mix of high-yielding seed varieties, fertilizers, insecticides, and herbicides. Some government banks give priority to the credit requirements of farmers participating in the program. Other government agencies and banks train and assign extension workers to supervise the farmers and help them market their produce. The marketing scheme involves price supports for corn established and maintained jointly by the National Grains Authority, rural banks, Philippines National Bank, Agricultural Credit Administration, and farmers' cooperatives.

The National Food and Agricultural Council, which oversees the program, has set ambitious goals for its corn and feedgrain program. It aims to increase yields from 17 to 35 cavans per hectare. To do so, it is seeking to bring 70,000 hectares of land already committed to corn production under modern production methods. Cultivation of sorghum and soybeans on this land is also encouraged. This extensive and ambitious project is of great interest because it affects 25 percent of the nation's corn hectarage, forty-one of its seventy provinces, and about 230,000 farmers, many of whom operate at the subsistence level outside the money economy.

Significant amounts of credit are required to provide subsistence farmers with working capital. Table 5-29 shows that, even by limiting credit to 500 pesos per hectare, the total financing required reaches an estimated 253 million pesos. The Philippine National Bank, the government-owned commercial bank, provides over one half of this financing; rural banks provide most of the remainder.

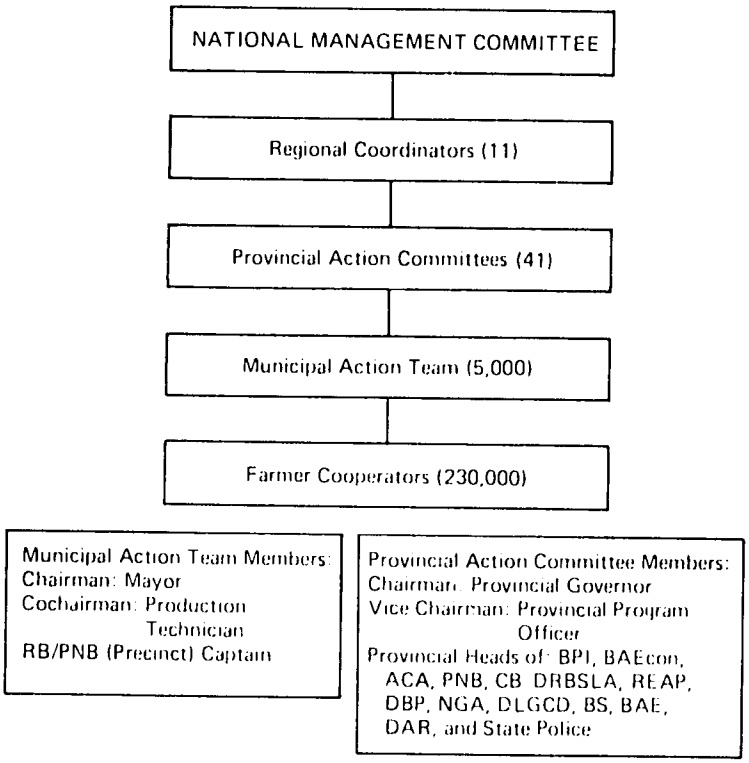
Responsibility for implementing the Maisan program is vested in a National Management Committee under the National Food and Agriculture Council (NFAC). The Secretary of Agriculture and/or the NFAC Executive Director chair regular policy council meetings in which representatives of the following organizations participate:

- Bureau of Plant Industries (BPI)
- Bureau of Agricultural Extensions (BAE)
- Central Bank–Department of Rural Banks and Savings and Loan Associations (CB-DRBSLA)
- Philippine National Bank (PNB)
- Agricultural Credit Administration (ACA)
- Development Bank of the Philippines (DBP)
- Rural Bank Association of the Philippines (RBAP)
- National Grains Administration (NGA)
- Philippine Association of Feed Millers, Inc. (PAFMI)
- U.S. Agency for International Development (USAID)
- Agricultural Pesticide Institute of the Philippines (APIP)
- Fertilizer Industry Authority (FIA)
- Department of Local Government Land Community Development (DLGCD)
- Bureau of Cooperatives
- Bureau of Soils (B.S.)
- Bureau of Agricultural Economics (BAEcon)
- Central Bank–Land Bank (CB-LB)
- Department of Agrarian Reform (DAR)
- University of the Philippines at Los Banos College of Agriculture (UPLB-CA)
- National Media Production Center (NMPC)
- Rural Broadcasters' Council (RBC)
- representatives from the private sector.

At local levels, the National Management Committee operates through the regional coordinators, provincial action committees, and municipal action teams charted in Figure 5-9. The National Food and Agricultural Council case in Appendix E includes a fuller description of the Masaganang Maisan program and its experience. The case demonstrates that even when government uses a conducted systems approach to help small corn producers improve their operations, the implementation of the program is at least as important as the plan it is based on.

Other government programs also encourage development of the corn system. The Investment Incentives Act, enacted in September of 1967, prescribes the government's incentives and guarantees to domestic and foreign enterprises in preferred investment areas. The Export Incentives Act gives export-oriented firms additional inducements. Both laws were revised by Presidential Decree No. 92, which liberalized regulations on foreign investments in certain activities. The Board of Investments (BOI) annually prepares an Investment Priorities Plan (IPP), which enumerates the agricultural, mining, and manufacturing activities to be accorded preferred status.

Corn production has been listed in the Sixth IPP as a preferred nonpioneer investment area with a targeted additional capacity of 358,000 metric tons of



Source: National Food and Agricultural Council.

Figure 5-9. Organizational Structure for Implementation of Masaganang Maisan

corn for domestic consumption. Presidential Decree No. 194 has opened corn production to foreign investment.

The incentives provided by the government for BOI-registered enterprises engaged in corn production are the following:

1. deduction of organizational and preoperational expenses from taxable income over a period of not more than ten years from start of the operation
2. deduction from taxable income of labor-training expenses equivalent to 1.2 percent of expenses but not more than 10 percent of direct labor wages
3. accelerated depreciation
4. carryover, as deductions from taxable income, of net operating losses incurred in any of the first ten years immediately following the year of such losses
5. exemption from tariff duties and compensating taxes on imported machinery, equipment, and spare parts

6. tax credit equivalent to 100 percent of the value of compensating taxes and customs duties that would have been paid on machinery, equipment, and spare parts purchased from a domestic manufacturer had those items been imported
7. tax credit for tax withheld on interest payments on foreign loans, provided that such credit is not enjoyed by the lender-remittee in his country and that a registered enterprise has assumed liability for the tax payment
8. the right to employ foreign nationals in supervisory, technical, and advisory positions within five years of registration
9. in the year of reinvestment deduction from taxable income of a percentage of the amount of undistributed profits or surplus transferred to capital stock for procurement of machinery, equipment, or other expansion
10. antidumping protection
11. protection from government competition
12. tax credits equivalent to sales, compensating and specific taxes and duties on supplies, raw materials, and semimanufactured products used in the manufacture, processing, or production of export products
13. additional deductions from taxable income of direct labor costs and the cost of local raw materials used to manufacture export products
14. preference in the awarding of government loans.

Clearly, the Philippine Government is deeply involved in all levels of the corn system in the Philippines. More so than in either Indonesia or Thailand, it directly influences the environment in which participants in the corn sysem operate.

Trade Associations. Trade Associations are more significant coordinators in the Philippines than in the other countries of Southeast Asia. In the Philippines, trade associations at all levels of the corn commodity system permit participants to confer on common problems and to communicate coherently with each other and with government. There are organizations of producers, input suppliers, assemblers, millers, traders, wholesalers, and retailers. The organizations of traders and of millers are especially tight-knit, reinforced as they often are by ties of kinship among their members.[25] Of the various participants in the corn commodity system, the producers are probably the most fragmented group and least represented by effective trade associations.

Regional Coordination and Outlook

Government and industry have taken few steps to relate the Philippine corn system to those of surrounding nations- unlike Thailand, and to a lesser extent, Indonesia. Rather, the Philippine system is to some degree insulated from others in the region as a result of its price-control policies. The government places a high priority on price stability for both farmer and consumer; it does

not allow the rather large variations in price that characterize the Indonesian system. How long this stability will be considered desirable remains to be seen. As long as the Philippines remains barely self-sufficient in white corn and an importer of yellow corn, the policy will probably shield Filipino farmers and consumers from vagaries in the world market. Should production-expansion programs result in surpluses, though, government and industry will probably turn their attention to developing markets in the region.

In 1976, the Secretary of Agriculture mentioned the potential for such developments. He stated:

> The Philippines has been self-sufficient in white corn for the past three years . . . . By the year 2000, assuming we continue increasing productivity, 600,000 hectares of the 1.6 million hectares now planted to white corn should have been shifted to yellow corn, sorghum, and soybeans . . . .
>
> The livestock industry's feedgrain requirements are growing very rapidly at 11 percent to 12 percent per year. Moving part of the present rice and white corn hectarages into feedgrains will enable the country to reach self-sufficiency at least in corn and sorghum within the next five years. Continued increases, threafter, will hopefully make us a major exporter of yellow corn and sorghum to Japan, Taiwan, and Korea, even before the year 2000.[26]

In line with this objective, consideration is currently being given to diverting 30 percent of the Philippines' 513,000-hectare sugar area to feedgrain production. The increasing availability of downy mildew-resistant synthetic (DMR-1 and DMR-3) and hybrid seed varieties, and the nation's near self-sufficiency in corn are encouraging government and industry to consider regional marketing opportunities seriously.

THE CORN SYSTEM IN THAILAND

The corn industry in Thailand is simpler than the systems of Indonesia and the Philippines because human consumption of corn is minimal. Most corn follows well-defined channels to the export market, although a smaller and rapidly growing share goes to the feed-milling industry. The Thai corn industry is especially interesting, however, because the Thai government has set out to develop it as an exporter and foreign-exchange earner. Other governments and foreign private concerns have assisted it in this effort. The Thai system provides an excellent example of the opportunities for and difficulties in relating developed and developing agribusiness.

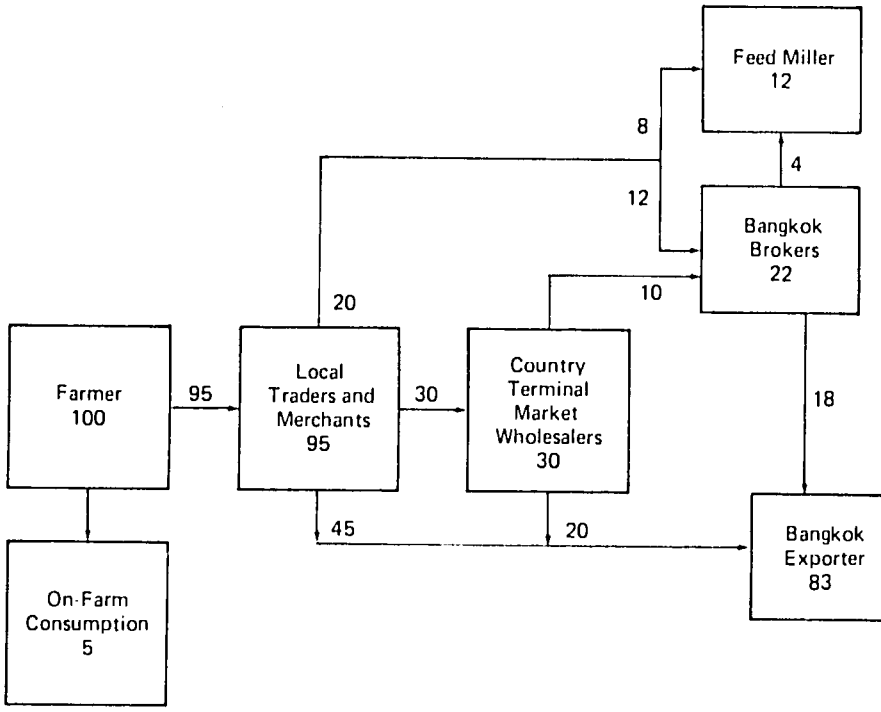
Structure

The flow of 2.5 million metric tons of corn from producer to market is shown in Figure 5-10. An extremely high percentage of all corn produced in

Thailand moves into commercial channels, and essentially all of it is the yellow variety suited to export. Very little of Thailand's corn is intended for domestic human consumption.

The primary purchasers of farmers' corn in the rural markets are local merchants. They account for 75 percent of farm sales, although they may be involved in several other lines of business. Local grain wholesalers purchase the other 20 percent of the corn leaving the farm, plus about a fifth of the amount originally obtained by local merchants. Commission agents also operate to some extent in rural markets by locating, purchasing, and assembling grain of a desired quality within the price range established by their employers (usually Bangkok exporters). An agent receives a commission on the value of corn purchased, so he can offer growers and rural merchants a higher price if he reduces his own commission. At the local level, farm cooperatives handled only about 2 percent of total production in 1975-76.[27]

After rural assembly, corn flows to Bangkok either directly or through upcountry terminal markets at Tha Rua, Lopburi, and other locations. Accord-



Note: Figures are percents. Diagram adapted from one appearing in SEARCA, *The Thailand Corn Commodity System* (n.p.), 1974, p. 79. Figures have been altered from the original to reflect recent changes that have occurred in flow of corn to feed millers and exporters.

Figure 5-10. Distribution Channels in the Thai Corn System

ing to sources in the grain trade, about 70 percent of the corn reaching Bangkok arrives by truck directly from producing areas; about 25 percent passes through Tha Rua and arrives in Bangkok by barge; and the remainder passes through Lopburi and other smaller country terminals.

The importance of the country terminal markets appears to have declined in recent years. Tha Rua is important because of its proximity to the main corn-growing areas and its ability to ship grain barges 100 kilometers south to Bangkok. In 1971, it was estimated that as much as 40 percent to 60 percent of all exported corn passed through Tha Rua. This figure has declined, however, as Bangkok buyers have "reached back" to production areas for more reliable and coordinated sources of supply.

Bangkok is the terminal market for corn. Its wholesale merchants buy from—and sometimes extend credit to—rural merchants, assembly merchants, commission agents, and brokers of both rural and central markets. Using their large warehouses, the wholesalers employ brokers to assemble the large quantities of corn they accumulate and sell them to exporters and feed millers. The brokers receive a commission for their services. Exporters buy most of their corn from Bangkok merchants and brokers, although many of them send representatives to buy corn at rural growers' markets and at various assembly central markets. Some of these large exporters own huge modern storage facilities.

The Agricultural Cooperative Federation of Thailand, Ltd. (ACFT), is an exporter of corn in the Bangkok terminal market. It purchases corn from local agricultural cooperatives that are members of ACFT, from local and country terminal wholesalers, and from Bangkok brokers. When ACFT was established, its organizers (primarily government agencies) believed that it would improve the corn marketing system by providing farmers a direct way of moving their grain through local cooperatives to exporters. ACFT has been slow to develop, however, due to management and financial difficulties and very strong competition from private traders and merchants. As seen in the Zen-Noh case of Chapter 2 and as further discussed below, ACFT is strongly supported by the Japanese cooperative movement.

The flow of corn through this sytem is heaviest during and immediately following the harvest periods of October/December and February/March. Because about 70 percent of all farmers lack storage facilities on the farm, they must sell their corn, still on the cob, immediately after harvest without any chance of taking advantage of price movements.

Industry sources reveal that the storage facilities owned by farmers and rural assemblers have increased in number and capacity, especially since 1971, when thrice-daily broadcasts of Chicago corn futures prices began. Rural assemblers and some farmers have learned to predict changes in the Bangkok price as a result of Chicago price movements and to profit from them. The quantity of corn held up-country by farmers and middlemen has increased so much over the last few years that Bangkok traders are experiencing increasing difficulty in

obtaining corn at prices and in volumes to allow them to fulfill export commitments later in the season. In 1976, and again in 1977, Bangkok traders failed to meet export commitments in January and February because of the withholding tactics of grain traders outside Bangkok.

The coordination of the Thai corn industry has been facilitated by an extensive and well-maintained national highway system linking rural growers' markets, assembly central markets, and the terminal market at Bangkok. Especially important is a highway linking Bangkok and the current corn-producing regions; it is estimated that this highway has reduced the marketing cost of corn by 20 percent.[28] New roads and the concentration of corn production in central and northeastern Thailand have made the grain's movement from rural market to terminal market much easier and cheaper than in Indonesia and the Philippines. At the farm areas, however, corn transportation to rural markets can still be inconvenient, slow, and costly due to the inefficient feeder road system that permits only carts, small tractors, and trucks to pass. In the wet season especially, only bullock carts or tractors with trailers can haul grain to the main road. This time-consuming task is made more costly by the transfer of corn from the farmer's conveyance to the trader's truck.

The growth of the Thai corn industry is reflected in changes in the numbers, size, and types of enterprises making up the system. At each decisionmaking point shown in Figure 5-10, the number of operators increases with the volume of corn passing through that point. Expansion is especially impressive at the production level. The area committed to corn production increased from 36,000 hectares in 1950 to about 1.1 million hectares in 1974. The number of producers rose from about 12,000 in 1950 to about 400,000 in 1976.[29] According to sources at Kasetsart University, the size of the average farm has also increased: from 4.5 hectares in 1959 to 6.8 hectares in 1973. Smaller farmers have been increasing the size of their operations by acquiring additional pieces of land, and Table 5-30 shows how this trend has affected the distribution of farm size. At the other end of the system, exporters have also increased in number. Although figures for the entire 1950-75 period are lacking, Table 5-31 shows a definitely

Table 5-30. Percentage Distribution of Corn Farm Size, Thailand: 1959 and 1973

Farm Size	*1959*	*1973*
Under 4 hectares	61	29
Under 4-8 hectares	26	36
Under 9-12 hectares	8	20
Over 12 hectares	5	15
	100	100

Source: Faculty of Economics and Business Administration, Kasetsart University.

growing group of exporters since 1970. Most of this growth has been amon smaller firms as a result of the government's export quota system, which is di: cussed below.

The ownership of terminal storage capacity, however, is highly concentratec Table 5-32 shows that five firms own port facilities with a total capacity o 458,000 metric tons. Export firms not owning their own silo facilities use gc downs, lease silo capacity, or sell their export quotas and handle no grain at all

Table 5-31. Number of Corn Exporting Firms in Bangkok by Group Size 1969/1970-1974/1975

Annual Corn Exports (metric tons)	*1969-70*	*1970-71*	*1971-72*	*1972-73*	*1973-74*	*1974-7*
under 1,000	12	8	9	22	30	59
1,000-5,000	29	48	16	48	14	15
5,000-10,000	17	22	42	28	38	58
10,000-15,000	7	8	20	8	25	22
15,000-20,000	9	7	10	9	14	10
20,000-30,000	3	6	5	6	7	9
30,000-40,000	4	4	6	5	9	6
40,000-50,000	3	2	5	1	2	2
50,000-100,000	9	10	9	–	6	5
100,000-over	1	1	1	–	1	1
Total	94	116	123	127	146	187

Source: Chaiwat Konjing, *Thailand's Maize Export Agreement Policy: An Economic Analysis*, University of Minnesota, Department of Agriculture and Applied Economics, Economic Report 76-8, November 1976, p. 88.

Table 5-32. Capacity and Ownership of Port Terminal Facilities in Thailand: 1975

	Capacity (metric tons)		
Company	*Silo*	*Warehouse*	*Total*
Bangkok Drying and Silo Company, Ltd.	33,850	9,000	42,850
Laem Thong Silo Corporation	50,200	110,000	160,200
United Silo Corporation	36,200	90,000	126,200
Agricultural Cooperative Federation of Thailand	31,550	25,000	56,550
Goldenland Drying and Silo Company	17,800	55,000	72,800
Total	169,600	289,000	458,600

Source: Overseas Merchandise Inspection Company, Ltd., *Maize Situation in Thailand*, June 1976.

Silo capacity in Bangkok approximately doubled between 1972 and 1976. Up to the early 1970s, silo capacity had been inadequate to handle peak-season corn shipments to Japan and Taiwan,[30] but this situation no longer exists.

The feed-milling industry in Thailand has been growing very rapidly. Table 5-6 estimated Thailand's 1975 consumption of corn for feed at 350,000 metric tons. Industry estimates place the figure for 1976 at 500,000 metric tons, and for 1977 at 700,000 metric tons. Similarly, output of mixed feeds has grown rapidly from 58,000 tons in 1965, to 174,000 tons in 1970, to 459,000 tons in 1975.[31] Growth slowed in the face of high ingredient costs during the mid-1970s, but it is expected to resume again.

In the late 1960s the Thai Board of Investment began granting investment promotion privileges to new feed-milling firms. Subsequently, ten new firms joined the thirty-five firms then operating. Fifteen larger millers are now operating in addition to thirty smaller firms, and Table 5-33 compares their capacity in 1974. The opportunity for feed millers is indicated by comparing the potential demand for livestock feed in 1976 of 3 million metric tons with the esti-

Table 5-33. Major Thai Feed Manufacturers: 1974

Firm	*Capacity (metric tons)*	*Percentage*
Firms Having Board of Investment Promotional Privileges		
Beta Company, Ltd.	57,600	6.1
Australian Siam Agricultural Development Association, Ltd.	45,360	4.8
Ayudhya Distiller Feed Company, Ltd.	10,000	1.1
Bangkok Feedmill Company, Ltd.	145,000	15.4
Ralston Purina Thailand	38,000	4.0
Central Food Manufacturers	38,400	4.1
Betagro Company, Ltd.	96,000	10.2
Laem Thong Saithorn	120,000	12.7
Thai-Japan Industries Company, Ltd.	60,000	6.4
P. Patamawat Company, Ltd.	15,000	1.6
Subtotal	625,360	66.4
Firms not Having Board of Investment Promotional Privileges		
Charoen Pokphand Feedmill Company, Ltd.	120,000	12.7
Sri Thai Livestock Company	54,000	5.7
Inter Industrial Trade Company, Ltd.	38,350	4.1
Lampang Asia Livestock Company, Ltd.	12,000	1.3
P. Charoenphand Company, Ltd.	20,000	2.1
Subtotal	244,350	25.9
30 small producers	72,000	7.7
Grand total	941,710	100.0

Source: Bangkok Bank, *Monthly Review* (Thai), Vol. 5, May 1976, p. 292. Reproduced with permission.

mated actual output in that year of 811,500 tons. Industry capacity is expected to increase from its 1974 level of 942,000 metric tons to 1.14 million in 1978.[32] A livestock feed market of 3 million metric tons would require approximately 2 million tons of corn annually. Thus, importers of Thai corn might eventually find themselves competing with Thailand's feed millers for the nation's corn.

Determination of the number and size of all the participants in the Thai corn industry is difficult. The 1975 *Thai Industrial Directory* lists twenty producers of agricultural chemicals, five seed suppliers, and six producers of agricultural machinery. Formal estimates of the number of traders, merchants, and wholesalers operating in rural and central markets are lacking, but industry sources place the figure at about twenty-one hundred. One industry source, in fact, asserts that the biggest change in industry structure in the last ten years has been the tripling or quadrupling of middlemen. According to this source, practically every shopkeeper stores a few bags of corn.

Behavior and Performance

The Thailand corn system is a very competitive one tied to the world markets through the U.S. Chicago Board of Trade quotations. The competitive and sophisticated nature of the system is set forth below in an analysis of the inventory management, price stability, and profitability of the various segments of the corn industry.

Inventory Management. As market information becomes widespread, rural merchants and larger farmers grow increasingly sophisticated in its use, and their greater tendency to store corn has lessened the primacy of Bangkok traders and exporters in managing Thailand's supply. Large shares of Thailand's corn crop are increasingly likely to be held up-country until their owners consider prices satisfactory or until they are forced to sell for need of cash or to make room for a new crop. With continued heavy demand from Japan and Taiwan and rapid growth in Thailand's feed-milling industry, this trend should result in increased rural income, although farmers may not be the beneficiaries.

Prices and Price Stability. During the 1960s, relatively stable Thai corn prices reflected the stability in world markets induced by abundant surplus stocks held in the United States. Table 5-34 shows that Thai prices continued to follow world prices when, beginning in 1972, they rose over 200 percent in two years. Prices at the wholesale and farm level also escalated during this period. In fact, a comparison of farm and wholesale prices in 1972 and 1974 suggests that wholesalers had to reduce their 1974 margins just to purchase from farmers. Note, too, the negative margin earned by exporters who, in 1972, were caught with fixed-price export commitments late in the calendar year—just as world corn prices began their dramatic ascent.

It is also interesting to compare the exporter's margin over the farm price

Table 5-34. Export Prices, Wholesale Prices, and Farm Price of Corn in Thailand: 1960-75 (baht per ton)

Year	*Export Price*[a]	*Wholesale Price*[b] *(Bangkok)*	*Farm Price*[c]
1960	1,070	1,010	n.a.
1961	1,052	1,108	n.a.
1962	1,066	989	n.a.
1963	1,177	1,027	n.a.
1964	1,210	1,042	n.a.
1965	1,208	1,203	n.a.
1966	1,250	1,125	n.a.
1967	1,249	1,165	970
1968	1,057	971	710
1969	1,144	1,105	760
1970	1,360	1,230	840
1971	1,220	1,189	700
1972	1,131	1,160	860
1973	2,142	1,785	1,350
1974	2,641	2,558	2,060
1975	2,711	2,482	1,850

[a]Bank of Thailand *Monthly Bulletin*, January 1977, p. 74.
[b]Bank of Thailand *Monthly Bulletin*, January 1977, p. 97.
[c]Faculty of Economics and Business Administration, Kasetsart University.
Note: One U.S. dollar equals 20.8 baht.

with those elsewhere. From 1960 to 1975, the average margin over the farm price in Thailand averaged just under 50 percent. In Indonesia, this margin approached 100 percent, and in the United States, about 10 percent.

Profitability. Indicators of the profitability of only certain participants in the Thai corn system are available. For instance, we know that corn was a profitable crop for farmers during 1975, when prices were high (see Table 5-35). But we have little information about the profitability for traders and middlemen. An interview conducted early in 1977 found that the prevailing farm price was 1.66 baht per kilo, while the Bangkok wholesale price was 1.83 to 1.92 baht per kilo. With a spread of 0.17 to 0.26 baht per kilo, and with estimated per-kilo costs of 0.13 to 0.17 baht, at least some traders and middlemen are operating on relatively narrow margins.[33] The same source reported that exporters normally hope to earn a net profit of about 0.05 baht per kilo, which results in a net profit margin of about 2.5 percent.

Data regarding the profitability of feed manufacturing are just as fragmentary. Because new firms have made the industry much more competitive in recent years, profit margins may very well have narrowed. Early in 1977, a major feed miller reported that production costs had steadily increased from 75 percent of market prices in 1974 to 85 percent in 1977. This development also suggests pressure on profits.

Table 5-35. Profitability of Corn Production Using Traditional Methods, Pakchong and Maug Lek Provinces: 1975 (baht per hectare)

Item	*Maug Lek*	*Pakchong*
Fixed costs		
Rent	593.75	587.5
Tax	12.50	12.5
Depreciation	17.00	17.0
Subtotal	623.25	617.0
Variable costs		
Planting	498.06	495.63
Caring	266.56	386.75
Harvesting	263.13	185.81
Shelling	134.69	122.19
Transport	102.69	67.25
Interest on capital	95.88	94.88
Subtotal	1,361.01	1,352.51
Total cost/hectare	1,984.26	1,969.51
Yield (kilogram/hectare)	2,416.88	2,238.25
Cost/kilo	.82	.88
Price (baht/kilo)	2.21	1.98
Net profit per kilo	1.39	1.10
Net profit per hectare	3,359.46	2,462.08

Note: One U.S. dollar equals 20.8 baht.

Source: Phaitoon Hathamart and Chamnien Boonma, "Economics of Corn," Research Report #20, Department of Agricultural Economics, Kasetsart University.

Coordination in the Thai Corn System

Many of the same coordinating devices used in the Philippine and Indonesian corn systems appear in Thailand's, though with different degrees of prominence. The government's influence, for example, is much less pervasive than in the Philippines, but stronger than in Indonesia. Cooperatives, although still weak, appear to be becoming increasingly effective coordinators of the farm and export segments of the system. The features that most distinguish the Thai system from those of Indonesia and the Philippines, however, are contracting and its orientation towards exports.

Local Coordination. The coordinating institutions and arrangements at the local level in Thailand are similar to those in the Philippines and include financial arrangements, cooperatives, and vertical and contractual integration.

Credit. As in the Philippines and Indonesia, trader credit is one of the chief means of involving the farmer in the system. Of the estimated 1.4 million baht in credit outstanding to Thai farmers from all sources in 1970, institutional sources (commercial banks and the Bank for Agriculture and Agricultural Cooperatives)

supplied only 10 to 15 percent of their total needs.[34] Middlemen apparently supplied most of the remainder and charged annual interest rates in excess of 50 percent. Although this rate may be justified by the riskiness of the middleman's business, it is still an onerous burden on the farmer. Government credit programs, agricultural banks, and cooperative societies have sought to make more attractive short-term loans available. These efforts may be having some effect. Using Ministry of Agriculture data, the Faculty of Economics and Business Administration at Kasetsart University estimates that in 1976 middlemen provided only about 57 percent of the credit outstanding to farmers. Commercial banks increased their share to 29 percent, while relatives and others provided 14 percent.

Cooperatives. Cooperatives are still quite weak in Thailand, but they appear to be enlarging their participation in the corn system. With some financial assistance from the Japanese National Federation of Agricultural Cooperatives (Zen-Noh), the Agricultural Cooperative Federation encourages local cooperatives to buy more corn from farmers and ship it directly to ACFT rather than through middlemen. In the 1976-77 season, 77 of the federation's 459 cooperatives shipped it some corn. Also, ACFT is embarking—again with the cooperation of Zen-Noh—on a 1 million dollar corn-improvement and production-expansion program. In July 1976, anticipating an increasing volume of corn exports from local cooperatives, ACFT purchased a port terminal export facility in Bangkok with a capacity of 56,000 metric tons. The federation now accounts for about 5 percent of Thai corn exports. It briefly produced livestock feed during the late 1960s, but procurement, operating, and competitive problems forced the operation's shutdown.

Presently, ACFT is an embryonic force in the Thai corn system. With continued backing from the government and from Zen-Noh, it may well evolve into a major coordinating element.

Vertical Integration. Although its full extent is unknown, this means of relating activity at several levels of a commodity system is just beginning to develop in Thailand. In addition to ACFT's effort to coordinate farm purchasing and exporting, one of Thailand's major feed millers, Charoen Pokphand, has integrated forward into poultry production. At least one major Bangkok exporter, Continental Overseas Corporation, owns grain storage facilities at Thailand's largest up-country terminal market in Tha Rua.

Contracting. The formal requirements of the Thai-Japanese corn agreement suggest that contractual integration is fairly common. The credit relation between Bangkok and up-country traders are almost certainly paralleled by other methods of contractual coordination. The rapidly developing feed-milling industry has undoubtedly devised innovative arrangements for relating its opera-

tions to changes elsewhere in the system. As the Thai system is studied more thoroughly, these arrangements will become clearer and their effectiveness will be easier to measure.

National Coordination: Government Programs. Since 1950, the government has managed a crop-improvement program aimed at increasing the output of corn and other crops. Program participants have tested several local corn varieties with impressive results. 'Tiquisate Golden Flint," also known as "Guatemala Variety," was multiplied at agricultural experiment stations during the 1952 growing season and distributed to farmers in 1953. By the early 1960s, 60 percent to 80 percent of the nation's corn was of this variety. Higher yielding varieties have been introduced more recently, and they now account for 34 percent of the corn planted. Five percent of Thailand's farmers already use a mildew-resistant variety released in 1974.

In 1961 the government instituted the Coordinated Corn Improvement Program to direct all corn research. In 1965 the Thailand National Corn and Soybean Research and Training Program was initiated with the participation of Kasetsart University, the Ministry of Agriculture, and the Rockefeller Foundation. This program's experimental farm released the seccessful mildew-resistant variety (DMR-4 or Thai Composite) mentioned above.

In 1972 the government set up the Accelerating Maize Production and Marketing Program. The program defined ambitious production and export targets for 1972-76: annual production increases of 9.6 percent and 10.8 percent increases in exports. It also encouraged increases in domestic consumption. Although unfavorable weather prevented meeting these production and export targets, domestic consumption targets were achieved. Realizing that areas planted to corn cannot expand much more, the program's strategy is to increase yields by improving seed varieties (i.e., Prabuddabat #5), soil fertility, fertilizer varieties (DMR-4) and production, and conservation practices. It coordinates its efforts with those of the Department of Agriculture and the Ministry of Economic Affairs to ensure market, price, and credit incentives to producers.

In 1974, the Department of Public Welfare began package programs to promote corn production in eight depressed rural areas. The integrated programs provide assistance in production planning, marketing, and credit services. Farmers are provided production loans through agricultural cooperatives to purchase seeds, fertilizer, and pesticides. The cooperatives later buy all the farmers' corn and market it through the Cooperative Marketing and Purchasing Federation.

With the establishment of the bank of Agriculture and Agricultural Cooperatives, the Thai Government has become involved in agricultural credit. This agency provides farm credit both directly and also by requiring commercial banks to allocate a portion of their loan portfolio to farm credit. Both sources extend credit primarily to larger farmers, though some smaller farmers are said to be forming groups of local cooperatives to apply for loans. Interest rates on these loans are currently about 10 percent.

To develop market access for unorganized farmers, the Thai government established the Marketing Organization for Farmers (MOF) in 1974 with 1-billion-baht capitalization ($50 million). The organization pursues five objectives:

1. to establish markets for agricultural commodities
2. to promote direct sales by farmers
3. to act as input supplier to small farmers
4. to trade, transport, and store agricultural commodities
5. to represent government, ministries, and departments in the procurement of agricultural products.

Although MOF emphasizes these activities on behalf of Thailand's numerous small farmers, it does not operate in connection with ACFT, which accomplishes similar activities for member cooperatives.

Regional Coordination. At the regional level the coordination of the Thailand corn system is most dependent on a variety of contractual arrangements between exporters and import feed manufacturers as well as cooperative-to-cooperative agreements and other types of joint ventures.

Contractual Arrangements. Probably the most significant coordinating device, and the one that happens also to be the primary corn-pricing mechanism for all of Southeast Asia, is the Japan-Thailand Agreement on Maize Trade. The agreement grew out of the Thai government's effort to impose some order on its rapidly growing maize trade. During the 1950s, many small, new firms, eager to establish themselves in the export trade, were in the habit of signing export contracts and only then trying to buy the corn to fill them. If the harvest was smaller than anticipated, or if it moved through the marketing chain to Bangkok more slowly than expected, the Bangkok price would rise above that at which those exporters had made their contracts. Many of them would break their contracts rather than absorb a loss. Conversely, when Bangkok prices were lower than anticipated, exporters with corn but without contracts would offer foreign buyers prices so low that they were encouraged to break contracts. These conditions made purchase of corn from Thai exporters risky and confusing.

Despite new regulations, the lack of information on up-country supplies and the irregularityof shipments to Bangkok continued to cause disruptions. So, in 1962, the Thai Department of Foreign Trade undertook to arrange in advance monthly export quantities for its largest customer (Japan). Simultaneously, it introduced a quota system for other countries in hopes of smoothing the flow of corn through the system. This arrangement evolved into the agreement that now exists, and which is described in Appendix B to Chapter 3.

In 1976 and again in 1977, up-country traders held substantial quantities of corn off the market as the September-March trading season advanced, causing sharp increases in domestic prices. Consequently in both years, the Thai government chose to terminate the contract to prevent widespread bankruptcy among exporters.

Table 5-36. Domestic Use of Corn in Thailand 1977 and Estimate for 1982

Corn Use	*1977*	*1982*
	(thousands of metric tons)	
Compound Feed	450	1,150
Direct Feeding to animals by farmers	460	600
Seed	60	90
Direct Human Consumption	30	60
Industrial Use	0	100
Total	1,000	2,000

Source: SEARCA.

Increasing difficulties of this nature have prompted appeals that the Thai government relax its restrictions on the corn trade. On the other hand, these difficulties may lead the government to review the possibility of creating a Thai trading company monopoly similar to the market boards in other countries and to the wheat pools in Canada. The control of export volumes clearly was an advantage in the smaller, disorganized market of the 1960s, but the quota system now appears to work to the advantage of less experienced and smaller exporters and to the disadvantage of larger or more aggressive firms. The quotas have therefore been criticized for hindering the development of new markets for Thai corn and hampering normal evolution in the number, size, and behavior of exporting firms.

Nevertheless, the benefits of the agreement for Thailand have been remarkable, and they deserve review here. A recent industry assessment[35] highlights the Japanese contribution to the Thai corn system. The agreement encourages storage construction by producer and middleman groups who realize that storage space will allow them to hold back on deliveries and force prices higher. Their higher profits rapidly cover their construction and holding costs. As a result, storage space for corn in the corn-producing areas of Thailand has increased 45 percent since 1961, and a government agency is planning to build more silos in those areas.

In addition, Japanese firms are helping to develop the feed industry, which is already the major domestic market for corn. Their help takes several forms, such as: capital participation as minor shareholders in Thai feed firms, technical assistance in formulation and quality control, and purchase of broilers of acceptable quality. It is estimated that Thailand now exports about 400 metric tons of frozen broilers to Japan monthly. Production of compound feed has increased remarkably from 109,000 metric tons in 1970 to 334,000 tons in 1975. Estimates for 1977 reach an amazing 750,000 tons.

Domestic corn consumption, estimated in November 1977 at one million metric tons, will undoubtedly expand as the local feed industry booms. Trading firms estimate it may expand to two million metric tons by 1982 (see Table 5-36). If this prediction comes true, the export agreement with Japan will actually have lessened the Thai corn system's dependence on the export market.

Cooperative-to-Cooperative Arrangements. In addition to the previously described support that Zen-Noh provides ACFT, the two cooperatives conclude a purchase and sale agreement under the terms of the Thai-Japan Agreement on Maize Trade. Whenever it has firm contract for export, ACFT is exempted from the quota restrictions BOT imposes on private exporting firms. Consequently, as Table 5-37 shows, its annual contract with Zen-Noh has allowed ACFT to increase its share of corn exports to Japan from nothing in the 1960s to about 13 percent in 1975 and 1976.

Still another relation between Zen-Noh and ACFT is the TJC Chemical Company, Ltd., a joint corporation in which ACFT holds a 51 percent interest. The company's purpose is to formulate, manufacture, and distribute agricultural chemicals and sprayers throughout the country through cooperatives and commercial distributors.

Joint Ventures. Several Thai and Japanese firms are involved in joint ventures with regional implications, such as Charoen Pokphand's feed-milling venture in Indonesia. Zen-Noh, Mitsui, Mitsubishi, and local partners jointly own the Bangkok Drying and Silo Co., Ltd. The local partners own 65 percent, Zen-Noh owns 15 percent, and the other two firms divide the rest.

A recently concluded arrangement of particular interest is the Sin-Thai Grain Company, Ltd., established by the primary Industries Enterprise (PTE) Ltd. of Singapore and Thailand's Marketing Organization for Farmers (MOF). Sin-Thai's initial transaction will be the shipment of 60,000 tons of corn from Thailand to Singapore in 1977. In subsequent years, this quantity is expected to increase to 300,000 tons annually. Sin-Thai will also act as a supplier of Thai rice, vegetables, cattle, and fruit to Singapore, and of Singapore's chemicals, agricultural equipment, and tools to Thailand.

SUMMARY: PROBLEMS AND OPPORTUNITIES IN SOUTHEAST ASIA'S CORN SYSTEM

In Chapter 4 we examined the corn system of the United States to show how each functional level responds to events in the world corn system. This chapter has shown how the lack of coordinating and risk-management institutions and arrangements has made it more difficult for the corn systems of Indonesia and the Philippines to adjust to major changes at the regional, national, and global levels. Thailand's corn industry has been more responsive to commercial pressures because corn is not an important food crop and because an established grain export market structure existed before corn became a major crop.

Figure 5-11 depicts the structure of the Southeast Asian corn system in its world context, represented by the major trading relationship between the United States and Japan. The corn system of each of the Southeast Asian nations could produce food for local consumption as well as a residual for export if certain internal problems were overcome. The commodity system approach employed in

Table 5-37. Significance of Zen-Noh/ACFT Trade within the Thai-Japan Agreement on Maize Trade: 1965-1976 (metric tons, years ending June 30)

		Japan-Thai Agreement on Maize Trade		*Zen-Noh/ACFT Contract*				
Year	*Total Thai Production*	*Target Quantity*	*Actually Exported to Japan*	*Target*	*Actually Exported by ACFT*	*Collected by ACFT from Local Thai Cooperatives*	*Unicoop's Purchases*	*Total Zen-Noh Purchases (including Unicoop)*
1965	1,021,300	800,000	755,269	30,000	41,543	6,950	57,565	254,965
1966	1,122,400	760,000	760,933	50,000	50,539	12,872	61,590	262,600
1967	1,314,900	720,000	617,440	60,000	32,103	14,846	67,720	226,630
1968	1,507,500	780,000	432,891	70,000	28,324	6,361	51,815	170,295
1969	1,700,000	600,000	548,513	60,000	51,000	15,375	62,620	209,640
1970	1,938,200	720,000	846,557	60,000	61,747	27,714	94,070	326,170
1971	2,300,000	1,000,000	932,255	80,000	85,445	71,136	102,385	382,100
1972	1,315,000	1,000,000	370,120	100,000	47,672	23,944	41,600	151,200
1973	2,300,000	1,000,000	876,538	100,000	97,869	65,787	101,080	363,780
1974	2,550,000	1,200,000	781,444	120,000	99,337	88,470	100,960	333,060
1975	3,000,000	1,100,000	942,309	130,000	123,274	95,635	128,990	392,170
1976	2,700,000	850,000	840,000	110,000	83,200	56,471		252,000

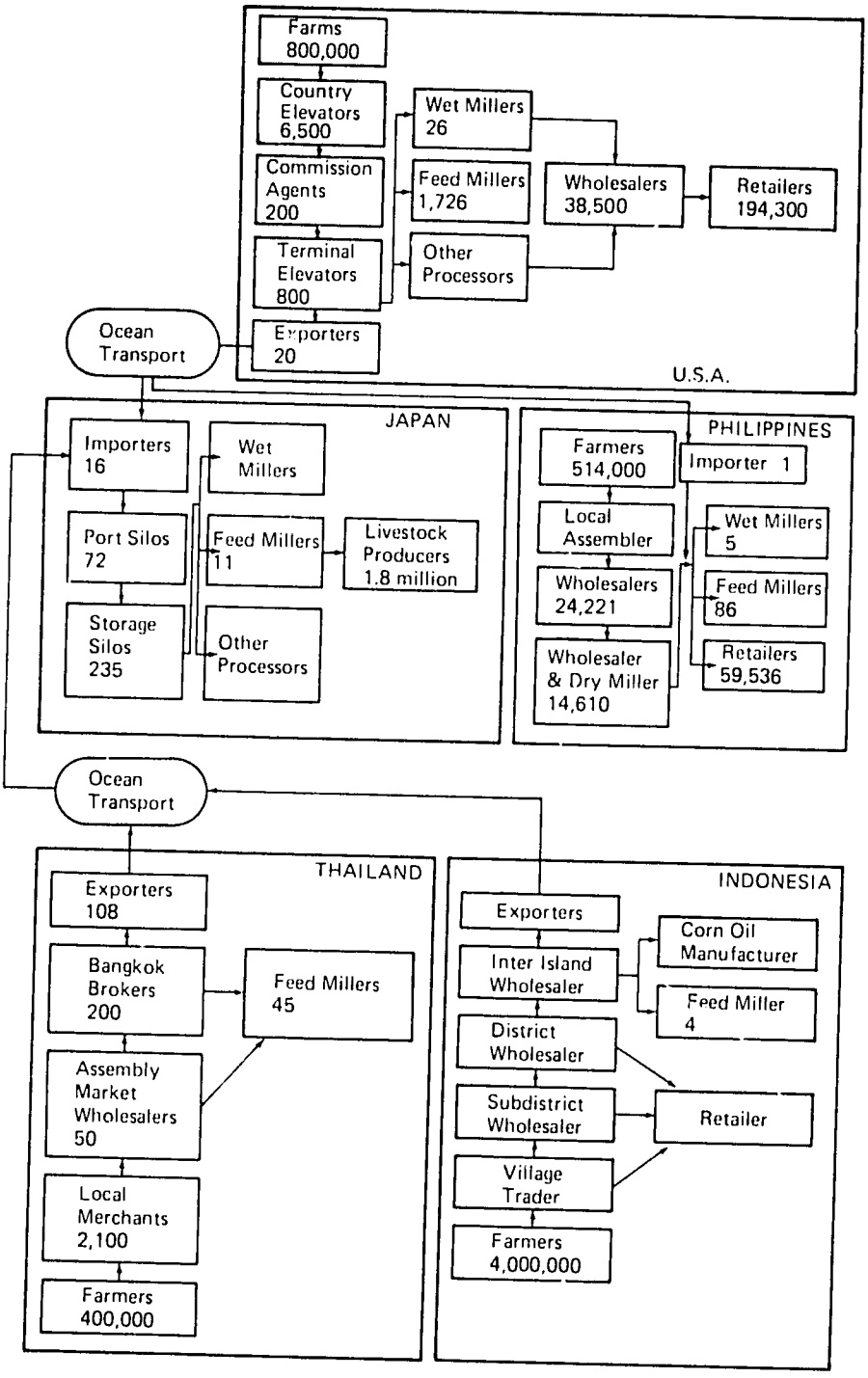
Source: Unicoop Japan, Bangkok office.

Table 5-38. Major Problems in the Corn System of Southeast Asia

Production	*Indonesia*	*Philippines*	*Thailand*
Credit	X	X	X
Delivery of HYV technology	X	X	X
Direct market access	X	X	X
Lack of market information	X	X	
Land tenure	X	X	X
Unstable prices	X		X
Lack of on-farm storage	X	X	X
Assembly/Wholesale			
Excessive fragmentation	X	X	X
Inadequate storage capacity	X	X	X
Inefficient grain handling facilities	X	X	X
Lack of industry information	X		X
Grades and standards	X	X	
Usurious lending practices	X	X	X
Processing (feed milling and wet milling)			
Unstable/inadequate supply	X	X	X
Unstable costs and prices	X		X
Excess capacity	X	X	
Transportation			
Inadequate road network	X		
High cost	X		
Inoperative/unreliable transport equipment	X	X	
Slow	X	X	
Export			
Lack of recognized regional pricing mechanism	X	X	X
Lack of sizable exportable surplus		X	
Small and inefficient harbor and port terminal facilities	X	X	
Public Policy			
Lack of clearly articulated policy for corn system	X		
Inadequate production incentives	X	X	

Source: Based on SEARCA data.

this study permits identification of these problems at each of the five main stages in the corn system, and Table 5-38 summarizes these problems by country and stage. This summary does not list all of the problems identified by commodity systems analysis in this chapter, but it does identify those major gaps in coordination and risk-management that clearly hamper the performance of these corn systems. Nevertheless, the list is long, for it reflects the size of the regional corn system and the variety of economic and social pressures affecting it. The table makes it clear that the systems of Indonesia, the Philippines, and Thailand have many problems in common. For example, timely and widespread availability of an appropriate package of farm inputs and credit is still a problem in each country, despite government programs designed to encourage the adoption



Sources: USDA and (SEARCA) Southeast Asian Regional Center for Graduate Study and Research in Agriculture.

of modern production technology. Common problems also exist in assembly/wholesaling, processing, transportation, and export. The most common problem of all, however, is the lack of coordination between production and domestic and export markets. All three nations need managers for the firms and institutions that control these areas.

The relative importance of the problems in Table 5-38 is difficult to define. In a sense all are critical because weakness in one part of the system inhibits the proper operation of others. Still we can identify several problems as relatively central. For example, marketing costs at the wholesale level add about 20 percent to the farm price of corn in the Philippines, about 50 percent in Thailand, but only about 10 percent in the United States. At the same time, wholesaler profits in the first three countries are not excessive. Apparently transportation and storage operations are very costly, and substantial shrinkage of handled grain occurs. Despite low production costs in Indonesia, high costs for transportation, handling, and ocean freight, plus a variety of export taxes and quality problems make Indonesian corn less competitive with U.S. and Thai corn in the Japanese market. Feed millers in both Indonesia and the Philippines have difficulty obtaining adequate supplies of corn despite substantial local production. Finally, more important demands on the national budgets of these countries prevent allocation of sufficient resources to statistical collection and analysis of the corn business. In summary, distribution is a key bottleneck in the corn system—but it also leads to lack of incentive feedback from the user to the producer and the need for some institution to do a more effective job of coordinating the corn system in a way that attracts human and agricultural resources to it.

These problems cannot be solved without strengthened relations between small farmers and commercial participants in the domestic corn systems and between national and international markets.

NOTES

1. An excellent study on the importance of price differences between various sources of protein-calorie intake is "The Impact of Indonesian Price Policy on the Distribution of Protein-Calorie Intake by Income Class and Commodity." Unpublished paper by C. Peter Timmer, Professor of Economics of Food and Agriculture, Harvard School of Public Health, 13 February 1978.

2. See Table 2-18 in Chapter 2.

3. The dimensions of this obstacle to the adoption of modern production methods are difficult to define. Accurate data on land ownership in Southeast Asia are not available, and distribution of land in operating units is a very poor indicator of the problem's scope. One means of overcoming this problem, however, is highlighted in the *Amul Dairy* case discussed in the next chapter. Al-

Figure 5-11. Major Participants in the Southeast Asian Corn System: 1974-75

though that dairy is not in Southeast Asia proper, the case's approach might be effective here.

4. This discussion is based on "The Indonesian Corn Commodity System," an unpublished manuscript written under the direction of SEARCA, and on "Outlook for the Indonesian Maize Industry" by Dr. A.J. Nyberg. The latter paper was delivered at the Indonesian Corn Commodity System First National Agribusiness Seminar Workshop, Bogor, 28–30 December 1975.

5. USAID, Weitz-Hettelsater Engineers, *Rice Storage, Handling, and Marketing*, 1972, pp. 160–61.

6. Source: U.S. Feed Grains Council.

7. Nyberg, p. 59.

8. C. Peter Timmer, *Factors Affecting Food Consumption in Indonesia: Some Preliminary Results*, written under the auspices of the Ford Foundation, Jakarta, Indonesia June 1978.

9. Ibid. p. 23.

10. See note 1, above.

11. Government of Japan, Overseas Technical Cooperation Agency, *Preliminary Survey on Construction of Silo System at the Port of Surabaya*, 12 May 1972, p. 26.

12. Belinda Dapice, *A Report on the Cropping Systems and Seasonal Employment in East Java and South Sulawesi*, Agricultural Extension Service, Bappenas, 1973; cited in A.J. Nyberg, "Outlook for the Indonesian Maize Industry," in SEARCA, *Proceedings of the Indonesian Corn Commodity System First National Agribusiness Seminar Workshop*, 1975.

13. One cavan is equal to fifty kilograms.

14. As is common elsewhere in Asia, many of these merchants are of Chinese descent.

15. "Inter-Island Shipping: More Incentives?" *Marketing Horizons*, April 1975.

16. Grains Economics Division, National Grains Authority.

17. Center for Research and Communication, *Study of the Feed Milling Industry in the Philippines*, 1975, p. iv.

18. "Feedmill Eyed in Cagayan de Oro," *Business Day*, 18 April 1977, Section II, p. 1.

19. Grain Economics Division, National Grains Authority.

20. Raised from 0.80 peso in mid-1976.

21. Agricultural Credit and Cooperative Financing Administration, reported in SEARCA, *The Philippine Corn Commodity System* (n.p.), 1974.

22. *Marketing Horizons*, May 1975.

23. "Masagana 99" for rice; "Masaganang Maisan" for corn.

24. Carabeef is the meat of *carabaos*, or water buffalos, a variety of cow used for farming.

25. Many Philippine grain-trading firms are owned by families of Chinese descent.

26. Arturo R. Tanco, Jr., Secretary of Agriculture, "Food: Directions for the Year 2000," paper given at the Conference on the Survival of Humankind: The Philippine Experiment, Tagaytay City, 26 December 1976.

27. UNICOOPJAPAN, Ltd., Bangkok, "Result of Maize Collection Quantity by Local Cooperatives During 1976/77 Season," in UNICOOP files.

28. Chaiyong Chuchart, et al., *Production and Marketing Problems Affecting the Expansion of Corn Growing in Thailand,* Economic Report No. 8, Kasetsart University, Bangkok, 1962.

29. Informal estimate by Faculty of Economics and Business Administration, Kasetsart University.

30. Export agreements with these countries require that corn be handled by modern silo and drying facilities in order to preserve the quality of the grain during September and October, when the moisture content of corn is high.

31. Bangkok Bank, *Monthly Review* (Thai) Vol. 5, May 1976, pp. 290-93.

32. Ibid., pp. 289-290.

33. Interview with purchasing vice president of major Thai feed miller.

34. Government of Thailand, National Economic Development Board, *The Third National Economic and Social Development Plan, 1972-1976,* p. 262.

35. C. Itoh & Co., November 1977.

INTRODUCTION TO APPENDIXES A-E

The Phil Hi-Bred, Inc. case is included here to indicate how one national firm in cooperation with a multinational seed firm evaluated the opportunity to develop high yielding corn varieties especially suited for the Philippines. During the time the case was written there was a shortage of corn and rice in the Philippines. The national government placed responsibility on the country's large-scale industries to provide food resources for their workers by the expansion and development of new landsites. Phil Hi-Bred worked closely with these firms in developing new production potential.

The Cebu Corn Dry Miller, Co. case is included to provide the reader one example of a corn price squeeze in the Philippines in which a firm is a processor and the raw material price for corn and the finished product price of the processed corn items are both determined by the government.

The East Java Corn Project is but one example of the cooperation that exists between Japan and its Southeast Asian neighbors in improving local agricultural productivity. In this particular situation the cooperation between the local cooperative Gakoperta and the Japanese Cooperative Zen-Noh was critical to the success of the project.

The Olimpio case represents an above average educated small-scale farmer, with accumulated resources to take immediate advantage of the new corn programs in the Philippines. This case documents his style of life, his methods of change, and his attitude toward the new corn programs. Unfortunately, the rural very poor do not have such resources on which to build major changes with appropriate technology. Chapter 6 addresses alternative ways in which the next layer of small-scale farmers may be helped.

The National Food and Agriculture Council case provides one perspective of an overall governmental attempt to improve the food supply of the Philippines. It serves as a summary case of Chapter 5, as it shows the government's attempts to overcome its perceived bottlenecks in the Philippine corn system. However, the reader will note, there are a number of constraints that develop as the program is set in motion—many of these problems are due to the seemingly conflicting needs of producer incentives versus low priced consumer food supplies. It also suggests that the private sector role of coordinating internal and external markets could have been used more fully by governmental agencies. Finally, in the government's great desire to get credit and new appropriate technology to the countryside as rapidly as possible, appropriate packages of inputs and effective extension education cannot keep up with the pace of activity. Perceptions as to what is expected from the producer requirements become blurred—and implementation problems and constraints develop, as outlined on pages 412–413 of the case.

APPENDIX A
PHIL HI-BRED, INCORPORATED

Early in 1975 the president of Phil Hi-Bred, Inc., Mrs. Nelia Gonzales, was seeking to devise a marketing plan for Pioneer brand hybrid seed corn in the Philippines. Pioneer Hi-Bred International, Inc., was a leading producer of hybrid seed corn in the United States, and it franchised production and marketing of its proprietary hybrid seed corn products in different parts of the world. Mrs. Gonzales, owner of the Pioneer franchise in the Philippines, was setting up a company to produce and market yellow corn and Pioneer seed corn. The financial success of the venture depended heavily on acceptance of Pioneer hybrid seeds by Filipino farmers. Mrs. Gonzales believed the main obstacle to the success of her company would be resistance to the use of high yielding seed corn varieties. Farmers were either unfamiliar with the potential of hybrids, unable to pay the premium prices for them or for the additional inputs (primarily fertilizer) required for their use, or too apprehensive of the risks of adopting a new production technology. Mrs. Gonzales felt that a well-designed marketing plan, perhaps involving government support of some kind, was necessary if Phil Hi-Bred was to succeed.

Background of Phil Hi-Bred, Inc.

Until recently, Mrs. Gonzales had been vice president for Agribusiness of Republic Flour Mills, Inc. (RFM), a leading Filipino feed and flour producer. Largely responsible for RFM's backward integration into grain production, she had introduced the contract farming concept into Philippine livestock production. It had relieved participating small farmers of the financial and marketing burdens of expanding their operations. Based on her education as a plant pathologist and on her experience in agribusiness management, Mrs. Gonzales believed that the Philippines could dramatically increase the production of yellow corn and the productivity of the industries consuming it. Thinking that significant opportunities existed for private enterprise in pursuit of this goal, she had left her position with RFM to establish a company that would produce hybrid seed corn in the Philippines. Together with Mrs. Ana Marie Santo-Ocampo, a successful businesswoman with top management experience in finance and agribusiness, Mrs. Gonzales obtained rights to the Pioneer franchise in the Philippines thorugh Pioneer Hi-Bred International's Asian licensee, Eastern Hi-Bred.

Phil Hi-Bred would engage in the production of hybrid seed corn for the domestic market and also for its own large scale yellow corn production effort. Parent seed required to produce the commercial hybrids would be imported from Pioneer Hi-Bred International in the United States. The new company was embarking on a three-year, three-phase program involving:

1. confirmation of the capability of hybrid corn seeds to increase yields dramatically in the Philippine environment
2. promotion of commercial hybrid corn seed and large-scale production of yellow corn
3. expansion of hybrid seed corn production capacity to 480 hectares and of yellow corn production to 2500 hectares (1 hectare = 2.47 acres).

At capacity, Phil Hi-Bred expected to produce 15,000 metric tons of yellow corn and 1000 metric tons of hybrid corn seed. Assuming the approval of certain incentives granted by the government to new agricultural enterprises, total investment in the project was expected to be 17.7 million pesos.

Production

Early in 1975, Phil Hi-Bred was in the early stages of developing a 3,000-hectare farm in eastern Mindoro. In its first year, the company was starting a plantation of 1000 hectares, 120 of which were devoted to hybrid seed production and 880 to yellow corn. In the second year the plantation would be increased to 2000 hectares, 240 for hybrid seed production and 1760 for yellow corn. In the third year the farm would be increased to 2980 hectares, 480 for hybrid seeds and 2500 for yellow corn. The area was chosen because it was, potentially, a highly productive area: downy mildew disease was rare, it had adequate water, and it was close to its potential market, the feed-milling industry concentrated on the island of Luzon.

The growing methods for hybrid seeds and yellow corn were similar, though seed production required more care. Land preparation, planting, fertilization, and cultivation would all be accomplished mechanically. Harvesting would be done manually because it was cheaper, the seed corn required careful handling, and many of Phil Hi-Bred's fields were small. Drying cobs, shelling them, and then cleaning and sizing the corn kernels would be done mechanically.

The major raw-material input to the project was hybrid corn seeds, which would be purchased in the United States. Other important inputs were herbicides, fertilizers, insecticides, and fuel, which were purchased from local suppliers. Electricity was being supplied by the farm's own generator. A deep well pump and a water distribution system supplied the water requirements of the farm. Table 5A-1 shows anticipated production costs.

Marketing

Phil Hi-Bred aimed to provide not only quality seeds but technical assistance to both commercial and medium-sized farms. To do so, it expected to employ a sales force of thirteen, including three sales supervisors and six sales representatives.

Phil Hi-Bred expected to price its products significantly below existing market prices. Although hybrid corn seed prices ranged from 12.00 to 15.00 pesos

Table 5A-1. Phil Hi-Bred, Inc.: Projected Production Costs, 1975-84 (pesos)

	1975	*1976*	*1977 and Each Succeeding Year Through 1984*
Direct materials cost			
Seeds cost	522	1,043	1,760
Fertilizer cost	846	1,692	2,466
Chemical cost	282	564	822
Bag cost	342	684	1,000
Farm supplies	50	100	150
Total	2,042	4,083	6,198
Direct labor cost	678	1,356	2,034
Production overhead cost			
Lease rental of farm land	–	1,000	2,000
Fuel and lubricants	66	132	192
Repairs and maintenance	148	285	405
Insurance expense	99	190	270
Depreciation	570	1,102	1,575
Total	883	2,709	4,442
Total production cost	3,603	8,148	12,674

Note: One U.S. dollar equals 7.50 pesos.
Source: Phil Hi-Bred, Inc.

per kilo, Phil Hi-Bred planned to price its seed at 8.00 pesos per kilo. The company also expected to offer its yellow corn at 1.00 peso per kilo (f.o.b. farm), significantly under the government's offering price of 1.14 peso per kilo and private trader prices of about 1.30 peso per kilo. Phil Hi-Bred felt it enjoyed a significant market opportunity because yellow corn prices in the Philippines were expected to increase to 1.50 or 2.00 pesos per kilo within a year. Based on these assumptions and on production targets, Phil Hi-Bred projected sales for its first ten years of operations as shown in Table 5A-2.

Finance

The Phil Hi-Bred project would require a capital investment of about 18 million pesos during the initial three-year period. The project was financed initially by capital subscriptions totaling 1.2 million pesos, representing 72,000 of the company's approved 420,000 shares of Class "A" (voting) common stock and 48,000 of its approved 280,000 shares of Class "B" (nonvoting) common stock. Both classes of stock carried par values of 10 pesos. Overall, Phil Hi-Bred was to be financed through a combination of equity, credit lines, and term loans.

Phil Hi-Bred management expected that the term loan would allow a grace period of three years with interest at 12 percent. Short-term loans were ex-

Table 5A-2. Phil Hi-Bred, Inc.: Projected Sales, 1975-84

	Quantity		*Selling Prices per Metric Ton*		*Sales*	
	(metric tons)		*(pesos)*		*(pesos)*	
Year	*Seeds*	*Grains*	*Seeds*	*Grains*	*Seeds*	*Grains*
1975	250	5,280	8,000	1,000	2,000,000	5,280,000
1976	500	10,560	8,000	1,000	4,000,000	10,560,000
1977	1,000	15,000	8,000	1,000	8,000,000	15,000,000
1978	1,000	15,000	8,000	1,000	8,000,000	15,000,000
1979	1,000	15,000	8,000	1,000	8,000,000	15,000,000
1980	1,000	15,000	8,000	1,000	8,000,000	15,000,000
1981	1,000	15,000	8,000	1,000	8,000,000	15,000,000
1982	1,000	15,000	8,000	1,000	8,000,000	15,000,000
1983	1,000	15,000	8,000	1,000	8,000,000	15,000,000
1984	1,000	15,000	8,000	1,000	8,000,000	15,000,000

Note: One U.S. dollar equals 7.50 pesos.
Source: Phil Hi-Bred, Inc.

pected to cost 14 percent. Tables 5A-3, 5A-4, and 5A-5 show pro forma financial statements for the first ten years.

The Market for Seed Corn in the Philippines

Consumption of seed corn in the Philippines was difficult to judge, since little analysis of the market had been made by public agencies and private organizations. Phil Hi-Bred's backers had attempted to quantify the total size of the market, however, by multiplying the number of hectares believed planted to corn by the government-recommended rate of seeding. This market was broken down by corn-producing regions on the basis of hectares committed to corn production in each. The regional markets for corn seed in recent years were further segmented according to white or yellow corn, the two major varieties grown in the Philippines. Most of the regions were primarily producers of white corn, since the population consumed white corn as a substitute for rice.

Future demand for seed corn was difficult to predict with much confidence. However, Phil Hi-Bred management believed that an annual increase in land devoted to corn production of 50,000 hectares was possible. The 50,000-hectare figure was chosen for two reasons:

1. Between 1964 and 1973, the area committed to corn production in the Philippines increased from 1.9 million hectares to 2.3 million, or about 42,000 per year.
2. In 1974 the Philippine government launched its Masaganang Maisan program aimed at intensifying production of white corn and feedgrains. Through the project, the government was giving substantial incentives to small farmers to increase their grain production by way of supervised-credit and guaranteed-price arrangements.

Table 5A-3. Phil Hi-Bred, Inc.: Pro Forma Income Statements, 1975-84 (thousands of pesos)

	1975	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	*1982*	*1983*	*1984*
Sales	7,280	14,560	23,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000
Cost of sales	3,603	8,148	12,674	12,674	12,674	12,674	12,674	12,674	12,674	12,674
Gross profit on sales	3,677	6,412	10,326	10,326	10,326	10,326	10,326	10,326	10,326	10,326
Operating expenses	905	1,073	1,326	1,326	1,326	1,326	1,326	1,326	1,326	1,326
Net profit on operations	2,772	5,339	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Financial charges										
Local	532	543	490	432	349	237	124	86	43	14
Foreign	382	810	1,227	1,354	1,348	1,196	917	604	289	85
Total	914	1,353	1,717	1,786	1,697	1,433	1,041	690	332	99
Net profit before income tax	1,858	3,986	7,283	7,214	7,303	7,567	7,959	8,310	8,668	8,901
Provision for income tax	448	999	1,998	1,964	1,995	2,638	2,776	2,898	3,024	3,105
Net profit after tax	1,417	2,987	5,285	5,250	5,308	4,929	5,183	5,412	5,644	5,796

Note: One U.S. dollar equals 7.50 pesos.

Source: Phil Hi-Bred, Inc.

Table 5A-4. Phil Hi-Bred, Inc.: Pro Forma Cash Flow Analysis, 1974-84 (thousands of pesos)

	July 31 1974	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	*1982*	*1983*	*1984*
Sources											
Stockholders' contribution	1,200	–	–	–	–	–	–	–	–	–	–
Foreign loan	–	3,182	3,182	2,672	–	–	–	–	–	–	–
Medium-term loan	–	3,500	–	–	–	–	–	–	–	–	–
Amortization of deferred charges	–	432	810	1,228	838	402	–	–	–	–	–
Depreciation	–	570	1,102	1,575	1,575	1,575	1,575	1,575	1,575	1,575	1,575
Short-term loan	–	460	–	–	–	–	–	–	–	–	–
Net income before income tax	–	1,858	3,986	7,283	7,214	7,303	7,567	7,959	8,310	8,668	8,901
Total sources	1,200	10,792	9,080	12,758	9,627	9,280	9,142	9,534	9,885	10,243	10,476
Application											
Land	960	1,540	–	–	–	–	–	–	–	–	–
Farm buildings	–	650	450	350	–	–	–	–	–	–	–
Farm equipment	–	1,768	1,768	1,768	–	–	–	–	–	–	–
Farm implements	–	904	904	904	–	–	–	–	–	–	–
Processing machinery	–	510	510	–	–	–	–	–	–	–	–
Transportation equipment	–	950	950	950	–	–	–	2,850	–	–	–
Office equipment and furnitures	–	150	–	–	–	–	150	–	–	–	–
Accounts payable	(62)	(38)	–	–	–	–	–	–	–	–	–
Income tax payable	–	–	441	999	1,998	1,964	1,995	2,638	2,776	2,898	3,024
Accounts receivable	–	1,200	1,200	1,400	–	–	–	–	–	–	–
Inventories	40	560	600	700	–	–	–	–	–	–	–
Loan payments:											
Foreign	–	–	–	–	699	1,484	2,254	2,532	2,846	1,946	935
Medium-term	–	–	547	615	691	776	871	–	–	–	–
Short-term	–	190	270	–	–	–	–	–	–	–	–
Taxes and duties	–	–	–	–	–	–	–	–	–	–	–
Preoperating	50	–	–	–	–	–	–	–	–	–	–
Total application	986	8,384	7,640	7,686	3,388	4,224	5,270	8,020	5,622	4,844	3,959
Cash inflow (outflow)	12	2,408	1,440	5,072	6,239	5,056	3,872	1,514	4,263	5,399	6,517
Cash balance, beginning	–	212	2,620	4,060	9,132	15,371	20,427	24,299	25,813	30,076	35,475
Cash balance, end	212	2,620	4,060	9,132	15,371	20,427	24,299	25,813	30,076	35,475	41,992

Note: One U.S. dollar equals 7.50 pesos.

Source: Phil Hi-Bred, Inc.

Table 5A-5. Phil Hi-Bred, Inc.: Pro Forma Balance Sheets, 1974-84 (thousands of pesos)

	July 31 1974	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	*1982*	*1983*	*1984*
Assets											
Current assets											
Cash	212	2,620	4,060	9,132	15,371	20,427	24,299	25,813	30,076	33,475	41,992
Accounts receivable	–	1,200	2,400	3,800	3,800	3,800	3,800	3,800	3,800	3,000	3,800
Inventories	40	600	1,200	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900
Total current assets	52	4,220	7,460	14,632	20,871	25,927	29,799	31,313	35,576	40,975	47,492
Fixed assets											
Land and improvements	960	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Farm buildings	–	618	1,013	1,291	1,219	1,147	1,075	1,003	931	859	787
Farm equipment	–	1,591	3,005	4,243	3,713	3,183	2,653	2,123	1,593	1,063	533
Farm implements	–	814	1,537	2,170	1,899	1,628	1,357	1,086	815	544	273
Processing machinery	–	459	867	765	663	561	459	357	255	153	51
Transportation equipment	–	760	1,330	1,710	1,140	570	–	2,280	1,710	1,140	570
Office equipment and furnitures	–	120	90	60	30	–	120	90	60	30	–
Total fixed assets	960	6,862	10,342	12,739	11,164	9,589	8,164	9,439	7,864	6,289	4,714
Deferred charges											
Preoperating expenses	50	–	–	–	–	–	–	–	–	–	–
Total assets	1,262	11,282	18,002	27,571	32,235	35,716	38,163	40,952	43,640	47,464	52,406
Liabilities and stockholders' equity											
Current liabilities											
Accounts payable	62	100	100	100	100	100	100	100	100	100	100
Income tax payable	–	441	999	1,998	1,964	1,995	2,638	2,776	2,898	3,024	3,105
Notes payable	–	270	–	–	–	–	–	–	–	–	–
Total current liabilities	62	811	1,099	2,098	2,064	2,095	2,738	2,876	2,998	3,124	3,205

(continued)

Table 5A-5. continued

	July 31 1974	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	*1982*	*1983*	*1984*
Long-term liabilities											
Foreign loan	–	3,564	7,556	11,456	11,595	10,513	8,259	5,727	2,881	935	–
Medium-term loan	–	3,500	2,953	2,338	1,647	871	–	–	–	–	–
Total long-term liabilities	–	7,064	10,509	13,794	13,242	11,384	8,259	5,727	2,881	935	–
Stockholders' equity											
Capital stock paid-up	1,200	1,990	3,580	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450
Retained earnings	–	1,417	2,814	6,229	11,479	16,787	21,716	26,899	32,311	37,955	43,751
Total stockholders' equity	1,200	3,407	6,394	11,679	16,929	22,237	27,166	32,349	37,761	43,405	49,201
Total liabilities and stockholders' equity	1,262	11,282	18,002	27,571	32,235	35,716	38,163	40,952	43,640	47,464	52,406

Note: One U.S. dollar equals 7.50 pesos.

Source: Phil Hi-Bred, Inc.

Management believed that the stimulus to the corn industry provided by the government would result in significant increases in corn acreage, production, and seed-corn demand (Table 5A-6).

Early in 1975, several seed sources existed in the Philippines. By far the most common source was the farmer himself, who typically set aside a share of one season's corn production to use as seed the following season. Usually, these seeds were low yielding local varieties. Higher yielding synthetic varieties[1] were available from the Bureau of Plant Industry (BPI, part of the Department of Agriculture and Natural Resources), from farmer-cooperators of the government whose seed was certified by and sold through BPI, and from agricultural schools. Synthetic seed varieties were in limited supply because of rather small-scale production,[2] indifferent demand, and relatively strict seed certification requirements. Hybrid-seed varieties were not ordinarily used or available; an attempt to market them in the 1960s had been unsuccessful. Synthetics and hybrids (HYVs) competed in price well above the level of native seed-corn varieties, which essentially sold at the commodity price of corn.

Because of the limited supply of synthetic varieties, it appeared that no more than 10 percent of the Philippines' corn-producing area was seeded with HYVs. At least 90 percent of the Philippines' 514,000 corn farmers used low yielding native varieties, citing such desirable properties as early maturity, high resistance to downy mildew disease, and high shelling recovery. Native varieties matured in 90 to 100 days, enabling farmers to plant three crops of corn annually, HYVs required two to four weeks longer to mature, and that extra time entailed a significant risk of typhoons and floods. Furthermore, while HYVs—especially hybrids such as Phil Hi-Bred's—could suffer 100 percent loss from downy mildew, at least 20 percent to 30 percent of a native variety crop would survive the disease. Finally, native varieties required relatively few inputs, whereas HYV

Table 5A-6. Phil Hi-Bred, Inc.: Projected Increases in Philippine Corn Area and Seed Corn Demand, 1974-83

Year	*Area (hectares)*	*Seed Corn Demand (metric tons)*
1974	2,350	35,250
1975	2,400	36,000
1976	2,450	36,750
1977	2,500	37,500
1978	2,550	38,250
1979	2,500	39,000
1980	2,650	39,750
1981	2,700	40,500
1982	2,750	41,250
1983	2,800	42,000

Source: Phil Hi-Bred, Inc.

technology involved costly ancillary inputs. Table 5A-7 compares the costs and returns from three different types of corn-farming operations.)

Many small farmers living on a subsistence level were therefore reluctant to use HYVs. They sought to minimize risk and financial loss by planting native varieties. Risk was an important factor in such farmers' decisionmaking. They could not accept risks that might threaten the survival of their families so they usually made decisions to avoid risk and increase security. Because the variability was the most serious risk these farmers faced, and because HYVs' yields were more sensitive to the supply of inputs and the availability of technical guidance than those of native feed varieties, small farmers could not help but consider HYVs a gamble.

The small size of the average farm and high tenancy rates also worked against adoption of HYVs and impeded productivity improvements. Under the share-tenancy system, the farmer had few incentives to adopt new techniques and increase his productivity because he would not receive all of the incremental yield (see Table 5A-8). Land reform, which had been instituted to reduce the tenancy

Table 5A-7. Typical Corn Production Costs and Returns on Farms in Three Major Corn Producing Areas: 1972-73

Item	*Location*		
	Cagayan	*Cebu*	*Northeastern Mindanao*
Effective crop area (hectares)	2.50	1.91	10.55
Quantity produced (cavans/hectare)	9.26	7.93	19.86
Returns (pesos/hectare)	285	269	524
Expenses			
Cash:			
Hired labor	22	49	125
Fertilizer	–	5	7
Chemicals	–	1	1
Food	7	18	3
Repair and maintenance	4	3	..
Others	–	1	4
Subtotal	33	77	140
Noncash:			
Landlord's share	56	59	39
Harvesters' and threshers' share	14	20	79
Own seeds produced	6	6	4
Subtotal	76	85	122
Total Expenses	110	162	262
Return above cash cost	251	192	384
Net farm income	175	107	262
Unpaid labor	115	54	37
Earnings on capital	60	53	225

Source: Southeast Asian Research Center for Graduate Study and Research in Agriculture.

Table 5A-8. Number of Farms and Farm Size by Region and Tenure of Farm Operator: 1970

	Tenure of Operator											
	Full Owner		Part Owner		Tenant (all types)		Manager		Other Forms of Tenure			
Region	Farms	Hectares (thousand)	Farms	Hectares (thousand)	Farms	Hectares (thousand)	Farms	Hectares (thousand)	Farms	Hectares (thousand)	Total Farms	Total Area
Ilocos	1,693	11,146	1,437	7,511	2,730	8,190	22	279	72	233	10,880	27,359
Cagayan Valley	21,428	141,101	1,816	9,497	31,320	93,960	224	2,878	551	1,793	101,274	249,229
Central Luzon	6,042	39,791	3,080	6,102	9,999	27,095	66	852	178	577	35,427	84,417
Southern Tagalog	14,905	98,146	6,429	33,611	21,870	65,610	156	2,017	393	1,277	80,064	200,661
Bicol	10,397	68,461	4,725	24,705	15,339	46,018	117	1,515	285	925	56,472	141,624
Eastern Visayas	8,115	53,431	3,863	20,196	12,033	36,098	87	1,124	228	741	44,506	111,590
Central and Western Visayas	38,701	254,831	15,419	80,616	56,340	169,022	400	5,152	971	3,158	204,667	512,779
Northern and Eastern Mindanao	18,674	122,966	7,853	41,057	27,330	81,990	195	2,515	485	1,575	99,802	250,103
Southern and Western Mindanao	58,489	385,127	22,157	119,705	85,005	225,017	590	7,668	1,453	4,721	306,908	772,238
	178,444	1,175,000	66,778	353,000	261,966	783,000	1,857	24,000	4,616	15,000	513,661	2,350,000

Source: Casewriter's estimate based on Phil Hi-Bred's estimated 1974 corn area in the Philippines and on the Department of Agriculture and Natural Resources, 1970 data on tenured and number of farms.

Table 5A-9. Corn Producing Area in the Philippines, by Region: 1963-74 (hectares)

Region	*1963*	*1964*	*1965*	*1966*	*1967*
Philippines	1,949,510	1,897,570	1,922,750	2,106,080	2,157,950
Ilocos	19,320	16,540	16,490	16,110	16,180
Cagayan Valley	126,270	118,140	121,770	102,590	90,420
Central Luzon	68,700	57,110	58,550	55,030	58,700
Southern Tagalog	96,880	94,930	93,290	118,630	119,770
Bicol	72,390	68,920	70,170	87,140	90,850
Eastern Visayas	393,580	366,640	367,610	419,710	423,610
Central and Western Visayas	257,370	272,220	275,210	250,970	195,940
Northern and Eastern Mindanao	234,910	215,610	210,550	223,720	264,990
Southern and Western Mindanao	685,090	687,460	709,110	832,180	897,490

[a]Estimated Area. This figure was published after Phil Hi-Bred made its market estimates. Phil Hi-Bred management believed the government figures were too optimistic.

Source: Bureau of Agricultural Economics, Department of Agriculture and Natural Resources.

rate, often reduced productivity because of the excessive fragmentation of farmlands. Small-scale operations did not permit adoption of advanced technological practices such as irrigation and mechanization. To enable small farmers to benefit from modern agricultural technology, the government was promoting cooperatives so that they might pool their resources and increase their bargaining power with suppliers and buyers. But cooperatives had not succeeded in the past because of inappropriate management and lack of interest in the concept.

Finally, the relatively low price for corn offered by the government (sixty-five centavos per kilo) provided most corn farmers rather narrow margins at best. Relatively low grain prices for farmers were the result of government's desire to maintain low consumer food prices; and such low prices coupled with high cost investment for high yielding varieties made the risk too great when compared to the potential reward for most small-scale producers.

Corn Production and the Feed-Milling Industry

The leading corn-producing areas in the Philippines were Mindanao, Cagayan, and Southern Tagalog, of which southwestern Mindanao was the most important. Total area planted there increased from 45,000 hectares in 1960 to over 930,000 hectares in 1974 (Table 5A-9). Southern Tagalog was the leading producer of yellow corn. About 55 percent of all corn produced was consumed on the farm. The balance was absorbed by local assemblers.

In the Philippines, yellow corn of the variety that would be produced from Phil Hi-Bred's seed and farming operation was primarily processed into feed. Consumption of corn as animal feed amounted to 303,000 metric tons in 1971

Table 5A-9. continued

1968	*1969*	*1970*	*1971*	*1972*	*1973*	*1974*[a]
2,247,860	2,256,140	2,419,600	2,392,000	2,431,700	2,325,410	2,821,280
15,060	17,310	20,860	21,600	21,570	19,560	56,780
133,520	157,130	201,090	238,500	266,530	279,470	296,450
58,450	81,200	79,260	82,300	91,220	76,850	67,090
117,790	127,440	161,420	164,500	163,200	193,560	311,420
95,980	97,230	101,540	99,400	120,270	134,190	168,520
402,590	308,960	333,230	324,600	311,510	104,130	134,630
271,540	293,820	303,990	301,700	284,550	506,930	579,390
253,340	264,030	260,700	262,700	265,140	243,200	274,580
899,590	909,020	957,510	896,900	907,710	767,520	932,420

and 288,000 metric tons in 1972, about 14 percent of the available corn supply including imports. Most feed consumers were poultry and swine producers who fed commercial, ready-mixed feeds to their flocks or herds.

In 1974, there were thirty-eight commercial feed millers operating in the Philippines. Nine of these millers were members of an association called the Philippine Association of Feed Millers, Inc. (PAFMI), and they controlled about 83 percent of the commercial feed market. Their operations were concentrated in Luzon, near Manila. Twenty-nine millers were located in Luzon, seven in Visayas, and two in Mindanao. The twenty-two feed mills in Luzon accounted for 90 percent of total national feed production.

Mrs. Gonzales' Problem

Mrs. Gonzales wondered how best to develop a market for her hybrid seeds. Although they were not downy mildew-resistant and would not be for several years—one company official estimated for as long as ten years—Mrs. Gonzales felt that Mindoro offered a potential market since downy mildew disease was uncommon on the island. She wondered how to encourage development of corn production on Mindoro, and which group of farmers (full owners, part owners, sharecroppers, or tenants) on Mindoro and elsewhere to choose as the focus on her marketing effort. Then, too, she wondered how best to market her yellow corn production to the feed-milling effort. Finally, she wondered if government agencies might be interested in her effort.

NOTES

1. Broadly speaking, there were three types of seed corn: local or "native," synthetic, and hybrid. Native varieties were unimproved seed types commonly

employed in a limited area. Synthetics and hybrids were much higher yielding varieties, and had been developed for use in conjunction with advanced agricultural practices including machine planting and cultivation, fertilization, pest control, etc. Synthetics were varieties developed through selective breeding of other varieties chosen for specific characteristics. Hybrids were varieties produced from strains of seeds which were inbred and which, when crossed, produced one generation of seed of great vigor. Hybrid seeds were produced to fit the need of a specific growing area.

2. In 1973–74, forty-five farmer-cooperators requested BPI certification of 6,380 cavans of synthetic corn seed. BPI rejected over half of the seeds submitted for certification.

APPENDIX B
CEBU CORN DRY MILLING COMPANY*

In January 1975, Mr. Roberto Ronaldo, president of the Cebu Corn Dry Milling Company, was very concerned about a cost-price squeeze in his industry in the Philippines. The government was successfully enforcing a corn-support price to the farmer of 0.80 peso per kilogram and a ceiling price of 1.45 peso for corn grits at retail. However, the oil shortage had caused energy costs at Mr. Ronaldo's plant to increase 300 percent over the past year. It also increased his procurement and distribution costs, since most Philippine corn was grown in the southern island of Mindanao and had to be shipped to the island of Cebu. In addition, the general inflation rate in the Philippines for 1974 had been about 43 percent. The result had been the erosion of margins, cash, and working capital that Mr. Ronaldo now found very threatening. He wondered what he could do to protect himself.

Purchasing Procedure

Mr. Ronaldo's mill could grind 20,000 kilograms, or 400 cavans, of corn per day. This corn was purchased almost entirely from grain traders in Cotabatu, Davau, and Cagayan de Oro in Mindanao. The traders sent Mr. Ronaldo's buyer telegrams offering corn at a specified price, and he responded with a telegram either accepting, rejecting, or making a counter offer. If the offer was accepted, the trader shipped the corn to Cebu. Upon its arrival about a week after shipping, Mr. Ronaldo assumed ownership and remitted payment.

The arriving corn was added to his warehouse inventory. An effort was made to maintain enough corn for six to ten days of milling. The profit of Mr. Ronaldo's mill depended on high utilization rates; and if the inventory fell too low, he feared that traders would demand exorbitant prices. When corn inventories fell to a three-day supply, Mr. Ronaldo became very concerned. Under such circumstances, a storm at sea or any other minor delay could expose him to an expensive inventory depletion. Not only would he lose revenues from processing on missed days, but his customers would be forced to seek additional sources to maintain a realiable supply. Consequently, Mr. Ronaldo was prepared to pay very high prices, if necessary, to keep his mill running. He did not doubt that his suppliers were aware of that fact, and he feared they might exploit him if he did not protect himself with sufficient inventory.

*This case was prepared by Richard C. Gartrell, Research Assistant, under the supervision of Professor Ray A. Goldberg, as a basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Corn Milling and Sales

Most of the corn Mr. Ronaldo processed was corn he purchased himself, then resold in its processed form. By the time corn reached him, it frequently cost 1.10 peso per kilo. When it was milled, it yielded grits in a number of grades and by-products including fines, bran, and germ (see Table 5B-1).

The grits were sold daily at wholesale prices to retailers who paid cash on the purchase date. The retailers then sold the grits at prices not in excess of 1.45 peso per kilo.

Ceiling prices were in effect on the by-products as well, but the government agencies responsible for enforcing them were less persistent about those products than about grits, a human food. Price enforcement officials seemed to feel that beef, pork, and poultry producers could pass on high feed costs to their customers because there was no price control on choice and preferred cuts. Although less desirable cuts did have price ceilings, the officials expected meat producers to recover their expenses by pricing select cuts higher.

Consequently, Mr. Ronaldo could charge for corn by-products whatever the

Table 5B-1. Typical Corn Milling Recovery: May 1973

	1st Class Milling (percentage)	*2nd Class Milling (percentage)*
I. *Corn Grits Number*		
8	16.24	
10	21.37	45.04
12	11.49	9.16
14	8.65	9.08
16	3.67	4.32
18	4.30	2.14
Total	65.72	69.74

II. *Quantity Used:*

1st Class milling: 7,065 kilograms milled
6,826.2 kilograms after cleaning (actual)

2nd Class milling: 28,074.77 kilograms
27,112 kilograms after cleaning (actual)

III. *By-Product Recovery*

By-Product	*1st Class (percentage)*	*2nd Class (percentage)*
Fines/Tiktik	5.84	4.56
Bran/Tahop	25.65	20.69
Germ/Sungo	2.78	5.01
Total	34.27	30.26
Loss	1.00	1.00

Source: Philippine National Grain Authority.

market would bear without fear of government intervention. Government inspectors seemed to understand that dry millers were in a cash squeeze; although they watched grit prices very closely, they paid little attention to by-product prices. Their leniency had allowed Mr. Ronaldo to stem the outflow of cash slightly, but not enough to keep pace with his rising costs.

In contrast to this method of milling, which required that he face the problems associated with its high cost and low selling price. Mr. Ronaldo sometimes performed contract milling. Under this arrangement, someone who owned corn simply paid him a negotiated fee for milling it. The payment might be either in cash or in kind. For instance, the corn owner might agree to accept grits equal to 70 percent of the weight of the corn milled, allowing the miller to keep the by-products as payment.

Working Capital

During the year, Mr. Ronaldo's costs had increased significantly, as evidenced by his 300 percent increase in energy costs. The result had been a smaller and smaller margin, which placed increasing importance on volume. The squeeze also meant that more and more cash revenues went to paying power bills, maintenance, transportation, and labor. The major asset that could be liquidated for cash was the inventory. Although Mr. Ronaldo tried to build an inventory large enough to buffer his business from temporary shortages and exploitation by traders, he found that he was forced repeatedly to draw down his inventory to dangerously low levels. The cash requirement was so demanding, however, that he simply could not afford to buy the stocks needed for a stronger buffer.

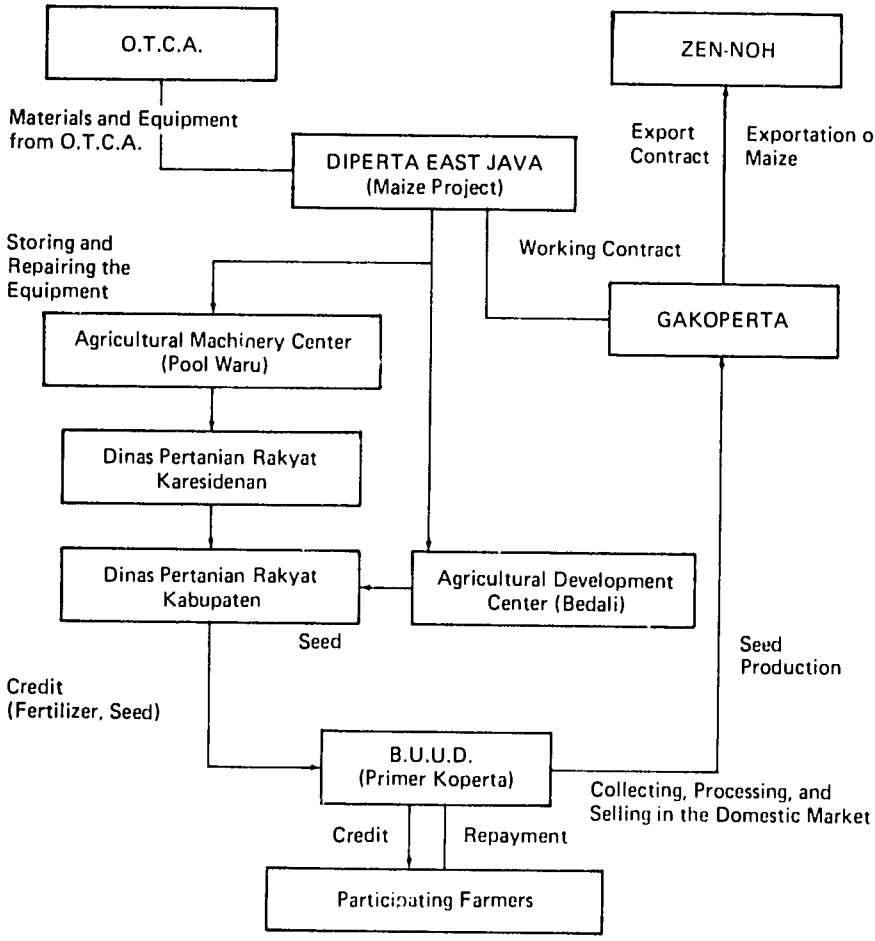
The Problem

Mr. Ronaldo had considered two possible solutions to his inventory problem. The first entailed establishing an inventory pool in the Cebu area. This action could be accomplished either by a cooperative effort among the millers or by convincing the government to carry the inventory pool and to guarantee millers routine access to it. The second possibility was to arrange for a bank to finance his inventory. Mr. Ronaldo wondered whether either of these steps were feasible in the long run and whether he was missing any more desirable alternatives. Fearing that the inventory problem was only a symptom of the risks he faced, he wondered what he would do in the months ahead as inflation continued.

APPENDIX C
EAST JAVA CORN PROJECT

The Project's Background

Under the auspices of the East Java Corn Project (as diagrammed in Figure 5C-1), farmers planted maize in five Kabupaten, or provinces: Malang, Lumajang, Kediri, Bondowoso, and Banyuwangi, in accordance with the Record of Discussion between the Japanese Government and the Indonesian Government (Department of Agriculture) signed on 16 December 1967. The initial agreement, in effect from 1968 to 1971, was renewed on 2 April 1971 for another three-year period (April 1971-July 1974). The project's budget consisted of



Source: ZEN-NOH Cooperative.

Figure 5C-1. East Java Corn Project

funds from the Indonesian government and from the Japanese government, which contributed materials and equipment.

The purposes of the project, based on the Record of Discussion, were as follows:

1. to increase the production of maize through better cultivation, fertilizer application, and plant protection
2. to improve the quality of corn with upgraded drying, processing, fumigation, grading, and storing operations
3. to make the marketing system for export corn more logical
4. to expand the corn trade between the two countries (see Table 5C-1).

In addition, the project was intended to promote the welfare and improve the skills of participating corn farmers, especially those in the upland areas. To accomplish these goals, the project, through the Primer Koperta cooperative, gave farmers credits in the form of fertilizer, superior seeds, warehouse space, and the use of tractors, corn shellers, and driers. The Palawija Development Center was established in 1971 to obtain and multiply improved seed varieties for the participating farmers.

Organization

The project was assisted by Primer Koperta, Gakoperta (the federation of agricultural cooperatives in the province), the Directorate of Cooperatives, and local administrators. Acting as the leader of project was the chief of the Agricultural Extension Service, East Java Province, who was assisted by a secretary, a treasurer, and several section chiefs. The responsibility for implementation of the project mainly lay with the Chief of Diperta Kabupaten.

From the beginning, the project was organized around the regional station system. In the first stage (1968-71), the experts stayed only in Malang and Surabaya, but after 1972, five experts were stationed in Kediri, Malang, Bondowoso, Banyuwangi, and Lumajang, and two remained in Surabaya. The purposes of the system were:

1. to sponsor close connections between farmers and officials in each region
2. to give concentrated guidance to participating farmers
3. to foster cooperation between field officials and Primer Koperta in the movement and marketing of maize.

Basic Policies

Because of the importance of corn in the rural diet in East Java, the Indonesian and Japanese governments, in cooperation with the local institutions (especially the local cooperatives), set out to develop a modern corn productivity project. The rationalization for the East Java corn project is set forth below.

Table 5C-1. Maize Exports from East Java Corn Project

Year	*Volume (kilograms)*	*Price*	*Exporter*	*Buyer*	*Moisture Content (percentage)*	*Damaged Kernels (percentage)*	*Broken Kernels and Foreign Materials (percentage)*
1968–1969	260,000	f.o.b. Surabaya US$ 49/metric ton	Gakoperta	Zenkoren (now Zen-noh)	13.7	0.4	0.2
1969–1970	500,000	f.o.b. Surabaya US$ 54/metric ton	Gakoperta	Zenkoren	14.5	4.6	1.9
1969–1970	601,060	f.o.b. Banyuwangi US$ 56/metric ton	Gakoperta	Zenkoren	14.3	4.6	1.0
1970–1971	900,600	f.o.b. Surabaya US$ 66/metric ton	Gakoperta	Zenkoren	13.7	3.8	0.9
1970–1971	350,000	f.o.b. Surabaya US$ 51.50/metric ton	Gakoperta	Zenkoren	14.5	11.0	2.0
1971–1972	225,000	f.o.b. Surabaya US$ 51.50/metric ton	Gakoperta	Zenkoren	14.5	6.0	2.0
Total	3,436,660				14.5	14.0	3.0

Source: Zen-Noh Cooperative.

The Choice of East Java as the Project Area. After studying corn production and consumption throughout Indonesia's provinces, planners selected East Java for four reasons.

1. As was well-known, East Java was one of the main foodstuff-production areas in Indonesia. It supplied not only maize, but also rice, ground nuts, cassava, and other products. With an average of 1.32 million hectares planted to corn, it could produce 966,000 tons of corn, or 37 percent of the nation's entire corn crop.
2. Most of the East Javanese population preferred maize as its main food or as a supplement. Moreover, local soil and climate conditions were suitable for planting maize.
3. Four harbors near the project areas were suitable for exporting corn: Surabaya, Probolinggo, Panarukan, and Banyuwangi.
4. The agricultural cooperatives in East Java were more developed than in other provinces.

APPENDIX D
A SMALL-SCALE CORN FARMER

The Farmer and His Family

Mr. Olimpio Aliliran, aged fifty-two, and his forty-one-year-old wife, Maria, lived with six of their eight children in their one-and-a-half room nipa-roofed hut in Sitio Lampog, Barrio Tinangis, Pili. Pili was the capital of the province of Camarines Sur in the southeastern part of Luzon, the Philippines. Tinangis was situated at the base of Mt. Isarog, an extinct volcano, which had given the immediate vicinity fertile soil suited to the raising of corn, coconuts, sugarcane, rice, and orchard crops. At an altitude of some five thousand feet above sea level, the soil in the area was sandy loam and well-drained; it was suited to the raising of corn and other feed crops.

Tatang Olimpio, as he was known, derived his income mostly from farming. His eldest son worked in a woodcarving shop in faraway Paete, Laguna, and his second child worked at her aunt's drugstore in the población, some ten kilometers away. In the past, Tatang Olimpio had worked part-time as a member of a road gang in one of the Department of Public Works' road-building projects.

Farming was not new to Tatang Olimpio. He started working on his father's farm at the age of nine. He alternated rice with his corn crop until, in 1971, he dropped rice altogether because corn was more suitable for his farm.

Tatang Olimpio built his house in 1960 at a cost of 3,000 pesos. He also bought three carabaos worth 2,800 pesos, one sow worth 250 pesos, and some chickens. He bought for his wife a used sewing machine for 450 pesos and a 180-peso transistor radio. He had accumulated through the years a sizable quantity of farm tools and equipment (see Table 5D-1).

The Farm

Tatang Olimpio owned 2.5 hectares of his 4-hectare farm; he rented the remaining portion by paying the owner 25 percent of its harvest. Besides corn, he planted as intercrops sweet potato or camote, cassava, and gabi. His 700-square-meter homelot, which adjoined the lower left corner of his rectangular farm, was grown to a few fruit trees, bananas, and vegetables. His cousin owned it, but Tutang Olimpio occupied it free of charge.

His cash expenses per hectare under the Masaganang Maisan program (Table 5D-2) of the government's National Food and Agriculture Council (NFAC) ran up to 1,721.55 pesos during the 1973-74 crop year. Cost of labor was 932 pesos; that of inputs was 693.35 pesos. No cash expenses, which included depreciation, crop lease, labor paid in kind, and unpaid operator/family labor, amounted to 1,903 pesos for the two cropping seasons.

Tatang Olimpio finished high school at the Camarines Sur National Agricultural School in Pili. Nevertheless, he consulted government agricultural technicians, visited his alma mater, and read agricultural publications to augment his knowledge of farming.

Table 5D-1. Olimpio Aliliran Corn Farm: Farm Tools and Equipment

Item	*Number*	*Year Acquired*	*1974 Value (pesos)*
Wooden plow	1	1962	40.00
Drag harrow	1	1963	36.00
Wooden comb harrow	1	1963	25.00
Shovel	2	1968	12.00
Bolo	6	1963	18.50
Pick	1	1934	3.00
Crowbar	1	1969	2.00
Saw—cross cut	1	1966	9.50
Saw—rip	1	1957	9.00
Plane	2	1966	7.00
Hammer	1	1966	6.50
Ratchet brace	1	1966	30.00
Auger bit	1	1970	3.50
Total Value			202.00

One U.S. dollar = 7.50 pesos.
Source: University of The Philippines.

The following are the steps and cultural practices that farmer Aliliran went through in corn farming:

1. *seed selection* One to two days before harvest, Tatang Olimpio would go through his corn field and select corn-seed material from his standing crop, marking off large ears that bore no signs of disease. He avoided plants next to vacant hills and those that grew at the very edge of the field.

   Ears thus selected for seed purposes were stored in two ways. During the dry season, the ears were dehusked and dried on the cob under the sun for one week. Then they were shelled, and the grains were sealed in a container with mothballs to ward off insects and parasites. The germination rate of seeds stored in this way remained high up to the third planting.

   During the wet season, the husks were left intact and the ears were tied together and allowed to dangle from the inside roof, usually near the fireplace. Care was taken to leave tassels intact to help prevent weevils (bukbok) from attacking the grains.
2. *land preparation* Plowing was done twice. After each plowing, the field was harrowed. The first plowing was done a week after the last harvest. The second plowing followed a week later. By this time, dead matter had started to decay.
3. *planting* During the dry season, the field was planted after the first heavy rainfall. In wet weather, planting was done on the first sunny day.

   Like their neighbors, Tatang Olimpio and Nanang Maria did the planting themselves. Tatang Olimpio and his carabao made deep furrows that were about seventy-five centimeters apart; Nanang Maria followed and dropped

400

Table 5D-2. Olimpio Aliliran Corn Farm: Farm Income Summary, Crop Year 1973-74 (pesos)

	1st Crop (June-September 1973)		*2nd Crop (November 1973-April 1974)*	
Receipts				
A. Cash				
Crops: Corn	986.00		1,706.00	
Camote	300.00		–	
Total crop sales		1,286.00		1,706.00
Livestock		300.00		500.00
Total sales		1,586.00		2,206.00
B. Noncash				
a. Crops:				
Corn–Home use	288.00		258.00	
Crop lease	108.00		195.00	
Harvesters' share	274.00		430.00	
	670.00		883.00	
Rootcrops–Home use	100.00		–	
b. Poultry:	50.00		125.00	
Total noncash		820.00		1,008.00
Total receipts		2,406.00		3,214.00
Expenses				
A. *Cash*				
Hired farm labor	258.00		576.00	
Shelling	51.00		47.00	
Seeds used	67.50		70.80	
Fertilizer	177.30		219.50	
Chemicals	11.25		20.00	
Sacks	41.00		20.00	
Transportation	26.00		40.00	
Interest on loans	35.95		40.45	
Taxes	3.00		16.80	
Total cash expenses		671.00		1,050.55
B. *Noncash*				
Depreciation	1.00		1.00	
Crop lease	108.00		195.00	
Harvesters' share	274.00		430.00	
Unpaid operator labor	254.00		640.00	
Total noncash expenses		637.00		1,266.00
Total expenses		1,308.00		2,316.55
Net cash income		915.00		1,155.45
Net farm earnings (returns to capital, labor and management)		1,098.00		897.45
Interest on investment (8% of 7,100 pesos)		284.00		284.00
Labor income (returns to labor and management)		814.00		613.45

One U.S. dollar = 7.50 pesos.

Source: University of Philippines.

two seeds every some fifty centimeters on the furrow and covered the grains with her foot.

4. *fertilizer application* Fertilizer was applied twice: the first at planting, or when four leaves had appeared, and the second when the plants were twenty-five days old. Fertilizer was applied two to three inches away from the corn seeds or the young plants when the weather was dry. During the wet season, the fertilizer was placed right at the base.
5. *cultivation* Off-barring was done when the plants were eight to ten inches high, or approximately two weeks old. Two weeks later came hilling-up.
6. *pest control* The farmer sprayed one or two days after off-barring and whenever insects or disease infested the area. As a preventive measure, he also sprayed during the tasseling period. The recommended dosage was 4 tablespoons of active ingredient to 5 gallons of water. One hectare required 245 gallons of solution.

Corn as a Source of Livelihood

Corn provided Tatang Olimpio's family with 70 percent of its total income, the rest coming from his other enterprises and occasional contributions from his eldest son. A small portion of his corn harvest went to the public market stalls as green corn, but most of it was sold as shelled corn to cereal and feed traders located in the town. Only a small portion of his total corn production was used by the household as food supplement and as feed for poultry and livestock.

The Community

Barrio Tinangis was made up of six sitios, or smaller settlements, of which sitio Lampog was one. From the población of Pili, one could travel to the barrio in two ways. The first was via the Tinangis-Binanuaanan road, which was ten kilometers long and passable during the dry season only. The other route, though longer by five kilometers, was through the concrete highway to Bo. Cadlan, eight kilometers from the town and along a six kilometer stretch of all-weather surface road to Bo. Caroyroyan. Another kilometer on foot brought one through sitio Lampog to Tinangis Centro, the barrio proper.

Tinangis Centro was the official seat of the barrio. The Barrio Captain (local political administrator) resided there, and there was a community school. It was also the business center of the community; three sari-sari (mom and pop, one-manager) stores served the daily needs of the barrio folk.

Barrio Tinangis was a typical farming community. Share tenancy predominated over other forms of land tenure, and Tatang Olimpio's 75/25 percent arrangement was common.

The cooperative movement had not made significant headway in the community. The planned Samahang Nayon (cooperative) had not yet been formed. One reason for this failure was, according to Tatant Olimpio, the failure of the government representative to arrive on time. "He told us he would come at 7 o'clock in the morning, but he made us wait until 1:00 P.M. When he finally

appeared, most of those who came had already gone home as they lived a considerable distance from the barrio center."

Under Masaganang Maisan, however, the community did practice a sort of cooperation on a minute scale. A new program scheme of assuring loan repayments by farmer-recipients had forced Tatang Olimpio and his fellow corn farmers to join groups of five farmers called *seldas* (cells). The members of the selda were individually and severally liable to the rural bank that extended them production loans. Under this setup, a defaulting member of the selda affected the entire group. Hence, to obtain a new loan for the next planting, the selda members who were able to meet their obligations on time pressured the delinquent member to pay up. If he wouldn't or couldn't, they would pool their resources to cover the indebtedness. This scheme was good for the bank, said Tatang Olimpio, but hard on the conscientious selda member. "That is why the government must carefully screen each farmer who wishes to be included in the Masaganang Maisan program," he stated.

Corn farmers in Tinangis could also obtain credit from several other sources--owners of the barrio retail stores, for example. Loans extended by these entities, however, were limited to home consumption goods. Private moneylenders operating from a neighboring barrio were another source of credit. When in dire need of immediate cash, farmers could quickly obtain up to 200 peros in cash this way. They did not mind very much if they had to pay interest of 20 percent per month. Still another certain souce was relatives or family members. For Tatang Olimpio, his other creditors were his eldest son, a woodcarver in Laguna, and his daughter.

The Marketing Channel for Corn

The municipality of Pili had fifteen rice and corn mills that were ready to buy all the corn they could get. The National Grains Authority provided a floor price of 0.60 peso per kilo.

The mills produced either grit (milled corn) or shelled corn for buyers as far away as Southern Tagalog and Legaspi City. The milled corn found its way into market bins, from whence it was sold as a rice substitute. Shelled corn went to poultry supply and feed stores.

Mr. Aliliran had seen how price behavior was influenced by supply. Buyers would try to outbid one another to corner the supply. Hence, they usually offered a higher price for a bigger volume. This happened especially during the dry season, when business was brisk and when farmers did not fear loss from rotting. During the wet months, it was a different story. Buyers tried to dictate the price of corn, and farmers who had no good storage facilities were forced to sell at low prices.

The Farmer's View of the World, the Government Agricultural Program, and Corn

Tatang Olimpio believed that the "New Society" brought hope to him and his kind. Peace and order had created a new life for his family; he could work secure

in the belief that the fruits of his labors would remain his and his family's. He felt that the government at last cared for him.

He pointed to such agricultural programs as Masagana 99 and Masaganang Maisan as proofs of this change for the better. He was also assured of a good price for his produce. However, he complained that some dealers in agricultural supplies were forcing farmers to buy items not specified in loan contracts. If the farmer refused to buy such items, the dealer threatened not to release the fertilizer allotment. Another of his complaints was that some agricultural technicians did not exercise good judgment in prescribing inputs. These technicians sometimes insisted on enforcing standard recommendations despite specific conditions.

Tatang Olimpio also observed that Masaganang Maisan had made many who stopped farming or went at it half-heartedly go at it more seriously. This change was good, he said, although now he found it harder to find anyone to help him on his farm, even at the high wage of five pesos per day.

Regarding irrigation, he thought it would greatly aid Masaganang Maisan in his barrio, but he wondered whether private water rights would limit the benefits of this important innovation to a very few. Could the government do something about this problem?

Finally, Tatang Olimpio was concerned about the tendency of farmers and officials to slip back into the "old ways." He feared that if this backsliding was allowed to continue, the new atmosphere that they were enjoying would soon turn into gloom and disaster.

Summary

This case was written by SEARCA (Southeast Asian Agricultural Research Center) as an example of one small-scale farmer's response to the corn program in the Philippines. One will note that Mr. Aliliran Olimpio had accumulated much more capital than a typical small farmer—but his attitude represents a serious desire to take advantage of new appropriate technologies that can improve his family's standard of living. A more difficult problem is reaching the rural poor who have very few resources.

APPENDIX E
NATIONAL FOOD AND AGRICULTURE COUNCIL

The National Food and Agriculture Council (NFAC) was a top level government policymaking body charged with the responsibility of increasing the supply of food in the Philippines. Organized in 1973 to oversee ongoing government food production programs, it consisted of high officials of what was then the Department of Agriculture and Natural Resources and of government-sponsored banking institutions that provided credit to the agricultural sector. Its executive director reported to the president through the secretary of agriculture.

Early in 1975, Mr. Domingo F. Panganiban, executive director of NFAC, confronted a major problem in Masaganang Maisan (literally, bountiful corn), an integrated program designed to increase production of white corn, sorghum, yellow corn, and soybeans in the Philippines. The program was a successor to an earlier and smaller white corn and feedgrains program. The new effort was a boldly conceived plan designed to encourage subsistence farmers to adopt modern methods of grain production, including the use of high yielding seed varieties, fertilizer, pesticides, and farm-management techniques. Credit was provided to cooperating farmers on an unsecured basis. After a year of operation, the Maisan program had succeeded in getting many farmers to undertake modern production methods. However, while average yields had improved, they had not reached the levels targeted. This failure created two related problems: many farmers were not profiting from adoption of modern production methods, and some were slow to repay their loans. As a result, credit institutions participating in the program were becoming apprehensive. Mr. Panganiban felt that some steps and changes in strategy had to be taken to maintain support for the Masaganang Maisan program.

Background of the Masaganang Maisan Program

Due largely to the growing requirements of the livestock and poultry industries and increased human consumption, the demand for corn and feedgrains in the Philippines had been rapidly increasing. However, production had not kept pace with demand (Table 5E-1), and imports had been heavy.

Corn played an especially important role in 1972 and 1973, when the Philippine rice crop was severely damaged by typhoons. In 1972, soybean meal imports amounted to 68,000 metric tons valued at $5.4 million. Yellow corn imports were approximately 93,000 metric tons valued at $5.4 million. For 1974, imports of both commodities were expected to increase significantly. One hundred thousand tons of yellow corn alone were expected to be imported by the feed-milling industry.

In an effort to close the gap between supply and demand, overcome production and marketing constraints that jeopardized self-sufficiency goals, and protect the Philippines against the worldwide grain shortage and high grain prices,

Table 5E-1. Production, Imports, and Consumption of Corn in the Philippines: 1964-74 (metric tons)

Crop Year	*Production*	*Imports*	*Consumption*
1964-1965	1,312,680	–	1,172,600
1965-1966	1,379,825	2,248	1,337,300
1966-1967	1,489,950	–	1,370,500
1967-1968	1,619,155	–	1,436,600
1968-1969	1,732,835	77	1,518,200
1969-1970	2,008,215	25,788	1,804,200
1970-1971	2,004,975	1,015	2,200,800
1971-1972	1,955,605	54,764	2,167,200
1972-1973	1,831,130	160,465	2,178,100
1973-1974	2,288,700	96,723	2,283,100

Source: National Food and Agriculture Council.

the government launched a large-scale white corn and feedgrain program in March of 1974. Called Masaganang Maisan, the program's objectives were:

1. satisfaction of increasing demand for human consumption of white corn
2. production of sufficient yellow corn, sorghum, and soybeans to satisfy the feed requirements of the poultry and livestock industries
3. production of corn for export in the form of starch and other by-products
4. study and establishment of joint-venture feedgrain projects with foreign investors.

To achieve the objectives of Masaganang Maisan, credit was made available to farmer-participants to enable them to purchase a recommended mix of high yielding seed varieties, fertilizers, insecticides, and herbicides. Government financial institutions–the Philippine National Bank and the Central Bank-Rural Banks–gave priority to the credit requirements of farmers participating in the program. Government agencies and banks trained and fielded extension workers to supervise the farmers. Assistance was also given farmers in marketing their produce. The marketing scheme involved price supports for corn, established and maintained jointly by the National Grains Authority, rural banks, Philippine National Bank, Agricultural Credit Administration, and farmers' cooperatives.

The National Food and Agricultural Council set ambitious goals for its corn and feedgrain program. It aimed to increase yields from the existing 17 cavans per hectare (Table 5E-2) to 35 cavans. To do so, it sought to bring 700,000 hectares of land already committed to corn production under modern production methods (Table 5E-3). Sorghum and soybeans were included in an effort to introduce new opportunities in grain farming to Philippine farmers. The program was rather extensive in that it affected 25 percent of the corn hectarage in the Philippines, forty-one of the Philippines' seventy provinces, and about 230,000

Table 5E-2. Corn Area, Production, and Yield in the Philippines: 1964-1974

Crop Year (Ending 30 June)	*Area (hectares)*	*Production (Sacks of 50 kilos each)*	*Yield (cavans per hectare)*
1964-1965	1,922,750	26,253,600	13.6
1965-1966	2,106,080	27,596,500	13.1
1966-1967	2,157,950	29,799,000	13.8
1967-1968	2,247,860	32,383,100	14.4
1968-1969	2,256,140	34,656,700	15.4
1969-1970	2,419,600	40,164,300	16.6
1970-1971	2,392,200	40,099,500	16.8
1971-1972	2,431,700	39,112,100	16.1
1972-1973	2,325,410	36,622,600	15.7
1973-1974	2,763,040	45,774,000	16.6

Source: National Food and Agriculture Council.

Table 5E-3. Masaganang Maisan Corn and Feedgrain Program—National Targets: 1974

Commodity	*Area (hectares)*	*Yield (cavans per hectare)*	*Production (cavans)*
White Corn	500,000	35	17,500,000
Yellow Corn	200,000	35	7,000,000
Sorghum	30,000	40	1,200,000
Soybeans	20,000	20	400,000
Total	750,000		26,100,000

Source: National Food and Agriculture Council.

farmers, many of whom operated at the subsistence level outside the money economy.

Significant amounts of credit were required to provide working capital to subsistence farmers who could not afford high yielding seed varieties and fertilizer. The inputs needed during the Maisan program's first year are shown in Table 5E-4. Credit was limited to 500 pesos per hectare, as shown in Table 5E-5. Total financing required was estimated at 253 million pesos. PNB, a government-owned commercial bank, would provide over half of the financing required. Rural banks (RB) would provide most of the remainder.

Implementation of the Maisan Program

Responsibility for implementing the Maisan program was vested in a National Management Committee under the National Food and Agriculture Council. Regular policy council meetings were held, chaired by the secretary of agricul-

Table 5E-4. Masaganang Maisan Corn and Feedgrain Program—Input Requirements: 1974-75

Commodity	*Target Area (hectares)*	*Seeds (cavans)*	*Fertilizer (bags)*			
			Urea	*Ammo-phos*	*Ammosul*	*Complete*
White Corn						
Credit	300,000	75,000	365,000	194,000	138,000	138,000
No credit	200,000	50,000	243,000	130,000	92,000	92,000
Yellow Corn						
Credit	150,000	37,500	85,875	53,250	187,500	187,500
No credit	50,000	12,500	28,625	17,750	62,500	62,500
Sorghum	30,000	10,000	34,700	9,800	20,400	20,400
Soybeans	20,000	20,000				40,000
Grand total:	750,000	205,000	752,200	404,800	500,400	540,400

Source: National Food and Agriculture Council.

Table 5E-5. Masaganang Maisan Corn and Feedgrain Program—Financing Targets: 1974-75

Commodity	*Target Area (hectares)*	*Financing Target (hectares)*	*Loan Rate (pesos per hectare)*	*Amount Needed (pesos)*
White Corn	50,000	300,000	500	150,000,000
Yellow Corn	200,000	150,000	500	75,000,000
Sorghum	30,000	30,000	500	15,000,000
Soybeans	20,000	20,000	650	13,000,000
Total	750,000	500,000		253,000,000

Source: National Food and Agriculture Council.

ture or the NFAC Executive Director, and participated in by .epresentatives of the following organizations:

- Bureau of Plant Industries (BPI)
- Bureau of Agriculture Extensions (BAE)
- Central Bank—Department of Rural Banks and Savings and Loan Associations (CB-DRBSLA)
- Philippine National Bank (PNB)
- Agricultural Credit Administration (ACA)
- Development Bank of the Philippines (DBP)
- Rural Bank Association of the Philippines (RBAP)
- National Grains Administration (NGA)
- Philippine Association of Feed Millers, Inc. (PAFMI)

- U.S. Agency for International Development (USAID)
- Agricultural Pesticide Institute of the Philippines (APIP)
- Fertilizer Industry Authority (FIA)
- Department of Local Government Land Community Development (DLGCD)
- Bureau of Cooperatives
- Bureau of Soils (B.S.)
- Bureau of Agricultural Economics (BAEcon)
- Central Bank-Land Bank (CB-LB)
- Department of Agrarian Reform (DAR)
- University of the Philippines at Los Banos-College of Agriculture (UPLB-CA)
- National Media Production Center (NMPC)
- Rural Broadcasters' Council (RBC)
- representatives from the private sector

At local levels, the National Management Committee operated through Regional Coordinators, Provincial Action Committees, and Municipal Action Teams as shown in Figure 5E-1.

At the municipal level, the program consisted essentially of six steps:

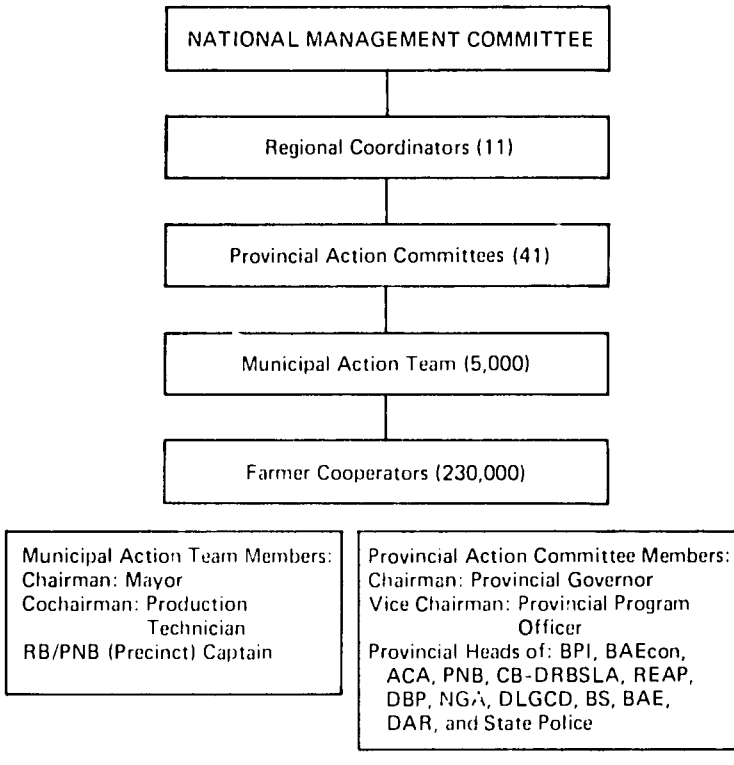
1. communication and organization
2. loan applications
3. budgeting and releases
4. payment to dealer
5. reporting
6. loan collection.

Communication. Production technicians encouraged grain farmers to participate in the Maisan program and provided local credit courses with a list of qualified farmer-cooperators[1] willing to participate in the program. Farmers lacking tangible collateral were organized into mutual liability groups (seldas). Eligible farmers and members of seldas were recommended to RB/PNB/ACA for loans available under the Maisan program's supervised credit scheme.

Loan Application. The farmer-cooperator, with the assistance of the local production technician, completed a loan form for submission to the RB/PNB/ACA. Loan privileges were also granted farmer groups and associations in which one farmer-member cosigned for another.

Budgeting and Release. The maximum loan under the supervised credit scheme was 500 pesos per hectare for corn and sorghum land and 650 pesos per hectare for soybeans. The loan budgeted as follows:

1. for the prescribed amount of fertilizer, pesticides, seed, and other inputs as



Source: National Food and Agriculture Council.

Figure 5E-1. National Food and Agriculture Council: Organizational Structure for Implementation of Masaganang Maisan

determined by the production technicians, 300 pesos per hectare for corn and 400 pesos per hectare for soybeans, issued in the form of purchase orders

2. for the cost of seeds and the cost of labor for planting, spraying, and so forth, 200 pesos per hectare for corn and sorghum and 250 pesos per hectare for soybeans, issued in cash.

If the farmer was a member of a registered cooperative, the participating rural bank of the Philippine National Bank branch would deduct 5 percent of the farmer's total loan amount and credit the deduction to the account of the cooperative. All loans matured in six months and carried an interest rate of 1 percent per month.

Upon arrival of the loan, PNB/RB/ACA branch would issue a booklet of serial-numbered purchase orders, or chits, to the local production technician for fertilizers, pesticides, and herbicides. (Seeds were usually obtained from local certified seed growers by barter or for cash). The production technician vali-

dated the chit when he and the farmer agreed a given input was to be applied. A chit was good for only fifteen days, so the farmer had to draw the input from the appropriate dealer within the allotted time. The dealer, the PNB/RB/ACA branch, and the production technician got a portion of the chit when the farmer drew his supplies. The dealer delivered the inputs to the farmer upon presentation of a validated chit.

Payment to Dealer. The dealer summarized the purchase orders filled during each week. Every Friday morning, the dealer submitted the weekly summary with supporting chits to the PNB/RB/ACA for payment out of the account established for the farmer-borrower. Chits were retained and filed by PNB/RB/ACA for audit and verification.

Reporting Procedures. PNB/RB/ACA submitted monthly reports to their head offices. The provincial program officers received monthly reports from their local production technicians, aggregated them, and forwarded them to the National Management Committee. The reports included hectarage covered, farmers affected, and yields attained at harvest.

Loan Collection. Farmers were allowed considerable flexibility in repaying their loans. The methods available to them were:

1. direct cash payment
2. payment in kind through NGA's authorized warehouse or a designated storage facility
3. payment in kind directly to lending institutions
4. payment through a marketing agreement between the lending institution and the farmer-borrower.

Critical to the involvement of small farmers in the Maisan program were the local efforts of production technicians. To encourage them to enroll farmers in the program, technicians were granted a monthly bonus of five pesos for working in the program, a six-peso bonus for assisting a farmer in obtaining a loan, a one-peso bonus per month for each farmer supervised, and a three-peso bonus per month for each farmer who repaid his loans. About 25 percent of all technicians were provided with motorcycles and a twenty-five peso allowance for gasoline.

Initial Results

The Maisan program had reached many farmers and introduced modern technology in many areas. By the end of November, much of the area targeted under the program had been reached. Tables 5E-6, 5E-7, and 5E-8 show some preliminary results for white corn as of 30 November 1974.

Table 5E-6. National Food and Agriculture Council: Planting Target Areas from March to 30 November 1974 in Relation to Annual Targets

Rank Order	*Province*	*Target Area from March-31 October 1974 (hectares)*	*Target Area for 30 November 1974 (hectares)*	*Total Target Area to Date (hectares)*	*Total Annual Target (hectares)*	*Target to Date as Against Annual Target (percent)*
1	Davao del Sur	30,000	–	30,000	30,000	100
2	Agusan del Sur	20,000	–	20,000	20,000	100
3	Capiz	1,000	–	1,000	1,000	100
4	Davao Norte	38,000	2,000	40,000	40,000	100
5	Pampanga	925	75	1,000	1,000	100
6	Davao Oriental	18,860	740	19,600	20,000	98
7	Lanao del Norte	21,500	1,000	22,500	23,000	98
8	Davao City	9,225	500	9,725	10,000	97
9	Zamboanga del Sur	31,000	1,810	32,810	35,000	94
10	Bukidnon	60,250	5,375	65,625	70,000	94
11	Sultan Kudarat	7,700	800	8,500	9,000	94
12	South Cotabato	39,905	6,390	46,295	50,000	93
13	Misamis Occidental	10,000	1,000	11,000	12,000	92
14	Negros Oriental	28,600	3,600	32,200	35,000	92
15	Misamis Oriental	15,470	2,975	18,445	20,000	92
16	Cebu	8,000	1,000	9,000	10,000	90
17	Negros Occidental	4,000	500	4,500	5,000	90
18	North Cotabato	20,700	3,700	24,400	27,000	90
19	Bohol	4,400	–	4,400	5,000	88
20	Zamboanga del Norte	18,900	3,100	22,000	25,000	88
21	Maguindanao	6,925	1,335	8,280	10,000	83
22	Masbate	8,100	–	8,100	10,000	81
23	Samar	6,500	3,000	9,500	12,000	79
24	Leyte	10,110	945	11,055	14,250	78
25	Isabela	7,000	500	7,500	10,000	75
	Total	427,070	40,365	467,435	504,250	93

Source: National Food and Agriculture Council.

Problem Areas

In general, the constraints impeding the progress of the program were the following:

1. Based on existing costs, yields, and government-support prices, corn appeared to be at best marginally profitable to farmers. Many farmers had difficulty repaying loans on time, and participating financial institutions were concerned.
2. Although good HYVs had been developed in the Philippines, they had not been produced in sufficient quantity. In addition, certified seed growers were few because the seed market was not deemed profitable; most farmers habitually used a portion of their harvests for subsequent planting.

Table 5E-7. National Food and Agriculture Council Planting Performance From March to 30 November 1974

		White Corn				
		Cumulative Area Planted from March-30 November 1974			Cumulative Target to date (hectares)	Percent of Accomplishment
Rank Order	Province	Without Credit	With Credit	Total (hectares)		
1	Maguindanao	13,351	3,760	17,111	8,280	207
2	Misamis Occidental	8,750	13,454	22,204	11,000	202
3	Bohol	5,128	3,684	8,812	4,400	200
4	Negros Occidental	3,885	4,906	8,791	4,500	195
5	North Cotabato	15,170	30,386	45,556	24,400	187
6	Isabela	8,763	5,270	14,033	7,500	187
7	South Cotabato	24,325	46,447	70,772	46,295	153
8	Davao Oriental	17,515	10,123	27,638	19,600	141
9	Davao City	4,496	5,987	10,483	9,725	108
10	Zamboanga del Sur	10,850	24,085	34,935	32,810	106
11	Lanal del Norte	19,367	3,660	23,027	22,500	102
12	Cebu	2,760	5,986	8,746	9,000	97
13	Davao del Sur	20,934	7,195	28,129	30,000	94
14	Misamis Oriental	4,712	11,858	16,570	18,445	90
15	Zamboanga del Norte	14,989	2,988	17,977	22,000	82
16	Masbate	5,649	494	6,143	8,100	76
17	Sultan Kudaret	1,878	4,526	6,404	8,500	75
18	Negros Oriental	13,835	7,668	21,503	32,200	67
19	Samar	2,117	3,932	6,049	9,500	64
20	Leyte	3,639	3,456	7,095	11,055	64
21	Bukidnon	22,824	18,136	40,960	65,625	62
22	Pampanga	444	160	604	1,000	60
23	Davao del Norte	11,416	11,959	23,375	40,000	58
24	Agusan del Sur	5,356	618	5,974	20,000	30
25	Capiz	–	1	1	1,000	[a]
	Total	242,153	230,739	472,892	467,435	101

[a]Less than 1 percent.

Source: National Food and Agriculture Council.

3. The cost of fertilizer and pesticides increased production costs tremendously.
4. Only 857 production technicians were available to advise the farmers and supervise their loans.
5. Major corn-producing areas lacked storage and milling facilities.
6. Newspapers published scattered complaints from farmers about alleged "connivance" among rural banks, production technicians, and input dealers. Invariably, the complaints charged that in some towns, farmers were being forced to buy excessive amounts of chemicals in order to receive fertilizer loans due them. Even so, newspaper stories reported that some corn farmers

Table 5E-8. National Food and Agriculture Council: Production Performance from March to 30 November 1974

		White Corn		
Rank Order	*Province*	*Total Production (50 kgm/sack)*	*Total Area Harvested (hectares)*	*Average Yield (sacks/hectare)*
1	South Cotabato	2,140,710	48,933	44
2	Davao City	330,874	8,089	41
3	North Cotabato	359,347	9,480	38
4	Lanao del Norte	540,264	16,195	33
5	Sultan Kudaret	110,754	3,321	33
6	Bohol	82,583	2,653	31
7	Bukidnon	545,430	18,126	30
8	Pampanga	5,632	195	29
9	Davao Oriental	731,597	26,573	28
10	Maguindanao	366,089	12,922	28
11	Davao del Norte	235,163	8,420	28
12	Misamis Occidental	271,913	9,605	28
13	Samar	87,420	3,415	26
14	Negros Occidental	83,821	3,249	26
15	Zamboanga del Norte	403,775	15,608	26
16	Misamis Oriental	272,238	10,670	26
17	Zamboanga del Sur	656,394	25,014	26
18	Davao Sur	720,586	28,679	25
19	Leyte	76,165	3,192	24
20	Negros Oriental	494,328	22,940	22
21	Agusan del Sur	22,390	1,008	22
22	Cebu	38,214	1,912	20
23	Isabela	146,841	7,312	20
24	Masbate	75,983	4,394	17
25	Capiz	–	–	–
	Total	8,798,511	291,905	30

Source: National Food and Agriculture Council.

were selling their subsidized fertilizer allocations to sugar farmers and profiting from the two-tiered fertilizer pricing structure.

Mr. Panganiban wondered what program of action he should design to overcome these constraints.

As one examines the Southeast Asian corn system and the problems and challenges facing Thailand, Indonesia, and the Philippines—each with a different approach to tackling its corn system—there emerge a number of changemakers in each country that are potential leadership models for other parts of the world corn system. These are discussed in Chapter 6 of this book.

NOTES

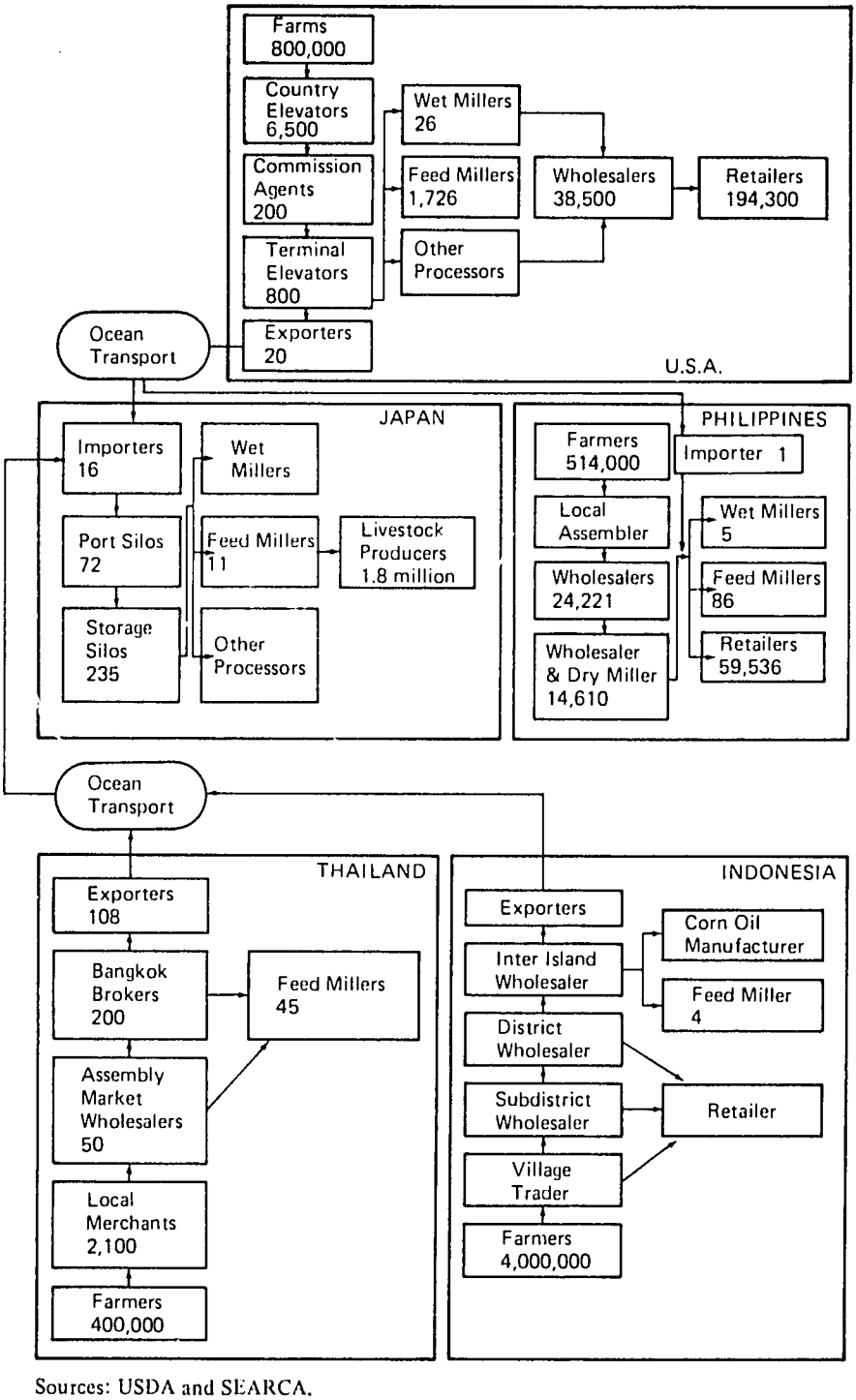
1. In order to qualify, farmers had to be:
   - engaged in corn or feedgrain production
   - willing to contract their crop to the National Grains Authority or approved feed millers and avail themselves of loans from PNB/RB/ACA
   - located where service facilities such as warehouses and financing institutions were located or accessible.

Chapter 6

Summary and Conclusions: The Changemakers

Throughout this discussion of the Southeast Asian corn system as represented by the Indonesian, Japanese, Philippine, and Thai corn economies, we have stressed the need to take a commodity-system approach to identify the problems of both the commercial and noncommercial participants in these systems. As noted in the first chapter, the term *agribusiness* includes *all* participants in the system, large and small, from farm input suppliers to the ultimate consumers of food and fiber products. It is important that the reader not be confused by well-meaning writers who inadvertently distort the concept of agribusiness (perhaps because it has the word *business* in it).[1] The distortion takes the form of equating agribusiness with large-scale entities that wish to control the food system of both the developed and developing world rather than equating agribusiness with its descriptive form of analyzing an interdependent, interrelated food and fiber system at any stage of development and in any form of governmental, economic, political, or social environment. An agribusiness-commodity-systems approach is a "perception" of a problem in its broadest setting.[2] How else can one help small and subsistent producers or impoverished consumers unless one relates their position or lack of position to the total food system? How else can public and private decisionmakers help these largely ignored groups to produce more, participate in the food system, and be more equitably rewarded?

As noted at the beginning of this book and in our previous book,[3] the agribusiness system exists for the ultimate purpose of satisfying the food and fiber needs of the consumer—given the political, economic, and social priorities of the government. It has three levels of operation. The first involves the total macroenvironment and public policy. We note that the government is not only a regulator and a facilitator of the agribusiness commodity system, but is also a



Sources: USDA and SEARCA.

Figure 6-1. Major Participants in the Southeast Asian Corn System

direct participant and joint-venture partner in many of the functions performed by the system. The second level involves the special commodity system itself in relation to its macroenvironment; the commodity system is described in great detail—its functions, its participants, and its coordinating arrangements, all of which are related to the ultimate purposes of the system. The third is the level of the firm or farm, in which management operations of individual participants are discussed in terms of specific needs of specific firms as noted by the case analyses at the end of each chapter. The needs of the individual firm or farm are stated not only in terms of productivity, efficiency, and profitability, but also in terms of national priorities such as greater utilization of landless labor, more participation of the small farmer, greater income, land, and other resource distribution.

Given these three levels of operation and changing national governmental priorities, what specific changemakers emerge from this study to enable private and public managers in the corn systems of Indonesia, Japan, the Phillipines, and Thailand to be more responsive to opportunities to develop their corn systems—bearing in mind the national priorities of each and the fact that corn is a human food in the Philippines and Indonesia and an export animal-feed crop and local feed and food crop in Thailand?[4] Before highlighting the specific changemakers that emerge from this study and other studies, let us keep in mind the major participants in the Southeast Asian corn system shown in Figure 6-1. Although there is much concentration at decision points in the system, many competitive entities are involved in its improvement—albeit with their own specific self-interests—as noted in this analysis of the changemakers.

A MULTINATIONAL FARM COOPERATIVE'S APPROACH TO THE CORN SYSTEM

The Zen-Noh Cooperative was the first case to be studied in the book because this changemaker represents many of the problems and opportunities of the Southeast Asian corn system. Most of the international trade in corn is for animal feed rather than human consumption. In this sense, both the producer and user of corn is a farmer. He produces feed corn in an export country, such as the United States or Thailand, and sells the corn to an importer in a feed-deficit country, such as Japan, where it is purchased by a feed manufacturer. The Zen-Noh Cooperative represents five million farmer-cooperative members as it performs its selling and procurement functions amounting to over $16 billion a year.

Zen-Noh performs these functions in a macro-food-policy environment that affects its operations and those of all the changemakers. This food-policy environment encompasses the following concerns:

1. cost of food to local consumers, given the inflation and the potential recession facing many countries

2. nutritional needs and safety standards of consumers as noted in Appendix B of this chapter
3. food policy and its relation to the foreign policy of each country
4. balance of payments requirements
5. national security
6. economic development
7. human welfare—food availability for the poor
8. ecology
9. price stability for producers and consumers
10. market system and other incentives
11. social style of life.

Zen-Noh's response to many of these food-policy concerns arises from the Japanese perspective. Although it represents the Japanese farmer, the cooperative feels that it has a responsibility to supply all kinds of food to the Japanese consumer at a stable and reasonable price, and it has integrated forward into the retail distribution of food. Zen-Noh believes that it must work closely with producers of other countries so that farmers in general have a greater voice in the total world food system. It believes strongly in coop-to-coop trade, although it also trades with multinational firms of many countries.

One of Zen-Noh's long-term objectives is to develop an international agribusiness cooperative center for the mutual benefit of all farmers. It already has established relations with cooperatives in developing countries such as Thailand, Brazil, Indonesia, and Argentina. In some cases, this help is in the form of technical assistance, and in other cases, in the form of direct loans and investment. It also has been asked to help such countries as North Vietnam, and it hopes to work more closely with the People's Republic of China now that relations between the two countries have improved. It is true that this aid is partly motivated by Japanese farmers' need for imported feedgrains (as noted in the case, they represent 40 percent of the Japanese feed manufacturing market). Nonetheless, much of its aid and joint-venture operations also develop the local grain and feed economies of the countries it helps. It has close working relations with cooperatives in developed countries, such as the United States, Canada, and Australia, too. Zen-Noh gets more effective acceptance by producers because it is a cooperative and will continue to be both a specific transfer agent in economic-development activities in developing countries and a potential leader in a global farmer-cooperative network.

Zen-Noh also represents the Japanese government's interest in improving its balance of payments with its trading nations in Southeast Asia, as well as with the developed countries of North America. In Japan, as in Europe, the private, cooperative, and public sectors work more in tandem than in the United States.

They have learned that the varied public-policy food objectives of their nations and the conflicts that sometimes surround them respond better to collaborative and cooperative activities than to the confrontation that sometimes exists among the cooperative, proprietary-corporation, and public decisionmakers in the United States.

Being a farmers' cooperative of an importing nation does not rule out conflict, however, in working with developing and developed country farmer cooperatives. The problem of transfer price is critical. The importing farmers' cooperative wants as low a price as possible and the exporting farmers' cooperative wants as high a price as possible. An international cooperative's only advantages lie in its ability to move the crop from one cooperative to another in a more efficient manner than could another entity, such as a multinational corporation (a difficult task indeed), and its ability to recognize more clearly the longer term needs of both "producing" farmers' cooperatives and "buying" farmers' cooperatives. In this latter connection, an adjustment for extremes in price volatility for both the buying and selling cooperative over time may be possible. Naturally, the presence of an impartial price-reporting reference point such as the Chicago Board of Trade futures quotations is critical in evaluating the success and the mutual benefit of coop-to-coop trading.

The sensitivity of leaders of farmer cooperatives in one country to the needs of farmers in other countries is greater than that of leaders of other types of institutions. Zen-Noh represents this attitude well in the world corn system. Similarly, U.S. cooperatives have a long history of helping their fellow farmers in the developing world through the granting of financial and technical help, such as in the case of the establishment of an Indian cooperative fertilizer firm. U.S. farmer cooperatives, through the joint efforts of the USDA Farmer Cooperative Service and joint cooperative organizational extension services, also have provided aid to farmers in developing countries.

Some 20 percent of the world's population belongs to one or more farmers' cooperatives and membership is growing. They can become a more important, if not the most important, institution in a developing country food system, since a cooperative can reach the small farmer and landless laborer and enable both to become more integral parts of their commodity systems and be rewarded more equitably in the process. (Further evidence of the importance of farmer cooperatives is noted in the Anand dairy case discussed in Appendix C of this chapter.)

In the long run, developing nations need institutions upon which to build their agribusiness commodity systems. Farmers' cooperatives are one of the most important elements in the development of a commodity system that includes small-scale farmers and landless laborers. Farmers as principal marketers and users of corn need to be represented in the broad global trade arena. Zen-Noh and its potential international agribusiness cooperative center are one way for the corn farmers of the world to achieve this representation.

A JAPANESE MULTINATIONAL FIRM'S APPROACH TO THE CORN SYSTEM

As in the case of Zen-Noh, Japanese multinational proprietary corporations are most interested in their importing role in the Japanese corn system. These firms also play a significant role in the Japanese mixed-feed industry. They work closely with the Japanese government in carrying out the government's priorities in its total food-policy setting, as noted above. They add dimensions over and above Zen-Noh's activities. In the Mitsubishi Corporation case in Chapter 3, we noted the direct entrance of Japanese firms into the U.S. grain economy: many of the facilities of the Cook Grain Company were purchased by Japanese multinational firms when Cook got into financial difficulty. These firms now add to the competitive environment in the U.S. grain and grain processing industry—and add one more link to a better coordinated world corn system. They are strong firms and powerful ones, but as John Kenneth Galbraith states:

> The exercise of power is not a matter of choice but of necessity. It is true of the multinational corporation, and it is wholly and equally true of the large national corporation . . . . Multinational intrusion by the corporations of one country also forces reciprocal actions by those intruded upon . . . . The only reasonable defense of the multinational corporation is now the truth. That it has power must be conceded. The only desirable defense is to hold that such exercise of power is inevitable and, if subject to proper guidance and restraint, socially useful.[5]

Similarly, Dr. Radha Sinha states:

> It is not argued here that multinationals have no role in the agricultural development of developing countries. If harnessed properly, they can play a significant part; but such harnessing is not going to be easy and certainly not within the means of one or a few developing countries. Some kind of international control, regulation and policing may be needed.[6]

Another creative activity of the Japanese multinational firm is the development of both an external and internal market system, as evidenced in the C. Itoh case in Chapter 3. This case indicates how the Japanese-Thailand Corn Agreement, existing since 1961, can provide mutuality of interest for both the Thai corn system and the Japanese feed industry. The existence of the agreement—and an assured market access for Thailand during a period of global corn surplus—provided a market incentive that led to a more than threefold expansion of Thai corn production during the 1961-78 period (with an occasional decline due to unusually adverse weather conditions). Not only was production increased but also, because the agreement was tied to the price of the nearest trading month for corn on the Chicago Board of Trade, price discovery in terms of pub-

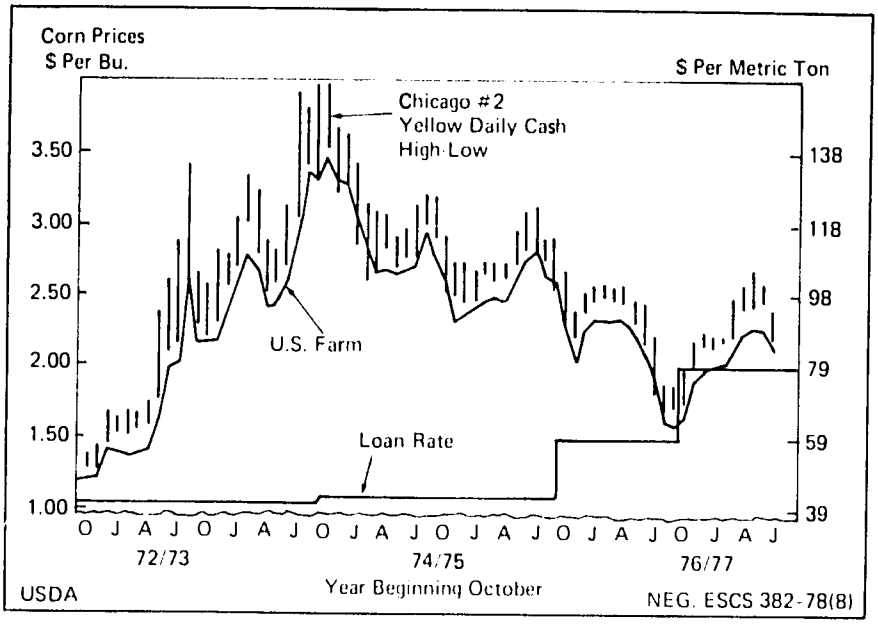
lished and broadcast price was more readily available to producers. Price discovery, price trends, and a guaranteed market led to more formal marketing arrangements at the farmer level and encouraged storage construction and the holding back of crops at harvest time to avoid gluts.

The agreement, tied to the U.S. Chicago Board of Trade corn futures market, enabled the U.S. price-support program, which provides the underpinning of price for U.S. corn farmers, to also provide the Thai farmers with the same price-level support. This is noted in Figure 6-2, which depicts the U.S. price-support level, the U.S. market price, and international corn prices. Until 1972, the U.S. crop surplus and the U.S. price-support program provided the underpinning of not only the Thai-Japanese Corn Agreement but also of the world corn price in general. This same agreement also had provisions for adjusting price if and when unusual conditions occurred in the United States, such as a dock strike, price controls, an embargo, and so forth. These contingency plans are highly unusual in a commodity agreement and have provided enough flexibility to maintain mutuality of interest of the two countries over the past seventeen years during unusual changes in the local and global corn commodity system. This agreement has much to offer, not only as an example of how assured markets help the development of a local corn economy, but also as a model for other potential international commodity agreements.

The Thai-Japanese Corn Agreement is also partially responsible for the fact that Thailand's corn producers are able to produce 16 percent of the Thai grain production on 13 percent of the grain land because of the incentives of an assured market and a quoted futures price.[7] These same provisions further provide a price quotation against which to measure the competitive position of Thai farmers versus U.S., Indonesian, and Philippine corn farmers (see Tables 6-1 and 6-2 and note the wide range of production costs both within and between countries).

Finally, the C. Itoh case and its description of the Thai-Japanese Corn Agreement provide one other provision critical to the development of both an efficient internal and external corn market structure: third-party enforcers of the contract. In the case of Japan, it is not only the authority and encouragement of the Japanese government that is important to the annual contract; the Japanese Feed Trade Association helps to negotiate and enforce it. Similarly, the Board of Trade of Thailand polices the contract, permits only a 5 percent share of export volume to any one exporter, and severely penalizes any breach of the contract by an exporter. In essence, the contract is flexible, enforceable, and related to an equitable market reference point, all of which enables incentives to reach back to the small-scale producers in Thailand and provide enough assurances to enable them to plan and build a viable local and export corn system. It stands as an excellent example for other developing-developed commodity-system interfaces.

Another approach that has proven beneficial is that of the Mitsui (Mitsugoro) project in Indonesia. In this case, over $5 million has been spent in developing



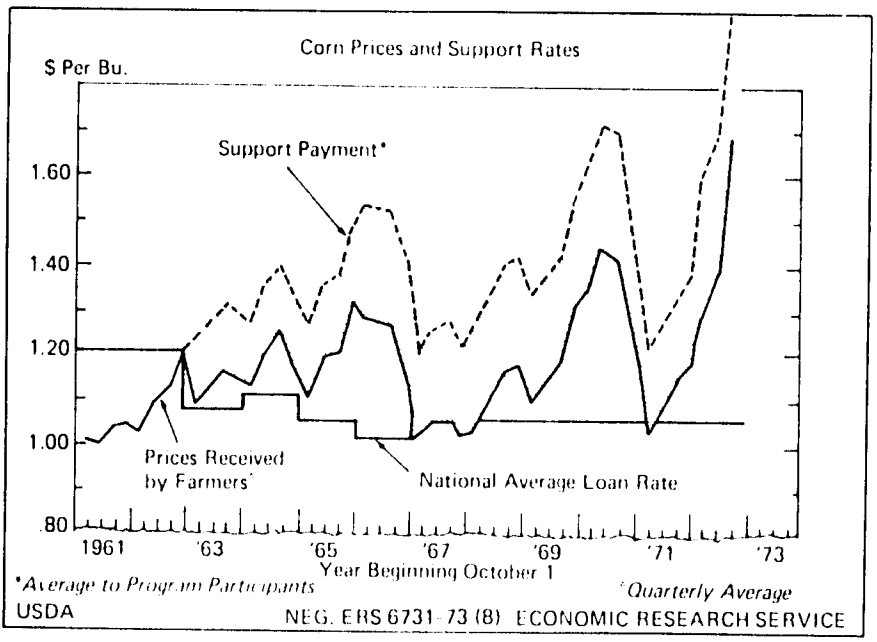


Figure 6-2. U.S. Corn and Price Support Levels 1961-1977 and World Export Price for Maize (Corn) Wheat, Soybeans, and Rice 1948-1973

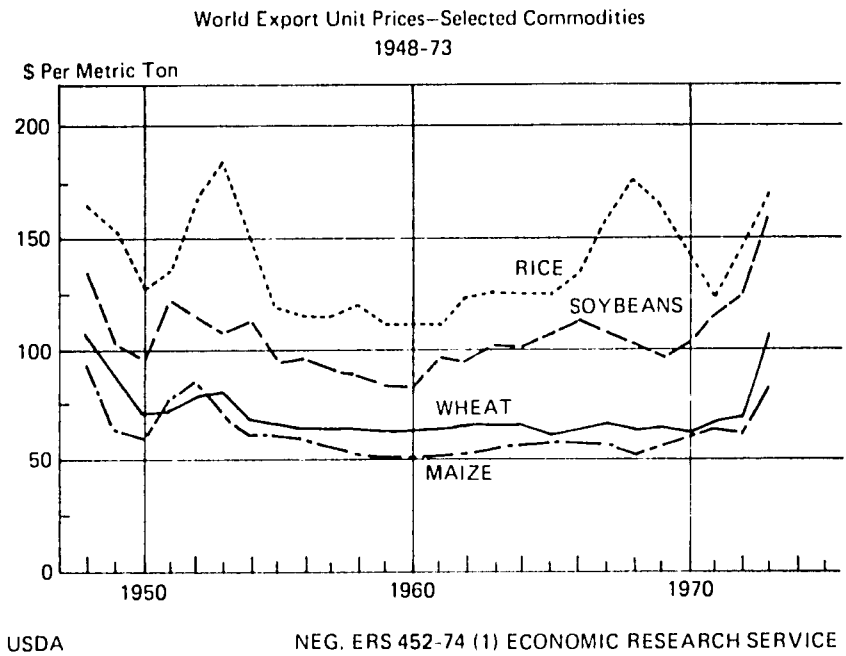


Figure 6-2 continued

undeveloped lands in a sparsely settled area of Indonesia. There were many technical difficulties; much misunderstanding resulted when some producers blamed the project for introducing an outbreak of a downy mildew corn blight in 1973-74; and the large-scale nature of the project seemed to be a threat. In spite of this, technology transfer has taken place, employment has increased, a town has been created, and proposals for an orderly transfer of the project to a cooperative of small-scale producers have been made in recent studies.[8] The Booker McConnell changemaker example at the end of this chapter starts with the small-scale producer as a major participant at the *initial* phase of the project. We believe that including the small-scale producer at the start of a project is essential for any development activity. The Mitsugoro project would have benefited from the Booker McConnell approach.

In summary, Japanese multinational firms are providing three valuable inputs into the world corn system: (1) backward integration into U.S. and other developed countries supplies; (2) contractual coordination that leads to economic development in the developing countries; and (3) direct investment in projects in developing countries and methods to transfer those projects to local ownership.

Table 6-1. Competitive Positions of Major and Potential Suppliers of Corn to Japan: 1974

	United States	*Indonesia*	*Philippines*	*Thailand*
Yield assumption (metric tons/per hectare)[b]	5.4	1.22	.84	2.26
Production costs (U.S. dollars per hectare)[c]	422.12	25.96	38.00	165.11
Farm cost per metric ton (U.S. dollars)	78.17	21.27	45.23	73.05
Farm price per metric ton (U.S. dollars)[d]	123.23	54.52	96.65	90.27
Wholesale price per metric ton (U.S. dollars)[e]	133.09	81.78	115.01	125.00
F.o.b. premium over wholesale price[f] per ton (U.S. dollars)	6.41	24.53	23.20	9.73
Export price per ton[g]	139.50	106.31	138.20[a]	134.73
Ocean freight per ton[h]	10.00	26.00	--	14.77
C&F Japanese port, per ton[i]	149.50	132.31	--	149.50

[a]Retail price.

[b]USDA, *Agricultural Statistics, 1976.*

[c]United States: Economic Research Service, USDA, *Costs of Producing Foodgrains, Feedgrains, Oilseeds, and Cotton, 1974-1976.* Land and management costs from *Costs of Producing Selected Crops in the United States–1975, 1976, and Projections for 1977,* Committee on Agriculture and Forestry, U.S. Senate. Indonesia: SEARCA, *The Indonesian Corn Commodity System,* p. 25. Figures for Java and Madura only. Philippines: SEARCA, reporting figures in *The Philippine Agricultural Situation,* June 1975, published by the Bureau of Agricultural Economics, Philippine Department of Agriculture. Thailand; SEARCA, *The Thailand Corn Commodity System,* Ch. 3, Table 3.7.

[d]United States: USDA, *Statistical Reporting Service.* Indonesia: SEARCA, *The Indonesian Corn Commodity System,* p. 25. Philippines: SEARCA, Based on *The Philippine Agricultural Situation,* June 1975, published by the Bureau of Agricultural Economics, Philippine Department of Agriculture. Thailand: Estimate, based on SEARCA estimate of farm price 67 percent of export price.

[e]Based on USDA and SEARCA estimates of wholesale margins, as follows: United States: 8 percent of farm price; Indonesia: 50 percent of farm price; Philippines: 19 percent of farm price; Thailand: 39 percent of farm price.

[f]Difference between wholesale price and export price.

[g]United States: cif price in Japan less $10 per ton ocean freight. Thailand: Based on SEARCA estimated export price as 195 percent of farm prices. Philippines: Based on SEARCA estimated retail price as 143 percent of farm price. Thailand: Average of monthly figures reported in the *Monthly Bulletin* of the Bank of Thailand.

[h]United States: UNICOOP Japan, Ltd. Indonesia: Mitsui & Co., Ltd. Thailand: UNICOOP Japan, Ltd.

[i]U.S. and Thailand: 1974 average, based on figures of Ministry of Finance, government of Japan. Indonesia: Sum of export price and ocean freight.

A U.S. MULTINATIONAL FIRM'S APPROACH TO THE CORN SYSTEM

The U.S. corn system has 24 percent of the world's corn acreage, about 45 percent of the world's corn production, and over 70 percent of the world's corn exports. The overwhelming presence of the United States in the world corn system means that what happens internally in the United States to our price policy, export policy, dollar value, or feed consumption has an immediate impact on that part of the world's corn system that does not insulate itself from th world market. U.S. multinationals have two strengths to offer the developing world—the ability to provide technological transference in an appropriate corn technology that fits local needs and the ability to relate that new corn system to the world market.

The two examples that stand out in this study are the Rafhan Maize Products Company and the Early and Daniel Company. In the case of Rafhan Maize, CPC International has a joint interest in a company in Pakistan. The local government extension service had been unable to improve the corn system and encouraged Rafhan to take on the task. With the help of the previous governmental extension director, Rafhan was able to improve the corn technology of many farmers by providing a local market, guaranteeing a minimum price for corn (even before it was planted), and providing credit, seed, fertilizer, and storage. In many cases, the new varieties of corn provided two crops where only one had been grown previously. Rafhan also provided a grading system where none existed before. The processing industry provided local oil and starch products, which had been previously imported. Critics of this project were concerned that part of the increased local corn production was being utilized for industrial rather than food purposes and that a stable food supply was being diverted away from on-farm consumption. At the same time, the government was so pleased with the success of the program that it asked Rafhan to develop a seed program for sorghums, even though this was not the company's major commodity activity. Rafhan provided a corn structure and a corn support system where none existed before and improved the productivity of corn production for its suppliers and for other small corn producers who now had the new seeds available to them.

The Early and Daniel case analysis was included in the book as an excellent example of a domestic exporting grain firm developing a whole range of procurement arrangements that enabled U.S. corn farmers to sell their corn over a crop year at their convenience. This farmer decision-flexibility and broad farmer access to overseas markets are coordinating activities that are useful and transferable to both developed and developing corn economies.

U.S. corn entities have also become more aware of small-scale farm operation in the United States as well as overseas. It is difficult to be convincing about helping the small farmer overseas without developing similar techniques in the

Table 6-2. Range of Corn Production Costs Per Planted Hectare and Per Kilo, by Cost Item, United States, Indonesia, the Philippines, and Thailand: 1975 (U.S. dollars per hectare; U.S. dollars per metric ton)

	United States[a]				*Indonesia*[c]		*Philippines*	
Cost Item	*Low*	*Mean*	*High*	*Thailand*[b]	*Java and Madura*	*Outside Java*	*Low*[d]	*High*[e]
Variable	224.60	225.29	274.00	111.83	22.16	5.87	24.67	156.73
Seed	23.49	22.97	20.30	4.33	2.64	1.89		4.93
Fertilizer	96.73	94.28	123.25	3.20[f]	6.20	.05		50.33
Lime	2.10	1.98	4.92	–	–	–		–
Chemicals	29.96	28.78	32.65	–	.05	.09		20.00
Custom operations	10.25	11.66	18.38[g]	24.25[h]	4.94[i]	2.17[j]		–
Labor	9.29	21.17	26.75	66.53	8.33	1.67		64.80
Fuel and lubrication	11.49	14.13	16.13	–	–	–		–
Repairs	12.89	13.73	16.18	–	–	–		–
Drying	9.90	8.27	5.83	11.10[k]	–	–		16.67
Miscellaneous	–	.05	–	2.42	–	–		–
Interest	8.50	8.27	9.61	–	–	–		–
Machinery ownership cost	52.61	56.24	56.51	–	–	–		–
Replacement	33.37	35.27	35.87	–	–	–		–
Interest	15.36	16.43	16.94	–	–	–		–
Tax and insurance	3.88	4.54	4.20	–	–	–		–
General farm overhead[l]	21.09	20.72	18.18	1.26	2.36	2.05	8.20	13.07
Management	38.73	36.46	28.21	14.78	–	–		–
Total, excluding land	337.03	338.71	376.90	–	–	–		–
Land allocation[m]	152.28	133.87	64.44	32.81	1.76	1.89		20.00
Total, including land	489.31	472.58	441.34	160.68	26.28	9.81	32.87	189.80
Yield (metric tons per hectare)	5.77	5.39	3.89	2.34	1.17	1.3	.6	2.5
Production cost per metric ton	84.80	87.68	113.45	67.51	22.46	7.5	54.78	75.92

[a]Research Service, USDA, *Costs of Producing Selected Crops in the United States--1975, and Projection for 1977;* pp. 14-15. Prepared for the Committee on Agriculture and Forestry, U.S. Senate, Washington, 1977. Per acre figure converted to hectares; 1 hectare equals 2.47 acres.

[b]SEARCA, *The Thailand Corn Commodity System,* Ch. 3, Table 3.7 cost figures in baht converted to U.S. dollars at rate of 20.8 baht equals U.S. $1.00.

[c]1974 Estimates. Source: SEARCA, *The Indonesian Corn Commodity System,* Ch. 3, p. 25.

[d]Figures for 1973 as reported by Philippine Bureau of Agriculture economics for region II in June 1975 using traditional methods. Figures were increased by 10 percent annually to arrive at 1975 estimate.

[e]Phil Hi-Bred, Inc.

[f]Includes cost of chemicals.

[g]Includes custom application of crop chemicals, custom harvesting and handling and cost shelling.

[h]Use of machinery for land preparation.

[i]Land preparation cost.

[j]Rental and animal cost.

[k]Use of machinery for shelling and drying.

[l]For Thailand, connotes fixed cost.

[m]Land allocation cost: United States: Based on prevailing tenure arrangements in 1974, reflecting actual confirmations of cash rent, net share rent, and owner operator land allocations using average value of cropland at time of acquisition. Thailand: Includes land rent and land use cost. Indonesia: "Other" costs as reported by SEARCA. Philippines: Land rental charges. No breakdown of land cost for "low" estimate.

U.S. environment. A typical changemaker indicating the increasing awareness of the problem is the Southern Agricultural Cooperative. Over the last decade, the small-scale black farmers in the United States were forced to sell off 7 million of their 14 million acres of farmland because they were no longer economic to farm. The Southern Agriculture Cooperative has combined several black farmer cooperatives in an effort to develop farm projects suitable to small-scale, land-based agriculture and still provide a reasonable standard of living for the black farmer. Similarly, the U.S. Department of Agriculture is beginning to pay more attention to the 2 million- out of a total farmer population of 2.7 million farmers who have less than a $20,000 gross farm income per year. Much of their total net income from all sources (as much as 80 percent) comes from nonfarm sources. Their maintaining small-scale agriculture is important to the social fabric of the country. This new interest in small-scale farming will also have transferability to the traditional small-scale agriculture of developing countries. Similarly overseas firms are bringing their experience of small-scale agriculture in developing countries to specific farm projects in U.S. agriculture.

INDIGENOUS CHANGEMAKERS IN INDONESIA, THE PHILIPPINES, AND THAILAND

Several types of changemakers were identified in the appendixes to Chapter 5. Unfortunately, in each situation some limitations to the effectiveness of the changemakers were noted. For example, six limitations were noted to the Philippine Masaganang Maisan (bountiful corn) project. But in spite of these, 230,000 farmer cooperaters were reached and some unusually productive successes were noted in Table 5E-8, with a range of forty-four 50-kilogram sacks per hectare at the top, to a low of seventeen 50-kilogram sacks per hectare. The frustrating aspect of this major effort to change the Philippine corn system is that there were no identifiable common patterns for productive success or failure. In some cases, the presence of a large number of extension workers led to success, in others, just the opposite. It would appear that favorable land and climatic conditions, together with access to credit and other inputs, were more important than just a "package" approach to corn development in the Philippines.

Again, in the case of the Phil Hi-Bred Seed Company, the attempt to work with new land development projects to respond to the government's decree that major firms be responsible for supplying food for their employees had mixed results, mainly because of the lack of experience of the firms involved. Other cases, such as the Cebu Corn Dry Milling Company, indicated that well-meaning government programs that set both the price of corn and the price of end products of corn may inadvertently lead to major distortions in the corn economy if these prices are unrelated to the real market conditions of the economy.

The East Java Corn Project of Indonesia appeared to have some success as a

changemaking endeavor primarily because of the coop-to-coop relationship with Zen-Noh as noted previously. Finally, the case of Mr. Olimpio Aliliran, selected by our collaborators from the Philippines, showed an interesting and encouraging response by a small-scale farmer. However, this example is not really relevant to the subsistent producers and landless laborers who are less fortunate and have a very limited resource base. For this reason, we felt compelled to include a changemaker leader in another country and in another commodity system to be representative of the indigenous changemakers needed in the developing food economies: we were most disappointed that such a leadership model did not emerge from this corn study.

OPERATION FLOOD—A KEY MODEL FOR THE FUTURE

The model indigenous developing country changemaker is the Anand Dairy described in Appendix C of this chapter. These village milk producers' cooperatives have 100 to 200 members and represent 50 to 90 percent of the village's families. The average family herd is 1.3 cows. About 20 to 30 percent of the members are landless laborers, 40 to 60 percent are smallholders, and the balance are medium-size producers. This project was the brain child of V. Kurien, whose vision was to improve the milk supply of the country and to help those who produced the milk. The institutional approach was unique—with the government-owned Indian Dairy Corporation responsible for both the quality of investments and for ensuring also that foreign aid in the form of surplus milk powder became part of processing and distribution and added resources to the project rather than competed with it. An independent National Dairy Development Board was responsible for stimulating the development of local dairy cooperatives as *independent* producers' decisionmaking bodies.

One must recognize that the milk commodity system has several unique advantages for development. The technology of improving the health and productivity of the animal is demonstrated on a daily basis in improved output. The producer sees this improved output each day and is immediately rewarded for it. The lesson to be learned is that there must be productivity in order to provide cash flow for the development process. Also dairying in India competes only in a very limited way for other resources, since much cattle feed is roughage, grass, and weeds that are unsuitable for human consumption. The cooperative, being built from the ground up rather than being superimposed by the government, also provides real leadership at the grassroots level and real involvement by the subsistent producer and landless laborer in the development process.

We believe this changemaker activity to be a beacon light in an agribusiness-commodity-system approach to development and believe in its transferability to other commodity systems both within and outside of India. So successful has this approach been that it is already being applied to the oil seed crops of India.

PRIVATE VOLUNTARY ORGANIZATIONS AS CHANGEMAKERS

Another changemaking group that develops novel and creative ways of improving the subsistent producer's position in his food system is private voluntary organizations such as church groups and development groups. Many of their activities encourage the development of grass roots farm cooperatives and local marketing, transportation, and credit societies They become the testing ground of much of what is new in development and rely heavily on local, indigenous leadership. They seldom get the credit they deserve, as much of their creativity is duplicated by larger scale, more formal institutions. Their presence and contribution are invaluable.

LEADING MULTINATIONAL CHANGEMAKERS

Just as there are leading changemakers at the indigenous and producer level in other commodity systems whose approach may be applicable to the needs of the corn system in Southeast Asia, so too are there unique multinational changemakers in other systems who are providing a much needed leadership in developing-country food systems. Two such changemakers are noted in Appendixes D, E, and F in this chapter. Tate & Lyle represents the evolution of a sugar firm that has moved from reacting defensively to local governmental programs to actively trying to anticipate changes and provide collaborative leadership with the local private and public decisionmakers in the food system. Its goal has been to create national companies that are run by local nationals but maintain strong bonds with the Tate & Lyle group. The company must be wanted and must fill a need of the developing country. This is not a philanthropic venture. It wants to provide technological and global marketing services to improve the public and private firms it serves, either on a joint-venture or service basis and at a profit to Tate & Lyle. It wants to have the best expertise in reaching both the commercial and small-scale producers in the system and to blend them together in an economic fashion.

One of the best examples of a similar agribusiness approach is Booker Agricultural International and its Mumias sugar scheme in Kenya (see Appendix F of this chapter). Even its severest critics and inadvertent distorters applaud Booker's approach in the Mumias project and consider it one of the most important ways multinational corporations in agribusiness can make contributions to developing food economies. As Susan George states in her book, *How the Other Half Dies*, "In another sense, the success of Mumias is a further argument that multinational agribusiness must be controlled, for when it is, it has a definite contribution to make . . . . it appears to be an excellent specimen of the contributions business *could* make to development if *social goals*, not merely profitability, were present in the project from the drawing board to the actual operation."[9]

Such is the case of Mumias, which originated with the Kenyan government requesting help and input from Booker on the project. Booker carried out a pilot project and with the government outlined a program to create a whole sugar system involving over 16,000 small-scale producers and 2,500 other employees—and do so on a managing agency agreement that compensates the company on a production and efficiency basis. The Kenyan government also requested that Booker invest 5 percent of the equity in the project. Thus far, 1978, the project is successful and an outgrowers' company (farmers' cooperative) has been created to promote and represent the growers of sugar and to provide credit, supplies, and such for its members. In a sense, the Kenyan government and Booker have had to take on the responsibility of helping producers and workers create their own institutions for development, just as the National Dairy Development Board did in the Anand Dairy case. Obviously, there are risks to all the parties involved in this project, as well as concerns such as the initial land acquisition procedure, appropriate technology, social effects, and danger of control of farmer activities. But in each instance, care has been taken to preserve and encourage alternatives and choices for the producers and to ensure that only part of each farm be used for sugar cane, leaving the outgrower free to use the rest of the land as he wishes. Because the government controls the prices of sugar and sugar products and the imports of machinery and related needs, the Mumias project is also dependent on the policies of the government as well as the efficiency of Booker's operational, managerial, and marketing skills.

Booker, as well as Tate & Lyle, are leaders on a "learning curve" on how to work with small-scale producers and governments to the mutual benefit of all parties concerned. Effective use of these skills should benefit the company, the commodity system, the government, the small-scale producer, and the ultimate cosumer. As Jonathan Taylor of Booker Agriculture International put it in a talk given at Oxford:

> I hope it does not sound unduly pompous to say that the future trade, stability, and perhaps peace of the world depends on satisfying the minimal needs and expectations of Third World countries and their teeming populations, where some 10,000 people die every day from malnutrition or its results.[10]

INTERNATIONAL CHANGEMAKERS

In September 1973, President Robert McNamara of the World Bank announced the bank's concern with the failure to include the bottom 40 percent of the population in the process of economic growth. By 1977, the bank's projects had been tailored to reach a target group of small farmers and farm workers of 46.5 million or approximately 8 percent of the 600 million rural poor. The World Bank, as well as other private, cooperative, and public institutions, is also at the

beginning of a learning curve on how to reach the rural poor. The decline of U.S grain surpluses in 1972 (now called reserves) refocused the world's attention on the complex world food problem and even more on its interrelated, interdependent nature. The World Bank provides a global focus so needed in an international-commodity-system approach to these problems.

Similarly, the Agency for International Development of the U.S. State Department has also developed "new directions." The Foreign Assistance Act of 1961, as amended in 1975, has two major objectives for helping developing countries: "(1) increase their capacity to expand and distribute food supplies to alleviate hunger and malnutrition, and (2) increase participation of poor people in the process and benefits of development."[11] AID is one of the few agencies with an interest in linking agricultural and general economic development. AID could become an institution with a more global economic perspective rather than a project-by-project orientation. AID is now in the process of developing an excellent global feedback system that will enable it to be a catalyst to changemakers attempting to blend the national nonmarket and national market systems into a global food economy.

Similarly, the International Fund for Agricultural Development created by the World Food Conference now has $1,022,000,000 of resources, of which $567 million were contributed by developed countries, $435 million by OPEC developing countries, and $20 million by other developing countries. The fund's resources are to be used to support projects that combine these interrelated objectives:

1. to raise food production, particularly on small farms
2. to provide employment and additional income for the poor and landless farmers
3. to reduce malnutrition by producing among other crops the kind of food that the poorest populations normally consume and by improving the food distribution system.

These objectives require the response of local institutions and local changemakers. We have noted above a few of the changemakers who have been effective in the corn and other commodity systems in developing countries. To identify these institutions and unique individuals is critical to the improvement of the corn system or any commodity system.[12] As Wayne Broehl so aptly puts it: "Innovation and change infuse the lives of every inhabitant of this globe, whether residing in a modern city of the developed world or in a traditional village of a less developed country. The person who takes these innovations and makes the idea/projects realities is a change agent, and a benefactor of moment to the world."[13]

An agribusiness commodity approach to identifying problems, opportunities, changemakers, and effective institutions in a Southeast Asian corn system may

be a useful device, but who will get the benefits of a more effective and socially responsive corn system? Ultimately this depends on the public policymakers of each nation. Some authors contend that the "inequality in control over productive resources is the primary constraint—on food production and on equitable distribution."[14] This book attempts to indicate how the corn system can be more productive—because there must be productivity before one has a product to share. Priorities of public and private policymakers are changing, and the rural poor cannot be ignored from the viewpoint of either productivity or humanitarianism. It is our hope that this book provides one way of analyzing the complex problems of the Southeast Asian corn system and indicates the type of changemakers who are leaders in responding to the need to improve both the effectiveness of their corn systems and the well-being of all participants, especially those who in the past have been neglected or rewarded inequitably.

NOTES

1. Two examples of the distortion of the term are the articles by Ernest Feder "Agribusiness and the Elimination of Latin America's Rural Proletariat," World Development 1977 Vol. No. 5-7, pp. 559-71, Pergamon Press, Great Britain, and Radha Sinha, "Agribusiness a Nuisance in Every Respect?" "MAZINGIRA" No. 3/4, pp. 16-23, Spring 1977, Pergamon Press, Great Britain.

2. One way of organizing and evaluating the many complex elements in the corn system is through the development of a model as set forth in Appendix 6G of this chapter.

3. R.A. Goldberg et al., *Agribusiness Management for Developing Countries—Latin America*, Ballinger Publishing Co., Cambridge, Mass., 1974, pp. 3-4.

4. Note the nutritional value in Appendix 6B of corn in these countries and its value as a cheap source of calories and protein.

5. John Kenneth Galbraith, "The Defense of the Multinational Firm," Harvard Business Review, March-April 1978, Boston, Mass., pp. 86-88.

6. Radha Sinha, "Agribusiness A Nuisance in Every Respect?" "MAZINGIRA" No. 3/4, p. 23, Spring 1977, Pergamon Press, Great Britain.

7. See Table 5-1, p. 299.

8. See, for example, Yoshi Tsurumi, "Transformation of the Mitsugoro Pilot Farms: Action Plans and Implementation," Research Report No. 4, Indonesian National Science Council (LIPI) 30 September 1977, Graduate School of Business, Columbia University, New York, N.Y.

9. Susan George, *How the Other Half Dies*, Penguin Books, New York, N.Y., 1976, pp. 182-85.

10. Appendix 6F, p. 537.

11. Agricultural Development Policy Paper, Agency for International Development, June 1978, p. 1, Washington, D.C.

12. As part of this research project, a seminar was held at Harvard with changemakers from developed and developing countries, including subsistent

producers, in order to test the corn-commodity-systems approach and the value of the institutions and arrangements developed by these changemakers (see Appendix 6A).

13. Wayne G. Broehl, Jr., *The Village Entrepreneur*, Harvard University Press, Cambridge, Mass., 1978, p. 183.

14. Francis Moore Lappe and Joseph Collins, "Food First Revisited," AgWorld, April 1978, pages A-1, St. Paul, Minn.

APPENDIX A
PARTICIPANTS IN AGRIBUSINESS MANAGEMENT FOR THE DEVELOPING AND DEVELOPED WORLD FOOD SYSTEMS SEMINAR

Dr. Carlos Acedo
IPADE
Floresta 20
Mexico 16, D.F.

Mr. Samuel Adams
2716 Wichita Street
Houston, Texas 77004

Syed Aftab Ahmad
G4-G-Gulberg
Lahore, Pakistan

Professor Emeritus Henry B. Arthur
Baker 100
Harvard Business School
Soldiers Field
Boston, Massachusetts 02163

Mr. J. W. Balano
International Center for Industrial Studies
UNIDO
Vienna, Austria A 10-11

Mr. Melvin R. Bandle
World Food Systems, Inc.
1707 L Street, N.W., Suite 510
Washington, D.C. 20036

Professor Chemnien Boonma
Agribusiness Program
Kasetsart University
Bangkok--9, Thailand

Mr. John Botts
Citicorp International Development
17 Brouton Street
London W1X 8AA, England

Dr. Wayne G. Broehl, Jr.
Amos Truck School of Business Administration
Dartmouth College
Hanover, New Hampshire 03755

Mr. E. Charles Brown
Southern Agriculture Corporation
210 Triangle Building
1775 The Exchange
Atlanta, Georgia 30339

Mr. Cherd Bumrungsri
c/o Dr. Delane Welsch
Rockefeller Foundation
GPO Box 2453
Bangkok, Thailand

Mr. George D. Bunce
Unilever, Ltd.
Kildare House
1516 Dorset Rise
London EC4, England

Mr. Philip Busbee
Sea-land Services
P.O. Box 1050
Elizabeth, New Jersey 07207

Mr. Cameron Chisholm
C.M. Chisholm & Associates, Ltd.
Via San Pantaleo 66
Rome 00186, Italy

Dr. Geronimo Collado
SEARCA
P.O. Box 720 MCC
College, Laguna 3720, Philippines

Held on 16-18 May 1976, Harvard Business School.

Mr. Paul F. Cornelsen
Ralston Purina Company
Checkerboard Square
St. Louis, Missouri 63188

Mr. Dean A. Cortopassi
Cortopassi Farm
11292 North Alpine Road
Stockton, California 95205

Mr. Richard Crisler
AA/PPC
AID
Department of State
Washington, D.C. 20523

Mr. Frank Curtis
Belize Sugar Industries, Ltd.
Libertad, Corozal, Belize

Mr. Neil Denaut
International Division
Foremost Foods Company
1 Post Street
San Francisco, California 94104

Mr. Thomas DiMare
DiMare Brothers
30 Water Street
Arlington, Massachusetts 02174

Mr. Abraham Dominguez Cerezo
FIRA
La Zaro Cardenas
#24660
Morelia
Mich, Mexico

Dr. J.D. Drilon, Jr.
SEARCA
College, Laguna 3720
Philippines

Mr. Rodney F. DuBois
Alexander & Baldwin Agribusiness Corporation
P.O. Box 3440
Honolulu, Hawaii 96801

Mr. Shigeru Endo
Agri-Products Department
Mitsui & Company
200 Park Avenue
New York, New York 10017

Mr. James Evans
Booker McConnell, Ltd.
Bucklersbury House
83 Cannon Street
London EC4N 8EJ, England

Mr. Hervey Evans, Jr.
McNair Seed Company
P.O. Box 706
Lauringburg, North Carolina 28352

Mr. Curtis Farrar
Assistant Administrator
Agency for International Development
Department of State
Washington, D.C. 20523

Mr. Roy C. Ferguson
Southern Agriculture Corporation
210 Triangle Building
1775 The Exchange
Atlanta, Georgia 30339

Mr. Ray Fitzgerald
Agricultural Cooperative Development International
1430 K Street, N.W., Suite 1200
Washington, D.C. 20433

Mr. Richard Frank
World Bank
1818 H Street, N.W.
Washington, D.C. 20433

Mr. Jerome French
Office of Development Administration
Technical Assistance Bureau
Agency for International Development
Department of State
Washington, D.C. 20523

Ing. Jorge Friedmann Requena
Fondo de Garantia Agriculture
Thirteenth Floor
Insurgentes Norte #423
Mexico 3, D.F.

Mr. Alan Goldie
First National City Bank of New York
399 Park Avenue
New York, New York 10022

Señorita Marina Gonzales
Arrozera Los Corrales
Finca San Francisco
Villa Nueva, Guatemala,
Central America

Mr. Warren Hageman
Del Monte Corporation
P.O. Box 3575
1 Market Plaza
San Francisco, California 94119

Professor Rusli Hakim
Central Institute for Agriculture
Merdeka 99, Bogor
Indonesia

Mr. Michael Halse
National Dairy Development Board
Post Box No. 30
Anand–388 001, India

Mr. John Hammock
AITEC
10-C Mount Auburn Street
Cambridge, Massachusetts 02138

Mr. Howard Harris
CPC International, Inc.
International Plaza
Englewood Cliffs, New Jersey 07632

Mr. Kenneth Hoadley
INCAE
Apartado Postal 2485
Managua, Nicaragua
Central America

Mr. Willima S. Hoofnagle
Foreign Development Division
ERS
USDA
Washington, D.C. 20250

Dr. Robert House
Socio-Engineering Department
Vanderbilt University
Nashville, Tennessee 37325

Ms. Frances Johnson
ES/RAS
Room 5945
New State Agency for International Development
320 21st Street, N.W.
Washington, D.C. 20523

Mr. Frans J. Kok
Booz-Allen & Hamilton, International
1025 Connecticut Avenue, N.W.
Washington, D.C. 20036

Mr. Jack Koteen
Association for Management and Evaluation, Inc.
6400 Majory Lane
Bethesda, Maryland 20034

Dr. C.Y. Lee
Food and Agricultural Organization of the United Nations
Maliwan Mansion
Phra Atit Road
Bangkok 2, Thailand

Mr. Princeton Lyman
AFR/DS
AID
Department of State
Washington, D.C. 20523

Mr. Malcolm Macdonald
CPC International (Asia), Ltd.
1903 Realty Building
P.O. Box 846
Hong Kong

Mr. Bernard Manuel
Louis Dreyfus Corporation
One State Street Plaza
New York, New York 10004

Dr. Martin M. McLaughlin
Overseas Development Council
1717 Massachusetts Avenue, N.W.
Washington, D.C. 20036

Dr. Donald F. McMillen
East-West International Corporation
18552 MacArthur Boulevard
Suite 460
Irvine, California 92707

Dr. Frank Meissner
Inter-American Development Bank
1801 17th Street, N.W.
Washington, D.C. 20572

Mr. Walter W. Minger
National Trust and Savings Association
Bank of America
555 California Street
San Francisco, California 94104

Mr. Yukio Miyazawa
Senior Vice President
C. Itoh & Company (America), Inc.
270 Park Avenue
New York, New York 10017

Mr. Sergio Ulises Molina
Central Bank of Nicaragua
Managua, Nicaragua

Mr. David Morrissy
Farmer Cooperative Service
United States Department of
Agriculture
500 12th Street
Washington, D.C. 20250

Mr. Naoki Niimi
Feed & Grain Department
UnicoopJapan, Ltd.
1 World Trade Center, Room 5301
New York, New York 10048

Dr. Abbas Ordoobadi
Embassy of Iran
3005 Massachusetts Avenue, N.W.
Washington, D.C. 20008

Mr. Hiroshi Ohara
Corporate Planning Division
Mitsui & Company, Ltd.
P.O. Box 822
Tokyo Central Post Office
Tokyo, Japan

Mr. Arthur J. Olsen
FMC Corporation
Prudential Plaza
Chicago, Illinois 60601

Shri Narendrabhai S. Patel
Kaira District Cooperative
Milk Producers' Union, Ltd.
Anand 388 001, India

Shri Ramanbhai S. Patel
Kaira District Cooperative
Milk Producers' Union, Ltd.
Anand 388 001. India

Mr. Derek G. Pearce
Oaks Farm, Kerdeston
Reepham, Norwich
Norfolk NR10 4 RP
England

Mr. Fletcher Riggs
ASIA/TD
AID
Department of State
Washington, D.C. 20523

Mr. Armando Rodriguez Sanchez
Ejido de Jacona
Zamora, Michoacan, Mexico

Mr. Robert Ross
Latin American Agribusiness Development Corporation, South America
100 N. Biscayne Boulevard, Suite 901
Miami, Florida 33132

Mr. Edward Schaefer
LA/RD
AID
Department of State
Washington, D.C. 20523

Mr. Walter W. Simons
Industry Cooperative Programme
United Nations Headquarters
Room 845
New York, New York 10017

Mr. Ted Sitkoff
Public Administration Service
1776 Massachusetts Avenue
Washington, D.C. 20036

Dr. Robert R. Spitzer
Office of Food for Peace
Room 6212
AID
Department of State
Washington, D.C. 20523

Mr. Murray Stewart
International Agribusiness
Alexander & Baldwin, Inc.
P.O. Box 3440
Honolulu, Hawaii 96801

Mr. Michael G. Storey
International Projects Operations
Booz-Allen & Hamilton, International
1025 Connecticut Avenue, N.W.
Washington, D.C. 20036

Mr. Saxon Tate
Tate & Lyle, Ltd.
21 Mincing Lane
London, EC3R, 7QY, England

Mr. Steve Tavilla
P. Tavilla Company, Inc.
78 New England Produce Center
Chelsea, Massachusetts 02150

Mr. George Thomas
Tri-Valley Growers
100 California Street
San Francisco, California 94106

Mr. Agustin Torrez Cruz
Ejido de Jacona
Zamora, Michoacan, Mexico

Mr. George A. Truitt
International Development Foundation
175 Clearbrook Road
Elmsford, New York 10523

Dr. Fred N. Twining
Pacific School of Religion
2465 LeConte
Berkeley, California 94709

Mr. Richard Wheeler
WINROCK Livestock Foundation
Petit Jean Mountain
Morrilton, Arkansas 72201

Mr. Graham Williams
Overseas Private Investment
Corporation
1129-20th Street, N.W.
Washington, D.C. 20527

Mr. Paul Worthington
Technical Assistance Bureau
AID
Department of State
Washington, D.C. 20523

Dr. Robert E. Wunderle
Pathmark Division
Supermarket General Corporation
301 Blair Road
Woodbridge, New Jersey 07095

APPENDIX B
NUTRITION

An examination of any major food commodity system is incomplete unless it treats the nutritional aspects of the staple. The fundamental objective of all basic commodity systems is to provide the nutrients needed and desired to sustain the nutritional well-being of the populace. Accordingly, a nutrition analysis of a commodity system should cover four key dimensions:

1. the role of the commodity in the diet of the population
2. the nutrient profile of the foodstuff
3. the nutritional status of the populace
4. the nutritional implications of policies affecting the commodity system.

This appendix will use this general framework to examine the nutritional dimension of the maize system first globally and then more specifically in the three Southeast Asian countries—the Philippines, Indonesia, and Thailand—examined in depth in this book. To provide an overview we shall first examine the role maize plays in the global diet and look at the nutritional characteristics of this staple. We will then sharpen our focus by specifying the role of maize in the diets of the three Southeast Asian nations. This discussion is followed by a description of the malnutrition problems confronting these countries and the nutrition policies and programs undertaken by their governments to combat them. The final section discusses the implications of these efforts for maize policy.

Maize's Role in the World's Diet

Cereals in general are the major food of the world, accounting for 52 percent of the average per-capita intake of calories, 47 percent of the protein, and 9 percent of the fats. Maize is the least nutritionally significant of the three major cereals. It provides 6.2 percent of the world's calories and 5.5 percent of its protein, whereas wheat supplies 19 percent and 20 percent and rice 19 percent and 13 percent of the calories and protein, respectively (see Table 6B-1).

These global averages, however, cloak the dominant role maize plays in the diets of particular regions and countries. Although fifty countries have an intake of less than 100 grams per person per day, fourteen countries consume 350 grams per capita (see Table 6B-2). Native to Latin America, maize is the dominant cereal in Mexico, for example, where it provides 43 percent of the calories and 44 percent of the protein, while wheat accounts for 8 percent and 9 percent and rice only 2 percent and 1 percent. In Asia, rice dominates the diet. In Thailand, 72 percent of the caloric intake and 58 percent of the protein consumed is from rice.

Dietary differences stem from many factors, including the agronomic suitabil-

Table 6B-1. Relative Importance of Various Food Groups in Average World Daily Per Capita Intake: 1964-66.

	Calories		*Proteins*		*Fats*	
	Number	*Percent*	*Grams*	*Percent*	*Grams*	*Percent*
Cereals	1,245	52.4	31.1	47.4	5.1	9.3
Wheat	441	18.6	13.3	20.3	1.5	2.7
Rice	459	19.3	8.5	13.0	1.0	1.8
Maize	147	6.2	3.6	5.5	1.0	1.8
Millet and sorghum	119	5.0	3.5	5.3	1.2	2.2
Others	76	3.2	2.1	3.2	0.4	0.7
Roots and tubers	184	7.8	2.8	4.3	0.4	0.7
Sugar and sugar products	210	8.8	0.1	0.2	–	–
Pulses, nuts, and oilseeds	121	5.1	7.9	12.0	3.6	6.5
Vegetables	36	1.5	2.2	3.4	0.3	0.5
Fruits	47	2.0	0.6	0.9	0.3	0.5
Total, animal products	322	13.6	20.7	31.5	22.4	40.8
Meat	168	7.1	9.2	14.0	14.3	26.0
Eggs	18	0.8	1.4	2.1	1.3	2.4
Fish	19	0.8	3.0	4.6	0.6	1.1
Milk	117	4.9	7.1	10.8	6.2	11.3
Fats and oils	199	8.4	0.1	0.2	22.5	40.9
Vegetable oils	127	5.3	–	–	14.4	26.2
Animal fats	72	3.1	0.1	0.2	8.1	14.7
Total	2,374	100.0	65.6	100.0	55.0	100.0
Animal origin	396	16.7	20.8	31.7	30.5	55.5

Source: Food and Agriculture Organization Agricultural Commodity Projections, 1970-80, p. 40.

ity of the country for certain crops and cultural food preferences. Even regional generalizations can be misleading. In the geographically concentrated region of Central America, one can discern some sharp contrasts. The average daily per-capita intake of maize in rural Panama is 4 grams, and in Costa Rica it is 41; but in Guatemala and El Salvador maize consumption figures are 318 and 352 grams, respectively. Urban intakes appear to be about 1/3 of rural intakes, but regional differences within countries also exist. In the Philippines, where rice dominates the national diet, only 21 percent of the total population eat maize, but in the Eastern Visays region the figure reaches 50 percent.

One generalization about food preference that does hold for most countries is that meat is preferred over cereals and meat intake increases as incomes rise. The exceptions to this generalization are those countries where religious beliefs restrict meat consumption. Maize plays an important role in this preference pattern as the major feedgrain for the livestock industry.

Maize and the other grains (wheat, rice, oats, barley, rye) are used as human food or as animal feed in varying proportions in different countries. In the high-

Table 6B-2. Maize Intake and its Calorie and Protein Contribution to the Daily Diet

	Maize		
Country	*Intake (grams per day per person)*	*Calories (per day per person)*	*Protein (grams per day per person)*
Afghanistan	112	402	10.4
Bolivia	119	429	11.1
Brazil	100	360	9.3
Colombia	122	437	11.5
El Salvador	245	871	23.3
Guatemala	349	1242	33.2
Honduras	228	813	21.7
Mexico	272	978	25.2
Nicaragua	131	472	11.1
Portugal	100	357	8.3
Rumania	192	694	16.1
South Africa	308	1096	29.3
Arabia	166	597	15.4
Venezuela	108	393	8.7

Food and Agriculture Organization, Food Balance Sheets 1960-62.

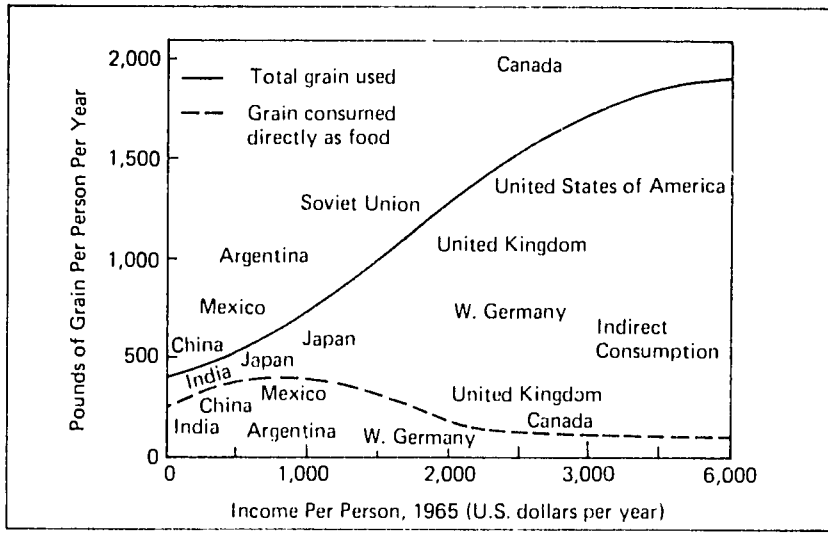
er income countries, 66 percent of the grains used are consumed as animal feed. In the developing countries, the reverse is true: 71 percent of the grain supply is consumed directly by humans. Figure 6B-1 shows the income effect on consumption patterns.

This brief overview makes it clear that maize plays a major nutritional role as one of the world's staples. The dynamics of its commodity system impinge directly on the food intake and nutritional status of millions of people every day. To fully understand that influence, it is necessary to examine maize's nutritional characteristics.

Nutritional Profile of Maize

The quantity of calories it contains, the quantity and quality of its protein, and the minerals and vitamins it provides determine the nutritional value of any cereal grain. Calories provide energy, and protein meets the growth and maintenance needs of the body.[1] The interaction of the quantity and quality factors determines the amount of usable protein available from the grain. The quality of the protein is determined primarily by the pattern of essential amino acids. If the grain is deficient in one or more of the amino acids, these acids become "limiting" factors; they limit the use of other amino acids present in greater quantities.

Maize is of poor nutritional value because of its low protein content and poor balance of essential amino acids. Although both protein quality and quantity



Source: USDA, Economic Research Service.

Figure 6B-1. Direct and Indirect Grain Consumption for Selected Countries by Per-Capita Income Levels

Table 6B-3. Average Approximate Chemical Composition of Maize

Content	*White*	*Yellow*
Dry matter	84.1	87.8
Ether extract	4.83	3.53
Nitrogen	1.29	1.34
Protein	8.06	8.37
Crude fiber	1.58	1.33
Ash	1.28	1.08
Carbohydrates	70.04	73.86
Carotene, milligram percent	–	0.30
Calories/100 grams	356	370

Source: Bressani, R., L.G. Elías, M. Santos, D. Navarrette and N.S. Scrimshaw, El contenido de nitrógeno y de aminoacidos esenciales de diversas selecciones de maiz. Arch. Venez. Nut. 10:85-100, 1960.

vary under different environmental conditions and among maize varieties, protein content is around 8 to 10 percent (see Table 6B-3), and most varieties show deficiencies in two essential amino acids: lysine and tryptophan. All cereal grains are relatively low in protein content, with rice having the lowest and maize having slightly less than wheat. However, these differences are not great, so protein quality is the major determinant of the amount of usable protein in each. In terms of quality, rice has the highest value among grains and maize and sorghum have the lowest.

The nutritional value of grain is not solely a function of genetics at the production stage. Once grown, grain's nutritional quality can be affected at each stage in the food system: storage, processing, handling, and cooking. Consider cooking. In the northern maize-consuming countries of Latin America, maize is used primarily to make tortillas. In the southern countries, the most common form is the *arepa*, a type of flat cornbread. In preparing tortillas, people cook the whole kernel of maize in a lime solution that removes the seed coat but leaves the endosperm and germ. In arepa preparation, lime is not used and the germ is discarded. The use of the lime considerably increases the calcium content even though other nutrients are lost. Because rural communities generally consume little milk, the lime cooking process provides (unintentionally) a vital source of calcium that does not exist when maize is made into arepas. Similarly, the retention of the germ for the tortillas adds to the final product's protein quantity, for the germ is about 12 percent of the weight of the kernel and contains protein of a very high quality. Thus, the same maize used to make tortillas and arepas ends up as a nutritionally superior product in tortillas. We find similar examples of the nutritionally deleterious effects of various maize preparation methods in Africa. Furthermore, such differences are introduced at other stages in the commodity system. Polished rice processing, for example, decreases nutrient values while parboiling methods preserve them. Various storage methods also have different effects on grain's nutritional value.

Maize's Role in the Flilipino Diet. The Philippines consists of some 7100 islands, about 880 of which are inhabited. The population of 36.6 million consumes a diet high in carbohydrates but low in protein and fat. Staple cereals, mostly rice, are the main contributors of nutrients in the diet. Maize ranks second to rice in importance. Corn is an important crop both as human food and as raw material for food and feed-processing industries. Its use patterns indicate that about 60 percent of total production is used directly for human consumption, 30 percent for poultry and other livestock feed, 6 percent for other industrial uses, and the rest for seeds.[2]

Only white and yellow flint maize are raised on a commercial scale because of their high percentage yield for corn grits and their suitability to the tropical climate. Sweet maize, popcorn, and glutinous maize are grown in negligible quantities due to limited demand. Dent maize production is insignificant because of its low percentage yield for maize grits and its high susceptibility to weevils. Maize production for the last ten years has been short of requirements and has limited the growth of the poultry and livestock industries, whose products could help close the protein/calorie gap in Philippine nutrition. Corn imports have continued to be necessary.

About 21 percent of the entire population, mostly located in the Visayan and Mindanao regions, eat maize as a staple cereal (Table 6B–4). Residents of these areas say they eat corn primarily because of its low price, availability, and palat-

Table 6B-4. Proportion of Regional Population Eating Corn in the Philippines: 1960 and 1968 (percentage)

Region	*1960*[b]	*1968*[c]
Eastern Visayas	67.0	49.9
Northern and Eastern Mindanao	42.9	29.4
Southern and Western Mindanao	23.0	26.4
Western Visayas	12.5	24.1
Cagayan Valley	38.7	21.9
Bicol	8.0	14.7
Others[a]	n.a.	6.0

[a]Includes the Central Luzon, Ilocos, and Southern Tagalog regions.
[b]Bureau of Census and Statistics, *Philippine Statistical Survey on Census and Statistics*, 1960.
[c]V.R. Carangal, *Maize Production Conditions in the Philippines and Future Problems*, a reprint from Proceedings of Symposium on Tropical Agriculture Researches, September 1968.

ability. As human food, maize is taken mainly in the form of maize grits and secondarily as green maize, canned sweet maize, maize flour, cakes, popcorn, and food shortening.

Despite maize's versatility as human food, most Filipinos do not consider it as a main part of their diet; they prefer rice to maize for reasons of taste and status. Maize, however, is an excellent "rice extender," as the nation's mid-1973 rice shortage proved. Maize was consumed in increasing quantities as rice availability fell and rice prices rose. In addition, a rice-maize mixture, particularly in a one-to-two proportion, has higher nutritional value than either grain alone because of the complementary effect of their amino acids. Maize is deficient in tryptophan, which is substantially present in rice, whereas, lysine, which is limited in rice, is present in maize.

The lower consumption of maize is in part due to its image for many as "poor man's food." For instance, even in a major maize-eating center like Cebu City, the upper-middle and upper-income groups prefer rice. The consumption of maize as a human food also seems to be strongly affected by changes in income and the price ratio between rice and maize. Shifts in consumption toward rice may be expected with higher incomes and/or a lower price for rice. This tendency is reflected in an income elasticity of 0.53 for all maize and maize products. As incomes rise, consumers tend to shift to preferred substitutes like rice, especially when its price is relatively low.[3]

Maize's Role in the Indonesian Diet. As with the Philippines, Indonesia's main staple is rice, but here again maize plays a significant role in the diets of certain segments of the population. In the typical Javanese diet, maize contributes approximately 19 percent of the total daily calories and 24 percent of the total dietary protein (see Table 6B-5); however, in other areas of Indonesia, like

Table 6B-5. Typical Daily Diets: Java and Sumatra

	Java			*Sumatra*		
Food	*Grams of Intake*	*Calories*	*Grams of Protein*	*Grams of Intake*	*Calories*	*Grams of Protein*
Rice	210(31)[a]	754(49)	14.9(45)	372(69)	1355(83)	26.4(83)
Maize	83(12)	295(19)	7.9(24)	18(3)	64(4)	1.7(6)
Cassava	318(47)	347(23)	2.9(9)	122(22)	133(8)	1.1(3)
Sweet Potato	47(7)	46(3)	0.5(2)	20(4)	49(3)	0.6(2)
Peanut	8(1)	44(3)	2.0(6)	3(1)	16(1)	0.8(3)
Soy	12(2)	40(3)	4.6(14)	3(1)	10(1)	1.1(3)
Total	678	1526	32.8	538	1607	31.7

[a]( ) = %

Source: E.D. Dosayln and C.B. Darrah, "Summary of Four Economic Surveys of Food Consumption," Department of Agriculture and Natural Resources, 1973.

Sumatra, maize's contribution to overall nutrition is much less significant. Nevertheless, maize is the least expensive cereal source of calories for the Indonesian consumer.

Maize production has been steadily increasing from a level of 2.3 million metric tons in 1969 to 3.5 million metric tons in 1975-76.[4] Of this production, 3 percent is exported, 5 percent is used for animal feed, and the remainder is destined for human consumption. The domestic production of maize is surpassed only by that of rice and cassava.

Maize's Role in the Thai Diet. Of the three Southeast Asian countries studied in this book, Thailand's dietary pattern is least influenced by maize. Rice, of course, is the dominant calorie and protein source, supplying 87 percent of the calories and 65 percent of the protein in the average diet. Maize is not widely used for human consumption, although in some rural tribal groups it supplements rice when production is low.

Even though its direct role in the diet is minimal, maize is the nation's most rapidly expanding crop. Therefore, it plays a significant role in the agricultural system. During the 1975-76 crop year, 3 million metric tons of maize were produced in Thailand, a production level surpassed only by rice.[5] Of this output, 2.4 million metric tons (80 percent) were exported. Of domestic maize consumption, 58 percent went to animal feed and 42 percent to direct human use.

Nutritional Status Profile of the Philippines. In 1968, the Food and Nutrition Research Center (F.N.R.C.) completed a survey that shows the extent and seriousness of the malnutrition problem in the Philippines. Malnutrition is widespread, and those who are particularly vulnerable are infants, preschool children, and pregnant and lactating women. The problem involves deficiencies in calories, protein, and other key nutrients.

Most consistent is the deficit in energy-providing calories. The average daily per-capita calorie intake for all regions from 1958 to 1969 was an estimated 1673, only 84 percent of the recommended allowance of 2006 calories. An analysis of the nutrient intake in nine regions is presented in Table 6B-6. In conjunction with caloric deficits, there is a concurrent deficiency of calcium, vitamin A, thiamin, and riboflavin. Caloric insufficiency results in dietary protein being diverted from tissue repair and growth to be used to meet the body's energy needs. This use of protein is wasteful.

During periods of rapid growth, the body is more susceptible to nutritional trauma. Infants and pregnant and lactating women are therefore particularly vulnerable to protein and calorie inadequacy. F.N.R.C. statistics indicate that about 80 percent of the 0-to-6-year-old population of the Philippines suffers from varying degrees of malnutrition. Anthropometric measurements using the Gomez classification of weight for age reveal that:

- five percent of the children surveyed suffer from third-degree malnutrition (below standard weight by 40 percent or more)
- thirty percent suffer from second-degree malnutrition (below standard weight by 25 to 39 percent)
- forty-five percent suffer from first-degree malnutrition (below standard weight by 10 to 24 percent).

Poorly nourished children are also highly susceptible to infection, disease, and death. Of the child population, 25 percent to 35 percent die before reaching five years of age.

Among pregnant women, protein/calorie inadequacy appears to be related to complications of pregnancy and labor, premature delivery, and low birth-weight

Table 6B-6. Average Daily Per-Capita Nutrient Intakes Compared to Recommended Allowances in Nine Regions of the Philippines, 1958-69

Nutrients	*Intake*	*Recommended Allowances*	*Intake as Percentage of Recommended Allowances*
Calories	1673	2006	83.5
Protein (grams)	47	49.4	95.1
Calcium (grams)	0.35	0.57	61.4
Iron (grams)	9.73	10.00	97.3
Vitamin A (International Units)	1886	4066	46.4
Thiamine (milligrams)	0.74	1.02	72.6
Riboflavin (milligrams)	0.49	1.02	48.0
Niacin (milligrams)	14	13	107.7
Ascorbic Acid (milligrams)	66	69	98.6

Source: Food and Nutrition Research Center of the Philippines.

of the baby. It is known that infant mortality varies more according to birth weight than any other maternal or infant characteristic.[6] For 10 percent of infants who weigh 2500 grams (about 5½ pounds) or less at birth, the infant mortality rate is 140.5 per 1000, compared to 8.4 for infants of 2501 grams or more. Therefore, nutritional trauma during pregnancy can seriously jeopardize the future health of an infant.

Nutritional Status Profile of Indonesia. Malnutrition is a problem for all age groups in the Indonesian population. A food consumption survey conducted for heads of household shows an average caloric intake of 1588 with a protein intake of 35.9 grams.[7] The data reveal an obvious deficit of calories as well as a deficiency of protein quantity and quality.

Indonesia's most serious nutrition problem is the malnutrition of the child in the first years of life, exacerbated in many cases by the inadequate nutrition of the mother during pregnancy and lactation. The severity of the malnutrition problem in Indonesia speaks for itself. Estimates of infant mortality within the first year of life range from 125 to 198 per 1000 live births.[8] These estimates are approximately equal to infant mortality rates estimated for Indian (139) and are much higher than those reported for Guatemala (88) and El Salvador (67).[9] Infant mortality rates in more developed nations are generally 20 per 1000 or less.

As mentioned earlier, low birth weight exacerbates the malnutrition problem. In Jakarta and Bardunz, 22.6 percent and 13.9 percent, respectively, of infants born weigh below 2500 grams.[10] Between 20 and 50 percent of all Indonesian children suffer from what could be categorized as moderate or severe malnutrition (second or third degree, according to the Gomez weight classification).[11] In addition, there are serious problems with vitamin-A deficiency, anemia, and goiter among young children as well as in the population as a whole.

Nutritional Status Profile of Thailand. Despite the fact that the 1972 Food Balance Sheet (FBS) for Thailand[12] showed an average per-capita caloric consumption of 2580, nutritional deficiencies are present in certain subgroups of the population. A survey of rural and urban eating habits for heads of household conducted between 1972 and 1973[13] shows an average caloric intake of 1821 for rural residents and 1504 for persons living in the Bangkok slums.

In a typical rural community where income is low and relatively few money transactions take place, variations in the eating pattern of the population generally are limited and markedly influenced by the community's ecology. In general, all members of both the rural and urban family share the meal; there is no special distribution of protein or other essential nutrients to pregnant or lactating women and growing children. But the diet of poor families in Bangkok can be better than that of rural families, due to the market economy and the former's sometimes greater purchasing power. The poorest urban families, how-

ever, often short of cash to buy enough food, commonly experience micronutrient and caloric deficiencies.[14]

In the rural areas, the typical meal pattern consists of cooked rice consumed with *Kaeng* or *Nam Prick*, which are vegetables and small amounts of protein food such as fish, meat, or egg. The protein food is usually considered an appetizer, not main item of the diet. The preparation of Kaeng in the rural areas is simple; no coconut milk is used. Vegetables are consumed fresh.

Nam Prick, which is almost the only source of protein for rural Thais, is usually a mixture of shrimp paste, dried fish, and meat or vegetables with chillies and condiments. Fermented fish and chillies usually constitute the Nam Prick in the Northeast, while in the north it is prepared with fermented soybeans, meat, or vegetables as the principal ingredient. In the south, mostly in the Muslim community, fermented sauce is widely used. Nam Prick is consumed with leafy greens or other vegetables, either raw or cooked. In Bangkok, Nam Prick is usually consumed with vegetables, Pla-tu (a variety of marine fish), and other fish or eggs; thus it has more high quality protein than the typical rural diet. Residents of the Bangkok slum areas have a higher percentage of animal protein in their diet than their rural counterparts (40 percent compared to 31 percent), but middle-class residents of the city have a diet that is 50 percent protein.

Both calorie and protein deficiencies result among certain population groups consuming these diets. We know that such nutritional deficiencies are most critical in periods of rapid growth, and that malnutrition influences morbidity rates for various diseases, maternal and perinatal mortality rates, life expectancy, and other health statistics. A variety of vital statistics may therefore be considered as indirect indicators of the nutritional status. The vital statistics of Thailand show that 22.5 percent of total 1971 deaths in the birth-to-age-four category could be attributed to malnutrition. The birth weight of newborns under fifteen days of age is an indication of the nutritional status of the mother during pregnancy. Several observations indicate that severe caloric undernutrition significantly reduces the birth weight of the full-term infant. The average birth weight of Thai infants in the rural areas ranges from 2.5 to 2.6 kilograms, while Bangkok middle-class families have a mean birth weight of 3.1 kilograms.[15]

The situation is equally critical when assessing the nutritional status of preschool children. A recent study of early protein calorie malnutrition (PCM) in slum areas of Bangkok reveals that PCM is widespread in the birth-to-age-five category.[16] Nutritional status in the study was determined by anthropometric methods; each of the 1154 children were classified by calculating the observed weight as a percentage of expected weight for age in months. The anthropometric results showed that the middle class and rural Thai boys had mean heights and weights fully equal to the North American standard of the fiftieth percentile during the first six months of life. However, the slum Thai boys fell well below the fiftieth percentile in weight during the first six months and below the third percentile during the second six months of life.

Not until the second year of life are the mean heights and weights for rural and urban slum children similar; the familiar "flattening" of the growth curve is seen in the postweaning period. The data indicate that the nutritional status of the urban population is adversely affected at a much earlier age than that of the rural children. The decline in breast-feeding of urban infants may account for this phenomenon. Twenty-two percent of the preschoolers have never been breast-fed, and 23 percent are weaned within their first six months. These figures can be contrasted with our knowledge of rural practices. In rural areas, children are weaned after six months. This difference in practice closely parallels the disparities in growth between urban slum and middle-class Thai children.

Country Nutrition Programs. The governments of each of the three countries under study recognize the foregoing malnutrition problems as important areas for policy action, and to varying degrees and in different ways each has undertaken programs to address these problems.

The Philippines' Nutrition Programs. The government of the Philippines has developed an active nutrition program that it has incorporated into the overall national food program. Consequently, considerably more published data exist on nutrition activities there than in Indonesia and Thailand. Launched in 1971, the Philippine Food and Nutrition Program (PFNP) is an umbrella program grouping together all ongoing projects and activities related to food and nutrition. The policy objectives of PFNP include increasing food production, promoting proper use of food stuffs, stimulating income-generating activities to improve general family living conditions, intensifying food research, and establishing organizational machinery for coordination of interdisciplinary and intersectoral participation in nutrition activities.

The important function of policy formulation is undertaken by a Nutrition Policy Council composed of the heads of participating government agencies. The task of translating policies into action plans are then taken on by Nutrition Work Groups in the participating government agencies. These work groups also coordinate all food and nutrition activities in their respective agencies. The chairmen of the Nutrition Work Groups and representatives of private agencies form the management committee, which outlines agreements on strategies and translates policies into guidelines for sectoral project implementation.

Meanwhile, the Interagency Action Group (INTACT) evaluates the progress of current programs. This group, which is composed of representatives from participating agencies, conducts periodic field visits and meets with program personnel to assess progress made in the provinces.

Coordinating the development and distribution of information materials is the Interdepartmental Committee on Nutrition Communications (CNC), which is composed of representatives of agencies in nutrition information, education, and communication.

Work teams are organized at the barrio (village) level. These teams usually include a home management technician, a farm management technician, a rural health nurse or a midwife, a home economics teacher, and an agriculture or practical arts teacher. The group's composition reflects the interdisciplinary approach in the national nutrition program.

The major components of the PFNP are the following:

1. nutrition training to improve the competence of trainers in the program
2. nutrition education to promote appreciation of the value of proper nutrition in maintaining health
3. supplementary feeding to protect the health of young children, pregnant women, and nursing mothers, and to promote recovery of the severely malnourished
4. food-production projects to establish school, home, and communal gardens, and to operate seedbanks and nurseries to augment food supply, improve the diet of the community, and increase family income
5. nutrition rehabilitation wards to rehabilitate and preserve the health of the nutritionally sick child through proper nutrition and health education
6. nutrition mass communications to facilitate the spread of reliable information on food and nutrition
7. intensified research to develop the production and distribution of new and cheap high protein foods
8. income-generating activities to develop the vocational skills and creative potentials of Filipinos in the preservation of excess foodstuffs, in handicrafts, and in other similar projects.

PFNP has grown considerably. In fiscal year 1971-72, PFNP began operations in 75 barrios of 11 priority provinces. The program expanded the following year to 138 barrios in 10 additional provinces, bringing PFNP's coverage to 213 barrios in 21 provinces. Ten more provinces were included each year until 1977.

Here is a brief list of the progress that has been made:

1. Over 16,000 administrators, supervisors, and lay leaders on the national and provincial levels have undergone nutrition training.
2. In nutrition education, 196 Rural Improvement Clubs and 193 4-H Clubs with a total membership of over 11,000 homemakers and youths have been organized. Their activities include home gardening, poultry and livestock production, and preschool supplementary feeding.
3. In supplementary feeding, 737,000 preschool and school-age children have been served using locally produced foods augmented by donations from international organizations.[17]
4. Hectarage devoted to food production in homes, schools, and community

gardens has reached 135. About 69,000 homemakers have pushed food production activities in the rural areas.

5. Ten nutrition rehabilitation wards have been established in seven provincial hospitals. These wards have served some 1130 children.

Although the Philippine government has actively started to address the country's malnutrition problem, the current efforts are reaching less than a third of the nation's nutritionally needy. The feeding programs are serving under a million preschool children; yet of the 9 million children aged six months to six years, 3.15 million are deemed to be suffering from moderate or severe malnutrition.[18] At the root of this problem are absolute and relative poverty and rice shortages. Economic growth has not resulted in an improved income for the poor. In fact, inequality in income distribution appears to have worsened. Ten percent of the families account for 40 percent of the income.[19] Consequently, unless significant efforts are made to achieve more equitable income distribution patterns or unless nutrition programs are drastically increased, it is doubtful that the malnutrition problem will become less severe.

Indonesia's Nutrition Programs. The Indonesian government appreciates the malnutrition problem and high level officials recognize the need for programs to address it. Several nutrition policy statements appear in the second five-year plan, and five main nutrition programs have been developed to deal with the nutrition problems in Indonesia.[20]

The Applied Nutrition Program. This program was established in 1959 by the Ministry of Health with active assistance from U.N. agencies. It operates in about one hundred villages throughout eight provinces. It is designed to assist communities in increasing production of "protective foods," in improving environmental sanitation and reducing disease incidence, and in providing nutrition education to teachers and health personnel as well as directly to mothers and children. The agricultural production part of the scheme consists of the development of school gardens, fish ponds, and poultry units. The program has succeeded to a degree unusual among such programs in increasing the awareness of nutrition problems on the part of professional and paraprofessional personnel as well as among political leaders. Whether it has had a significant effect in increasing the production of protective foods or in improving child feeding and rearing practices, beyond areas of exceptional local support, is not clear.

Ministry Child Health Feeding Programs. Milk powder, supplied by the World Food Program, is now being used to feed children in roughly 1000 of the 2700 MCH centers in the country. Despite considerable effort, attendance at these centers is low and irregular due to some combination of (1) cost (most families have to make some payment to the center); (2) the unfamiliar or even undesirable form of the product; (3) inadequate staff; and (4) irregular availability of milk at the health centers. Less than one quarter of the centers studied

use 100 percent of their milk powder allocation. Average use is roughly 60 percent with a wide variance.

School Lunch Programs. School lunch programs, organized by CARE in West Java, cover approximately 300,000 children but are being phased down because of uncertain supplies from the U.S. Food for Peace Program. Feeding operations organized by Catholic Relief Services and Church World Service cover less than 50,000 children and are also being reduced.

Vitamin A Prophylaxis Program. With assistance from UNICEF and the American Foundation for Overseas Blind, this program aims to reduce the prevalence of vitamin A deficiency among one-to-five-year-old children through distribution at six-month intervals of a capsule containing 200,000 IUs of vitamin A plus 40 milligrams of vitamin E. The program was started in May 1973, initially covering 83,000 children. It has been undertaken with the aid of twenty paramedical personnel and two local village aides from each village. The program includes a built-in evaluation, and initial impressions indicate relatively smooth operational functioning and the desirability of its planned expansion until more universal approaches (i.e., vitamin A fortification programs) can be developed.

Nutrition Education. Programs in nutrition education have been undertaken by the government. The education activities carried out by the Directorate of Nutrition between April and December of 1973 are shown in Table 6B-7.

The Indonesian nutrition efforts are not as far along or as broad in scope as those in the Philippines, but the nation's malnourished population is much greater. Thus, current programs are only making a modest dent in the problem. Much remains to be done. One bottleneck is the lack of trained personnel. In the entire country there are only 215 active high-school-trained nutritionists, 226 college-level nutritionists, and 28 medical doctors with advanced training in nutrition. Fortunately, the rise in world oil prices has almost doubled government revenues and increased the country's capacity to expand its nutrition programing efforts.

Thailand's Nutrition Programs. The government of Thailand has organized several programs to raise the level of nutrition through the cooperative efforts

Table 6B-7. Nutrition Education Activities in Indonesia

Type of Activity	*Total Number*	*Estimated Audience*
Talks	2,315	81,382
Demonstrations	570	46,908
Exhibits	326	120,323
Courses	215	4,532
Radio Programs	25	(n.a.)

Source: SEARCA.

of the Ministries of Public Health, Education, Agriculture, and Interior, and international organizations including:

1. The Applied Nutrition Project, started in 1962, has been jointly sponsored by the local ministries and UNICEF, FAO, and WHO. Agricultural extension workers educate villagers in production of protective foods.
2. Protein food development was started with the cooperation of USAID. The project's main focus is provision of protein foods, especially locally grown pulses, for preschool children aged one to five. The three formulas that have been used in child nutrition centers include mung-bean protein and fish-protein concentrate, soybean milk powder, and bean cookies. The government's Applied Scientific Technical Research Center and Kasetsart University's Institute for Food Research and Product Development have played a leading role in the development of these high-protein products. Their cost is low compared to that of other local sources.
3. Feeding programs are operated in public schools, youth centers, and day-care centers. The latter have received increasing attention and expansion in recent years.
4. Nutritional rehabilitation efforts take place within Bangkok hospitals.
5. Nutrition research into nutritional status, nutrient metabolism, food toxins, and other areas has been carried out for many years in Kasetsart University's faculties of Medical Science and Medicine in Ramathibodi Hospital and in the faculties of Mahidol, Chiang Mai, and Chulalongkorn Universities.
6. Nutrition education programs are conducted by the Ministry of Education to train teachers and then students.
7. Salt iodization was started as a pilot project in 1965 to control endemic goiter. Initial evaluation shows a 31 percent decrease in goiter within experimental areas, compared to a 15.6 percent increase in control areas.

Although interest in nutrition programing has increased considerably in recent years, the current size of programs is very small relative to the need. For example, existing nutrition projects serve less than 10 percent of the seven million preschoolers and pregnant and lactating women. Thus, like the Philippines and Indonesia, Thailand must also accelerate its nutrition efforts if it is to address its nutritional needs adequately.

Nutritional Implications of Maize Policies

Having identified the nutritional significance of maize in these countries' diets, the nature of their malnutrition problems, and their efforts to combat them, we now examine the nutritional implications of alternative policies the governments might pursue to develop their maize systems.

Policy objectives are multiple and encompass more than just nutritional considerations. Valid non-nutrition objectives include creating employment,

generating or saving foreign exchange, achieving self-sufficiency, and using natural resources. To deal with nutrition reasonably in policy formation, policymakers should consider three basic questions:

1. Who would be affected nutritionally by the policy and how significantly?
2. How could the policy be adjusted to avoid exacerbating the nutritional situation?
3. How could policies be formed to make a positive contribution to nutritional improvement?

In effect, the policymakers should develop a "Nutritional Impact Statement" identifying the nature, extent, and positive or negative nutritional effects of a proposed policy measure. By making these considerations explicit, policymakers put themselves in a position to identify and reconcile conflicts among nutritional and non-nutrition objectives and to maximize the nutritional benefits of their policy.

In the context of this framework, three areas of maize policy formation stand out as warranting particular attention in Southeast Asia: the consumption form (direct or indirect) of maize; the relatively low nutritional quality of maize; and the relation of maize to the other staple, rice.

Consumption Form. In each of the three countries, efforts are underway to develop livestock—particularly poultry and swine—industries. The Philippines have moved furthest in this direction. A prerequisite to a strong livestock industry is a strong animal-feed industry, which in turn requires dependable, abundant, and economical supplies of feedgrains. In effect, this requirement involves the development of a protein conversion system that transforms grain protein into meat protein. The nutritional implications of this conversion process are several.

The first implication stems from the economic consequences of the inherent nutritional loss during the conversion process. Transformation from grain to meat requires energy in the form of calories as well as protein for growth. Thus, one pound of grain-fed beef requires approximately seven pounds of grain and roughage; one pound of pork requires about four pounds of grain; and one pound of poultry requires two to three pounds of grain. Calories that could have been consumed directly as grain are lost in exchange for a much higher quality form of protein. In one sense one is trading off calories against protein improvement. However, meat and eggs incur the costs of transformation and thus carry a higher price.

In a grain-short situation, as is the case in the Philippines with maize, increased meat production comes at the expense of direct human consumption of the maize because farmers have incentive to sell food-grade maize to feed mills instead of to the general public. The result can be decreased on-farm maize consumption or higher maize market prices, which reduce urban consumption.

To illustrate the potential nutritional impact, assume that direct human con-

sumption of maize decreased by 20 percent and only half of this decline was compensated for by an increase in rice intake. The net caloric and protein loss *on the average* will be about 2 percent in the Philippines and Indonesia and 1 percent in Thailand. However, for the segments of the population that consume much maize, the losses are on the order of as much as 5 to 10 percent. Since all of these countries already suffer from calorie deficits, such declines in calorie intake are undesirable.

This calorie and protein loss might be offset partially by increased availability of animal protein but the high prices of animal protein places these products beyond the purchasing power of the lower income groups who are also the most undernourished.[21] The net result might be that the rich consume meat protein at the expense of the poor. And even if the poor are able to afford the meat protein, its body-building value will be severely diluted by the energy-draining consequences of their calorie deficits.

Maize's relatively small role in the diet greatly reduces the magnitude of these adverse effects. The nutritional consequences of diversion from direct to indirect consumption is much more significant in a country such as Mexico, where maize dominates the diet. Nevertheless, any diversion policy (such as increasing maize exports in Thailand or accelerating feedgrain usage in the Philippines) that decreases human maize consumption carries negative nutritional consequences, especially for those relatively low on the income scale.

Decisionmakers should be aware of these possible trade-offs and seek ways to minimize the adverse effects of developing livestock industries. One positive policy measure in this regard is to support the layer-poultry industry so that egg prices drop within the range of low-income groups. Or price subsidies might be supplied to ensure equitable access to the expanding protein supply. Still another approach might be to stimulate the production of alternative feed supplies such as roughage, which do not divert grain from human consumption and can even reduce the pressure on the maize supply.

The Quality Factor. Review of the nutritional characteristics of maize reveals that its protein quality is relatively low. Quality improvement can be addressed in three not mutually exclusive ways: genetic breeding, protein fortification, and storage system changes.

Genetic Breeding. In the mid 1960s, researchers at Purdue University discovered a recessive maize gene called Opaque-2 that causes important changes in the amino-acid balance of maize endosperm protein.[22] This new amino-acid pattern has higher levels of lysine and tryptophan, the two limiting amino acids in normal maize, as well as a better balance of amino acids. The available usable protein is much greater in corn with this gene. Table 6B-8 summarizes the differences between this corn and common maize.

This quality improvement has significant implications for the feed industry.

Table 6B-8. Differences between Opaque-2 Maize and Common Maize

Protein Fraction	*Opaque-2*	*Common*
Nitrogen (percentage)	1.69	1.68
Acid soluble (percentage)	35	34
Alcohol soluble (percentage)	26	37
Soluble in alkaline solution (percentage)	39	29
Amino Acid		
Lysine	4.7	2.8
Tryptophan	1.5[a]	0.62[a]
Histidine	3.0	3.0
Arginine	6.5	4.8
Aspartic acid	10.6	6.7
Glutamic acid	17.9	20.8
Threonine	3.9	3.6
Serine	4.9	4.8
Proline	8.1	10.0
Glycine	4.8	3.8
Alanine	6.9	7.9
Valine	5.5	5.0
Cystine	1.4	1.2
Methionine	1.9	2.0
Isoleucine	2.8	4.0
Leucine	9.8	13.9
Tyrosine	3.6	4.0
Fenilalanine	4.8	5.2

[a]Data from the same sample of maize, but different laboratory.

Source: Bressani, R. et al. (eds.), *Nutritional Improvements of Maize*, Instituto de Nutricion de Centro America y Panama, Guatemala, 1972, p. 11.

Tests in the United States and Colombia with swine have shown weight gains two to three times greater with Opaque-2 than with normal maize (see Table 6B-9). Similar results have also been reported by the National Agricultural Institute in Mexico.[23] Feeding tests in Nigeria for layer hens showed that Opaque-2 feed resulted in higher production of large eggs.[24] Despite this apparent advantage, adoption of Opaque-2 maize has been slow, apparently because maize is very sensitive to local agronomic conditions and new varieties must go through extensive adaptation. Opaque-2 has to be crossbred with local varieties, and this plant-to-plant mating can take seven or more generations before producing plants with yields comparable to local commercial varieties. In many cases, Opaque-2 does have yields equal to or better than traditional unimproved varieties, but without adaptation breeding it remains inferior to improved local varieties. One of the key limiting factors on Opaque-2 yields is that the recessive genes also modify the endosperm starch structure, producing a totally floury kernel that has a lower weight, volume, and density than normal kernels.

Despite these obstacles, progress has been made developing, producing, and distributing Opaque-2, primarily in Latin America. Ten countries have started

Table 6B-9. Comparative Data of Protein Quality of Common and Opaque-2 Maize in Swine

	Swine	
Maize	*Weight Gain (grams per day)*	*Physiological Age*
Common–United States	120	growing
Opaque-2–United States	432	growing
Common–United States	690	finishing
Opaque-2–United States	1044	finishing
Common–Colombia	91	growing
Opaque-2–Colombia	310	growing

Source: Bressani, R. et al. (eds.), *Nutritional Improvement of Maize*, Instituto de Nutricion de Centro America y Panama, Guatemala, 1972, p. 15.

developing local Opaque-2 varieties, but Colombia and Brazil are the primary leaders. Colombia pioneered adaptation in 1964 with the efforts and assistance of the Colombian Agricultural Institute (ICA), the International Center for Tropical Agriculture (CIAT), the Rockefeller Foundation, and local private agribusiness firms. In Brazil the seed development was carried out by Agroceres, S.A., a private seed company. Presently, about 15,000 hectares of the new variety are planted, primarily by hog breeders.

If the conversion rates with Opaque-2 are superior to those for normal maize, there is an economic rationale for paying higher prices for the opaque varieties. Such a premium differential might be necessary in order to stimulate production because the lower yields and weights would normally lead farmers to avoid such varieties.[25] Colombia, in fact, has used a higher support price for the opaque varieties as a stimulus to production, and some food companies have provided a guaranteed market for the maize. Using selective pricing, financing, and contractual marketing agreements to stimulate production of nutritionally superior grains is a policy area that has received little attention in the past and merits considerable attention in the future.

Opaque-2 now appears to have greater potential as an animal feed than as a human food. The floury structure of the opaque varieties differentiates the kernels visibly from common maize and therefore has encountered consumer resistance. When converted to flour, these differences tend to disappear; but it is possible to lose the nutritional value of the opaque varieties in processing. In Nigeria, the preparation of the maize dish *ogi* for infant feeding leaches away all lysine and tryptophan.[26] Nonetheless, the high protein quality of the Opaque-2 flour makes it a potential substitute for the imported protein products the Philippine and Indonesian government currently use in their feeding programs. Opaque-2 can also be readily incorporated into the ongoing applied nutrition programs. The new variety clearly has considerable potential, but planners in

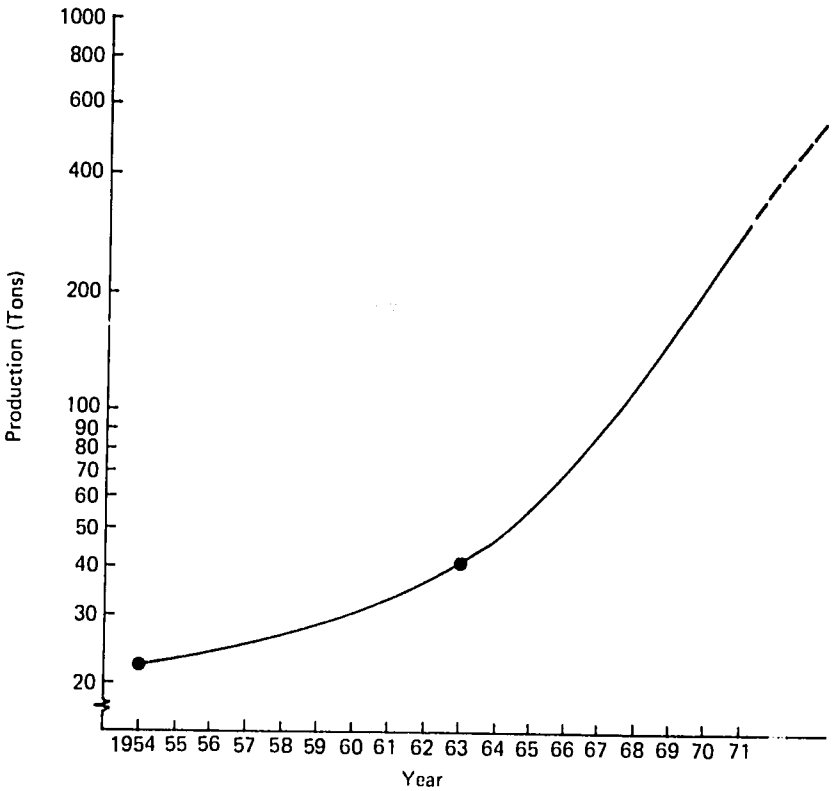
Southeast Asia must mount genetic adaptation research efforts to take advantage of it. Results will not come quickly.

Protein Fortification. The other major way of improving the protein quality of maize is to fortify it with synthetic amino acids or protein supplements in processing. Fortification has several appealing characteristics. It presumably does not change the taste or the cookability of the staple and therefore avoids consumer resistance. The technology of fortification is well known. Fortified staples reach large groups of people; and fortification is cheap.

The validity of these presumed strengths has not been tested. No large-scale protein-fortification program exists, although pilot projects aimed at testing the biological effect of fortification are in process for corn in Guatemala, wheat in Tunisia, and rice in Thailand.[27] The feasibility of maize fortification remains to be tested, but some evidence exists on the extent of possible obstacles.[28] Palatability tests in Guatemala and Colombia among adults and children indicate that consumer acceptability of fortified tortillas and arepas is high. However, the fortificant has to be added during the making of the flour, and much flour is made either in the home or in small village mills. Without centralized processing, the feasibility of fortification decreases. In Mexico the consumption of maize for tortillas is 6 million tons per year, while the consumption of tortilla flour is only 300,000 tons, or 5 percent of total consumption. In Venezuela the annual flour consumption for arepas in 1972 was 197,000 tons. However, in both countries as well as in other Latin American countries, the use of precooked flours is rising, as Figure 6B-2 shows for Mexico.

The economics of fortification are determined by the cost of the fortificant and the costs of the fortification process. Fortificant cost will vary depending on whether synthetic amino acids or another protein source is used. Also, in all cases, additional minerals and vitamins should be added in order to get better use of the added protein. Table 6B-10 presents three fortificant formulations for tortilla flour, and Table 6B-11 shows their cost. The soy-based fortificant is the least costly; it achieves the highest quality protein; and it also increases the protein content by 4 percent. But it is important to recognize that these fortificant costs can fluctuate considerably, especially when the protein source is another commodity such as soybeans. Even though the incremental cost (including only fortificant costs) of the fortified maize is less than a penny per pound, the percentage price increase was 18 percent. Because the fortified product does not appear different and more desirable than unfortified flour, consumers might refuse to pay a premium for the nutritionally superior product. For the planner, this problem might suggest the need for subsidies to absorb the added cost or for a consumer education program. Who should pay the costs of fortification remains a basic policy issue.

Maize fortification might be of particular interest to the three Southeast Asian countries as a regional program targeted at the specific and concentrated



Source: Bressani et al. (eds.), *Nutritional Improvement of Maize*, Instituto de Nutricion de Centro America y Panama, Guatemala, 1972, p. 60.

Figure 6B-2. Production of Maize Flour in Mexico: 1954-71

maize-consuming areas. It should be noted, however, that unless the prevailing calorie deficits are reduced by other interventions, the effect of protein fortification will be reduced by the body's use of the added protein to meet energy requirements.

Storage Systems. A problem common to many grain systems in developing countries, including the maize systems in Southeast Asia, is inadequate storage facilities. Systematic documentation of the magnitude of the losses due to improper maize storage and handling in the three countries does not exist, but estimates range from 5 to 25 percent. In addition to the physical disappearance of grain, the remaining grain frequently deteriorates due to insect damage and unfavorable storage conditions. Losses of stored grain are particularly costly because that grain represents investments from every point in the system from production to storage.

Accordingly, researchers would do well to document the nature and economic consequences of physical and nutritional storage losses in these three countries.

Table 6B-10. Maize Fortificant Formulations

Ingredients	*Formulations* No. 1	No. 2 (percentage)	No. 3
L-Lysine HCl	6.000	1.25000	1.25000
DL-Tryptophan	2.000	–	–
Maize	91.844	–	–
Skim milk powder	–	98.65250	–
Soya flour (Soyaflok 200)	–	–	98.65250
Riboflavin	0.0060	0.00375	0.00375
Thiamine	0.0400	0.02500	0.02500
Niacin	0.0600	0.03750	0.03750
Vitamin A, (grams)	0.0500[a]	0.03125[a]	0.03125[a]
	100.0000	100.00000	100.00000
Percent of addition	5	8[b]	8[c]

[a]Equivalent to 25,000 IUs of vitamin A or vitamin A acetate (500,000 IUs per gram). This amount supplies the half level recommended of 750 milligrams of retinol per 100 grams of tortilla.

[b]Amount of skim milk that supplies 0.04 percent L-Tryptophan and 2.8 grams of protein/ 100 grams.

[c]Amount of soya flour that supplies 0.05 percent L-Tryptophan and 4.0 grams of protein/ 100 grams.

Source: R. Bressani et al. (eds.), *Nutritional Improvement of Maize*, Instituto de Nutricion de Centro America y Panama, Guatemala, 1972, p. 181.

Table 6B-11. Cost of Fortification[a]

	Formulations No. 1	No. 2	No. 3
Cost per 100 pounds	$30.00	$35.00	$ 9.15
Percent added	5%	8%	8%
Fortification cost per 100 pounds	$ 1.50	$ 2.80	0.732
Cost of fortified maize per pound	5.5¢	6.8¢	4.732¢
Percent, price increase over unfortified corn[b]	37.5	70.0	18.3

[a]Considering only the cost of the ingredients.

[b]Current price of white maize in Guatemala: $4.00 per 100 lbs.

Source: Bressani, R. et al. (eds.), *Nutritional Improvement of Maize*, Instituto de Nutricion de Centro America y Panama, Guatemala, 1972, p. 183.

Such research would provide a basis for determining the cost-effectiveness of investments aimed at improving on- and off-farm storage systems.

Rice-Maize Relations. An essential part of the systems approach to agricultural planning is the recognition of commodity interrelations. This concept also holds when examining the nutritional dimension. People's nutritional well-being

is dependent on the total diet, not on any one staple. For maize in Southeas Asia, the most important intercommodity relation to examine is that with rice.

The first relation to explore is price. Both on a global and regional basis, rice prices are significantly higher than maize prices. Table 6B-12 shows that international maize prices have averaged about 39 percent of world rice prices. Thus the average international cost per 1000 calories between 1971 and 1976 was 2.8 cents for maize and 7.5 cents for rice. In the three Southeast Asian countries, maize prices per 1000 calories were half those of rice. The higher protein quality of rice somewhat offsets this price differential. The average 1971-1976 international price per 100 grams of usable protein was 20 cents for maize and 34 cents for rice. These lower prices for corn reflect lower production costs and —especially in Southeast Asia lower consumer preference. Given these price relations, any policy that results in a shift from maize to rice consumption means moving from a cheaper to a more expensive nutrient source. If incomes are unchanged and price relations hold, decreased calorie intake might result. Government price supports and market interventions that stimulate shifts from maize to rice should therefore be examined to determine the net effect on calorie and protein intake.

The second rice-maize relation deals with food preferences. It is known that rice is generally preferred over maize. Thus, commodity projections should always recognize that as their incomes rise, consumers will tend to increase rice consumption and eat less corn. Development programs that generate income increases will, accordingly, increase pressures on rice supplies and soften the direct human demand for maize supplies. On the other hand, meat consumption also rises at higher income levels and this might stimulate demand for maize as a feedgrain.

Rice and corn have complementary amino acid patterns; the net percentage of usable protein in each grain increases when they are consumed together. Consequently, governments might wish to consider joint pricing strategies to

Table 6B-12. International Maize and Rice Prices: 1971-76 (U.S. dollars per metric ton)

Year	*Maize Prices*[a]	*Rice Prices*[b]	*Maize/Rice Price Ratio*
1971	58	129	.45
1972	56	148	.38
1973	98	194[c]	.51
1974	132	542	.24
1975	120	362	.33
1976	112	263	.43

[a]U.S. # 2 yellow corn, Gulf f.o.b.

[b]Thailand white, 5 percent broken, Bangkok f.o.b.

[c]Trading suspended for most of 1973; U.S., NATO wholesale price during 1973 was $582.

stimulate the mixing of maize and rice. Food preferences are part of the cultural fabric, of course; changing them with modest price manipulation is difficult. Planners might complement pricing arrangements with publicity on the nutritional value of maize and maize-rice mixtures. Another approach might be to develop new maize and rice-based processed foods.

The protein combinations that may be adequate to meet the needs of adults are not necessarily sufficient for target individuals. Infants, for example, have a much higher essential amino-acid requirement per unit of body weight than do adults. It is therefore critical that the protein quality issue of infant diets be addressed. In Southeast Asia, infants in rural areas receive mother's milk up to age two or three; supplementary feeding often starts as early as two or three days after birth. Glutinous rice and in some cases bananas are the main supplementary foods. The quantities of fish and meat are almost negligible during the first year of life. Mixed-grain feedings of rice and maize will provide higher quality protein to these infants. For urban infants, the problem is more critical since statistics show that breast-feeding is discontinued very early. Improved weaning foods should be stressed for them.

A final area of policy concern is the effect of maize production stimulation efforts on crops other than rice. As maize acreage is increased, planners must know which crops, and therefore which nutrients, have been forsaken. In India, there is some evidence that increased use of high yielding wheat varieties has displaced pulse production. Although the new wheat output provides significant additions to the national calorie stockpile, the decline in pulse production has reduced supplies of protein that previously had been an integral part of the rural diet. Because the nutritional problems in each of the three countries under study in this book include both vitamin and mineral deficiencies, one should take care that cereal expansion does not displace food sources currently providing these micronutrients.

Finally, it is worth noting that agricultural policy decisions have generally ignored or dealt only indirectly with the nutritional dimension. This oversight has frequently resulted in unforeseen and undesirable nutritional consequences or in missed chances for improvements. The global malnutrition problem is too acute to afford us the luxury of such a haphazard approach.

NOTES

1. When caloric intake is less than energy requirements, proteins are diverted from growth metabolism to fill energy needs.

2. U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agricultural Circular: Grains*, May 1976, p. 87.

3. E.D. Dosayla and L.B. Darrah, "Summary of Four Economic Surveys of Food Consumption," Department of Agriculture of Natural Resources of the Philippines, 1973.

4. USDA, FAS, *Grains*, p. 50.

5. Ibid, p. 107.

6. Helen C. Chase, "A Study of Risks, Medical Care and Infant Mortality," *American Journal of Public Health*, Vol. 63, September 1973, Supplement.

7. Food and Agriculture Organization, Report to the Government of Indonesia, *Food and Nutrition Policy in Relation to the Food Needs*, (n.p.).

8. World Health Organization, Country Information—Indonesia and Ministry of Health, Second Five-Year Development Plan, (n.p.).

9. United Nations, *Demographic Yearbook: 1971*, Geneva, 1971.

10. Johanna Len Doeschite, *Causes of Blindness in and around Surabaja, East Java*, unpublished Thesis, University of Indonesia, Jakarta, 1968.

11. S.M.P. Tjondrogegaro, et al., Agricultural National Planning Survey Report, 1973.

12. Agricultural Statistics in Thailand, Crop Year 1972–73. Thailand Ministry of Agriculture.

13. V. Pisolyabutra, "Basic Data for Assessment of Nutritional Status of Thailand," Nutrition Planning Group, National Social and Economic Development Board, Thailand, August 1974.

14. A. Chandrapanend, "Diet Surveys in Thailand," *Journal of the Medical Association of Thailand*, Vol. 38, No. 2 (1955), pp. 111–59.

15. Faculty of Public Health, Mahital University: unpublished Report on Comprehensive Rural Health Program for Academic Year 1972–73.

16. Pensri Khanjara Sthiti and Joe D. Wray, "Early Protein Calorie Malnutrition (PCM) in Slum Areas of Bangkok Municipality," 1970–71. Ramathibodj Hospital, Bangkok, Thailand.

17. In fiscal year 1975–76, the Philippine government received $26 million worth of donated food through the Title II program of U.S. Public Law 480 Food for Peace Program. (U.S. General Accounting Office, "Impact of U.S. Development and Food Aid in Selected Developing Countries," 22 April 1976).

18. U.S. Department of State, the Inspector General of Foreign Assistance, "Inspection Report: AID Food and Nutrition Program in the Philippines," 24 June 1976.

19. S. Reutlinger and M. Selowsky, *Undernutrition and Poverty*, I.B.R.D. Working Paper 202, December 1975.

20. These program descriptions are largely excerpted with permission from the Massachusetts Institute of Technology International Nutrition Planning Program report, "Nutrition Program Development in Indonesia," May 1974.

21. For example, recent econometric analysis of the nutrient effect of commodity supply increases in Colombia revealed that only a small proportion of the increased output of meats, eggs, and milk would be consumed by the protein- and calorie-deficient groups. See Per Pinstrup-Andersen, Norha Ruize de Londono, and Edward Hoover, "The Impact of Increasing Food Supply on Human Nutrition," *American Journal of Agriculture Economics*, May 1976.

22. A similar gene called Floury-2 was also discovered shortly thereafter. Maize with either of these genes is referred to as opaque maize.

23. L. Martinez and A.S. Shimada, "Valor Alimenticia de una Variedad Mexicana de Maiz Opaco-2 para el Cerdo en Crecimiento," *Tecnica Pecuaria en Mexico*, 1971.

24. Lungu, op. cit.

25. The Centro Internacional De Mejoramiento de Maiz y Trigo (CIMMYT) is studying certain opaque varieties that reduce the floury structure and increase density without reducing the essential amino-acid content.

26. M.K. Akposoe, "Opaque-2 Maize Production and Problems in Africa," in Ricardo Bressoni, et al. (eds.) *Nutritional Improvement of Maize*, Institute of Nutrition of Central America and Panama, Guatemala City, Publication L-4 October 1972, page 7.

27. Several countries have national vitamin- and mineral-fortification programs.

28. A feasibility study of cereal fortification is currently being carried out by Harvard University with financing from the Agency for International Development.

APPENDIX C
OPERATION FLOOD II
THE EVOLUTION OF A RURAL DEVELOPMENT PROGRAM*

"Operation Flood II" is designed to build on the foundations laid by the original "Operation Flood," a dairy development program launched in India in mid-70. This earlier program was first scheduled for completion in mid-75, but has now been extended until mid-79.

Although it suffered delays, the original Operation Flood was considered to be successful by 1975—and by 1976, its designers, the National Dairy Development Board of India, had decided to propose to the government of India a second, larger Operation Flood. This appendix examines the achievements of the First Operation Flood; the difficulties experienced in implementing it; and how these factors influenced the design of Operation Flood II.

Anand Pattern Dairy Cooperatives: Model for the First Operation Flood

The major influence on the design of the first Operation Flood was a specialized form of milk producers' cooperative. The first cooperative of this kind was registered at a town called Anand—and such dairy cooperatives are now often referred to as *Anand Pattern Dairy Cooperatives.*

The basic unit of the Anand Pattern is the village milk producers' cooperative. This is a voluntary association of all milk producers in a village who wish to market their milk collectively. Membership is limited to one member from each milk-producer family. Members can market only their own family's milk through the coop. Most village coop's have 100 to 200 members, representing 50 to 90 percent of the village's families. A family's herd averages 1.3 cows and/or milch buffaloes, each producing 1 to 2 liters (1.75–3.5 pints) of milk daily. Often, 20 to 30 percent of members are landless laborers and another 40 to 60 percent are small-holders with less than 4 hectares (10 acres) of land. Milk earnings are between 70 and 40 percent of all earnings for these families.

All the village milk producers' cooperatives in a district are members of their district Cooperative Milk Producers' Union. There are 400 districts in India, each with an average of 1,250 villages or hamlets and a total rural population of 1.25 to 1.5 million (200–250,000 families).

The union is the core of the Anand Pattern. On behalf of its village coop members, it owns and operates a dairy processing plant and often a cattle-feed compounding plant, too; it organizes twice-daily collection of milk from the village coops; it markets balanced cattle-feed concentrates, green-fodder seeds, and so forth to the village coops; it operates mobile veterinary clinics, which visit

*Prepared for discussion purpose only, by Michael Halse, adviser, National Dairy Development Board, Anand, India. Any views expressed are the authors and do not necessarily reflect the policies of the organizations with which he is associated.

the village coops once weekly; it trains employees of each village coop for their work as secretary (chief executive), clerk, milk tester, lay artificial inseminator, lay animal first-aid worker and such, and it organizes the production of semen for artificial insemination and its distribution (by the trucks which collect milk) to member village coops. The union's employees (professional managers and technical personnel, equipment operators, etc.) run the dairy and cattle-feed plant. Milk processed at the dairy is marketed to urban centers as liquid milk and/or products, such as baby food. All the union's operating expenses are paid out of margins earned on milk marketed on behalf of its member village coops.

Each village coop has a small center in the village: a building with facilities for bulking milk in cans, carrying out fat tests, making payments for milk, and related needs. Milk producers bring their milk twice daily to the village coop, where it is measured and recorded. A sample is taken, tested for fat content - and payment is made, on the basis of quality, at the next collection time, twelve hours later. The village coop sells compounded cattle-feed to the milk producers, provides artificial insemination and first-aid services for producers' milch animals and bulks all the milk it has purchased, each morning and evening, in cans, so that it is ready (according to a strict schedule) for collection by the truck, which takes it to the union's dairy plant. Before the truck collects it, milk is also sold (at cost) to any who may wish to buy it in the village.

Each village milk producers' cooperative has a managing committee, usually with nine members. Three stand down and three are elected each year. Each managing committee elects one of its members as chairman. The committee is responsible for setting the coop's policies and for appointing the coop's secretary, who is responsible for day-to-day management of the coop.

Each district union has a board of directors. Usually, nine of the union's twelve directors are milk producers and chairmen of village cooperatives. Of these directors, one-third stand down and one-third are elected by the chairmen of all the union's village coops, when they meet at the union's annual general meeting. The board of directors is responsible for setting the union's policies and for appointing the union's general manager, who as the union's chief executive is responsible for seeing that the board's policies are implemented.

Thus, an important feature of the Anand Pattern's policymaking structure is that policymakers are all village cooperative milk producers. Only milk producers actively marketing milk to their village coop can be elected to their coop's managing committee. Only elected chairmen of village coop managing committees can be elected to their union's board of directors. This means that active milk-producer members are the policymakers throughout the structure.

For this reason, the policies of Anand Pattern Dairy Cooperatives emphasize the price paid to the milk producers for their milk and the services provided to members, to help them increase milk production and its profitability. These policies, however, are strongly influenced by the cooperatives' need to build up their position in the market and to command consumers' confidence. Less than

one-third of all milk produced in the villages is marketed outside the village—and, of that milk, the cooperatives handle some 15 percent, which in turn represents only one-tenth of all urban consumption. Competition from the traditional milk traders, using free market forces (*plus* frequent dilution), is tough. So the cooperatives have to keep their price structure competitive.

In this task, they are helped by their intensive grass-roots structure and their judicious use of modern dairy technology. Thanks to the intensive coverage achieved by the village milk producers' cooperatives, these coops achieve break-even when they procure some 200 liters (40–50 gallons) daily. Thereafter, they operate on 4 to 5 percent of payments for milk received from the union. The union's operating costs vary according to its product mix: processing for bulk shipment as liquid milk for urban consumption typically adds 20 to 25 percent to the price paid by the union for milk, while processing into conserved products adds 40 percent—and consumer packaging adds another 20 percent. When liquid milk is bulk-shipped to a city from a distant rural milkshed, it is reprocessed and either retailed unpackaged by a bulk-vending system, or it is packed in bottles or sachets, adding either 23 or 33 percent to the union's price paid for milk. Thus, the retail value of the modern dairies' output is estimated at 166 percent of the payments made to producers for their milk, while the comparable figure for rural milk handled by the traditional sector is 211 percent. As a result, the cooperative system pays producers some 15 percent more for milk than the traditional traders and the modern system as a whole gets the final product to consumers at prices 9 percent lower than those of the traditional system.

The modern system's price structure is based on using modern technology to get liquid milk to the consumer as efficiently as possible: on a milk-solids basis, its liquid milk retails at 28 percent less than the traditional traders's liquid milk, whereas its conserved (and packaged) products are priced to reflect their full cost—on a milk-solids basis, they retail at 9 percent more than traditional traders' products (and at 38 percent more than the modern dairies' liquid milk). In effect, the modern dairies' pricing policies are the opposite to those followed by dairy industries in the United States, where liquid milk is priced as high as the market will bear and conserved products are priced at whatever prices will clear the market—and, in some countries, when that is not achieved, the state buys "surplus" products and/or subsidizes milk. In India, milk as such is rarely subsidized. Operation Flood, for example, has used public funds to provide low-cost capital for modernization of milk production, processing, and marketing, rather than for subsidizing milk.

The Two Operation Flood Programs. The first Operation Flood was designed by the National Dairy Development Board of India (NDDB) in 1967–68. Its goal was to overcome the major problems that had so far prevented replication of the Anand Pattern of Dairy Cooperative outside the region in which the original

Anand Cooperative had established itself (Gujarat State). These problems—and the actions taken to counter them under the first Operation Flood—fell into three major groups.

Milk Marketing. By 1970, India's four major cities (Bombay, Calcutta, Delhi, and Madras) contained 4 percent of the country's human population and accounted for 10 percent of estimated expenditures on milk and milk products. Demand was fairly constant throughout the year—but, in the hot season, milk production fell to one-third of winter-season levels—and, quite often, in one (or more) of the country's major regions, the monsoon rains would fail, adding sharp year-long regional declines to the regular seasonal fluctuations in milk production. When this happened, milk prices rose rapidly in the region(s) involved—and the highly concentrated purchasing power of the cities enabled their traditional milk traders to bid strongly for milk in the hinterland milksheds. This, in turn, disrupted whatever orderly milk marketing and procurement systems might have existed in the milksheds—and often brought village milk coops to bankruptcy. It also caused the big cities (where 20 to 30 percent of milk consumed was produced by some 100,000 cattle kept *in* the cities) to attract more of the better milking animals from the milksheds. To counter these problems, the first Operation Flood contained provisions to finance the build-up of dairy processing capacities in the four major cities, to enable the modern dairies to capture at least 70 percent of those cities' liquid milk markets. Other provisions were made to finance a network of transport and storage facilities for interregional movement of milk, to help even out seasonal and regional imbalances between supply and demand; funds were also provided for resettlement of city-kept cattle.

Rural Organization. The NDDB had been established in 1965, at Anand, mainly to replicate the Anand Pattern of Dairy Cooperative in other milksheds. By 1970, however, although six of these coop organizations had developed in Gujarat State, the NDDB had been unable to help get even one established outside Gujarat. Yet such organizations were deemed to be necessary in the major milksheds, to pay a fair market-related price to producers, to help producers to increase their milk production—and to enable the milk production-processing-marketing system to become more efficient and, ultimately, self-financing. In addition to periodic disruptions, caused by the dominant purchasing power of the major cities, whenever milk supplies declined sharply, three major problems had prevented replication of the Anand Pattern: (1) the traditional milk trade used its influence and economic power to stop the development of coops, which would supplant the traditional structure; (2) bureaucrats often disliked and distrusted the idea of an autonomous coop, which would employ its own professionals to do work otherwise done by government departments (chiefly, the Veterinary, Cooperative, Extension, Animal Husbandry and Milk departments of

state governments); and (3) as bureaucrats largely controlled the developmental funds available—while no one, including the NDDB, had devised a method of systematically organizing village producers' coops on a large scale—when proposals were made to use official funds to help establish Anand Pattern Cooperatives, these proposals seemed to get lost in a maze of interdepartmental procedures, so that little actually happened. To overcome these three obstacles, Operation Flood was made self-financing (by sale of donated milk powder and butter oil, for recombination into liquid milk in the major cities) and funds were provided to help establish Anand Pattern Dairy Cooperatives in seventeen (later, raised to eighteen) milksheds around the four major cities. Provisions were made to cover fixed investments in cooperative organization, in setting up artificial insemination systems, and in erecting dairy processing plants—as well as covering all or parts of the associated recurring costs, in the early years, until the new coops could cover these costs by their operating margins.

Infrastructure. As the two paragraphs above show, most of the actions required for Operation Flood were to be taken either in the four major cities, or in eighteen hinterland milksheds; responsibility for getting these actions implemented would rest with the state governments concerned. A few actions, however, could not be implemented on such a basis, because they affected (and/or had to be implemented at) more than one location. This was the case with the long-distance transport and storage network (National Milk Grid) and, also, with the rearing of selected bulls to produce semen for artificial insemination. In addition, certain common services had to be built up, such as dairy plant design and erection, rural cooperative organization, manpower training and development, and unloading, clearance, and movement of donated milk powder and butter oil. Responsibility for these actions, it was decided, would rest with government of India's designated authority for the project, the Indian Dairy Corporation (IDC), a wholly government-owned, nonprofit making corporation, which generally contracted with the NDDB for such services (except the handling of donated dairy commodities, which in law was the IDC's responsibility).

As this three-part summary indicates, the original Operation Flood consisted of integrated actions of three types: milk marketing, rural organization and infrastructure. By 1975, the IDC-NDDB had concluded that the project's integrated approach to dairy development had some advantages, even though progress had been uneven and less integrative than desired. This can be seen from Table 6C-1, which summarizes progress up to 31 March, 1978. Concentrating particularly on Operation Flood's relative successes and failures, the policymakers and planners at Anand set about devising "Operation Flood II," with the aim of continuing and expanding whatever had worked in the first Operation Flood and finding alternatives for the parts that had worked less well. This planning process can most easily be described as having had the following five components.

Selection of the Major Objective and Duration of Operation Flood II. When the first Operation Flood was designed, in the 1960s, the NDDB recognized that, during the program period itself (initially, 1970-75), there would be little impact on the country's milk production. To produce bulls and build up a structure for artificial insemination takes several years. Therefore, the goal of the first Operation Flood, with regard to milk production, was confined to building up the infrastructure needed, before milk production could be increased. By the mid-1970s, the pure-bred bulls required for a large AI program were being produced in India and technology and training facilities were in place. Thus, in 1976, the NDDB decided that the main objective of Operation Flood II should be to ensure that there would be "enough" milk in India by the end of Operation Flood II. Nutritionists had estimated that an average of 180 grams (0.3 pints) of milk per capita daily would be enough to balance the national diet (versus current consumption of 110 grams daily). But would people be able to increase their milk consumption at that rate? In the past decade, incomes (measured by Gross Domestic Product) had, on the average, risen by 3.5 percent yearly. In the 1980s, projected annual increases in income ranged from 5 percent to 7 percent, indicating that effective demand for milk would rise to 149-176 grams per capita daily. The NDDB felt that it would be conservative to take the lower figure of 149 grams. However, it was also decided that the program should be implemented within seven years, from 1978-79 to 1984-85—and the NDDB estimated that milk production could be raised only to 144 grams capita daily by 1985, although the artificial insemination program, to be built up during Operation Flood II, would continue to increase milk production in the late 1980s, so that availability could rise to 185 grams per capita daily by 1989. This would be close to estimated effective demand in 1989 (some 190-195 grams per capita daily). The NDDB concluded that a program of seven years' maximum effort appeared unlikely to produce either the nutritional requirement of milk or the amount equal to effective demand by the end of the program—but that such a program could set in train increases in milk production that would satisfy effective demand by the end of the 1980s, at a level also approximating the country's nutritional requirement. Therefore, the NDDB decided to propose to the government of India a program of maximum effort from 1978-79 to 1984-85, designed to raise availability of milk to 144 grams per capita by 1985.

Priorities, Instruments, and Targets. The NDDB estimated that, by 1985, 66 percent of effective demand for milk would be from the rural population. Taking this factor into account, *plus* the projected increase in overall demand for milk, it was decided that the first priority in Operation Flood II should be to increase rural milk production and that investments in urban milk marketing should be minimized. The massive increase required in milk production could be

Table 6C-1. Operation Flood Progress

Operation Flood Milkshed Districts	Cooperative Union Registered Month	Cooperative Union Registered Year	Dairy Plant: Commissioned Year	Dairy Plant: With Union (Yes ✓) (No x)	Feed Plant: Commissioned Year	Feed Plant: With Union (Yes ✓) (No x)	Village Milk Producers' Cooperatives Anand Pattern	Village Milk Producers' Cooperatives Other	Milk Production: Villages with AI	Milk Production: Veterinarians with Union/Corporation
1. Guntur	3	77	78	x	Due in 80	x	32	119	137	5 Corp.
2. Patna	4	77	78	x	77	x	82	40	2	3 Corp.
3. Banaskantha	1	69	73	✓	77	✓	731	0	78	12 Union
4. Baroda	12	57	Expanded 72	✓	Due in 78	x	533	0	128	10 Union
5. Kaira (Anand)	12	46	Expanded 70	✓	64	✓	831	0	735	58 Union
6. Mehsana	11	60	Expanded 74	✓	Expanded 77	✓	581	175	70	29 Union
7. Sabarkantha	11	64	74	✓	76	✓	767	0	76	6 Union
8. Gurgaon	4	72	–	x	–	x	150	0	0	5 Corp.
9. Rohtak	3	72	77	x	76	x	144	204	0	7 Corp.
10. Jalgaon	11	71	76	✓	78	✓	350	167	53	13 Union
11. Bhatinda	–	–	74	x	Due in 80	x	100	0	0	4 Union
12. Ludhiana	7	72	74	x	74	x	33	21	50	15 Corp.
13. Bikaner	10	72	77	–	Due in 80	–	187	52	18	9 Union
14. Erode	2	75	Due in 80	x	Due in 80	x	139	0	151	18 Corp.
15. Meerut	–	–	Due in 78	x	Due in 80	x	335	0	0	4 PCDF
16. Varanasi	–	–	Due in 78	x	Due in 78	x	20	21	97	6 Corp.
17. Murshidabad	10	74	Due in 81	–	Due in 80	–	171	0	97	6 Corpn.
18. Matigara	1	73	74	x	Due in 78	x	191	0	77	10 Union
Additional Districts										
1. Madras	–	–	Expanded 74	–	–	x	407	51	106	11 Corp.
2. Ooty	–	–	–	x	–	x	90	149	38	12 Corp.
3. Vellore	–	–	–	x	–	x	209	76	184	15 Corp.
4. Madurai	–	–	Expanded 76	x	–	x	358	279	212	12 Corp.
World Bank Assisted Districts										
1. Bangalore	10	77	Due in 81	x	Due in 80	x	185	–	105	–
2. Mysore	10	77	Due in 81	x	–	x	171	–	142	26 Corp.
3. Tumkur	11	77	Due in 81	x	Due in 80	x	102	–	80	–
4. Hassan	11	77	Due in 81	x	–	x	92	–	80	–
5. Bhopal	12	77	Due in 82	x	Due in 80	x	90	–	90	12 Corp.

6. Ujjain	12	77	Due in 81	x	–	x	62	–	62	–
7. Indore	12	77	Due in 82	x	Due in 80	x	70	–	61	–
8. Alwar	9	72	Due in 79	x	Due in 79	x	122	–	70	9 Corp.
9. Ajmer	2	72	Due in 79	✓	Due in 80	✓	210	–	169	–

Eleven Action Items	*In Rupees Millions Original Allocation, 1970*	*Current Adjusted Allocation*	*Disbursements Through to January 1978*	
1. Expansion of existing dairies in four metropolitan cities	19.1	26.6	22.4	In million liters of milk daily: Capacity Mid-1970 1.0, End-1978 2.9; Output Mid-1970 0.9, End-1978 1.8; Target: 2.75 million liters
2. New dairies in four metropolitan cities	140.0	238.7	165.4	
3. Storage and long distance transport	31.7	37.7	23.6	30 rail tankers; 3 warehouses
4. Milk collection/chilling centers	62.8			17 dairy plants: 2.4 million liters/day with 2 million liters conservation
5. Feeder/balancing dairy plants	147.0	363.8	256.5	
6. Resettlement of city-kept milch animals	154.0	87.5	2.1	Economic forces depended on instead
7. Increasing milk production	285.0	269.1	92.4	Animals covered: 1.9 million (est.) Target: 2 million
8. Development of improved milch animals	40.0	40.0	20.2	13 Bull Mother Farms
9. Cooperative organization	18.0	26.0	11.9	Estimated milk producers covered: 2 million
10. Project planning, manpower	35.8	35.8	22.3	1000 metric ton: Original Target / Received by March 78: SMP 126 / 100; BO 42 / 35
11. Miscellaneous (donated SMP & BO handling)	20.6	36.8	39.7	
	954.0	1164.0	538.7	

Funds generated: Rupees 890 million

Source: National Dairy Board of India.

achieved only through a large-scale artificial insemination program—which, in turn, would call for the establishment of milk producers' coops in a very large number of villages. Moreover, the higher yielding milch animals produced under artificial insemination required an effective veterinary support system, which meant that the district unions of the village coops involved would have to be capable of organizing mobile veterinary clinics. Even then, within seven years, not more than two-thirds of the milk producers within the cooperatives' ambit could be expected to accept the use of artificial insemination. Taking these factors into account, the NDDB concluded that the number of milch animals brought within the coops' ambit could be raised from some three million in 1978 to fifteen million by 1985, of which just over ten million could by that time be bred by artificial insemination. Thus, the coop structure, artificial insemination, and veterinary support systems were adopted as major instruments of Operation Flood II. It was also estimated that the number of AI-bred milch animals would increase to fourteen million by 1989 and that this would enable milk production to rise close to estimated 1989 effective demand.

Location and Organization. From experience gained during the first Operation Flood, the NDDB concluded that the country's prime milksheds consisted of all or parts of some 150 to 160 districts, with a total adult milch animal population of some 33 to 34 million. Most of these milch animals were in twenty-five contiguous areas, each consisting on average of 5 to 7 districts. Considering how hard it had been to get 17 Anand Pattern District Cooperative Unions started during the first Operation Flood, the NDDB decided that the same approach could not be applied to the jobs of increasing the number of unions to 155 by 1985. On the other hand, the Anand Pattern of Dairy Cooperative had itself evolved further since the start of the first Operation Flood: in 1973, the 6 Anand Pattern District Cooperative Unions in Gujarat State (including the original model at Anand) had combined themselves into a cooperative milk marketing federation, so that they could have a common marketing program and provide members with common services. The NDDB therefore proposed that, to obtain the required coverage of milch animals by Operation Flood II, the program should aim at assisting up to 25 federations to develop by 1985, each covering a cluster of districts (average: 6 per cluster) and that each federation should, itself, become the "action taker" responsible for its own part of the program. This would limit the major centers of action to 25 which would be a manageable number vis-à-vis communications, developmental services, and funding. Of course, it was recognized that it would not be easy to achieve the evolution of 25 cluster federations, to the point that they could implement their own programs. On the other hand, the NDDB had evolved a relevant modus operandi, during the first Operation Flood, whereby it had helped district unions to implement their village cooperative organization programs. This modus operandi consisted mainly of assigning a Spearhead Team of NDDB's experienced veteri-

nary doctors and cooperative organizers to a new district union, to work for one or two years alongside a similarly composed team, recruited locally by the union. The NDDB concluded that the same principle could be used to help new federations, if each federation were provided with a Composite Spearhead Team, including not only veterinary doctors and cooperative organizers, but also engineers, marketers, quality control personnel, accountants, and so forth. These teams (each numbering 75 to 150) would be assigned to new federations *as their employees* and, thereafter, each federation would be responsible for its own part of Operation Flood II.

The NDDB projected cluster-federation start-ups during the program as follows: four in year 1, eight in year 2 and thirteen in year 3—however, in four of the clusters, the organizational structure was already quite strong; these would require considerably less help than the others, thereby reducing the size of the task by some 20 percent.

Projecting the Operation of the Market. The NDDB had, of course, detailed information on the milk markets in the country's four major cities and the seventeen milkshed districts covered by the first Operation Flood. It had surveyed a number of other cities, towns, and milksheds, to provide data for feasibility studies. On the basis of this information, the NDDB estimated that current urban milk consumption ranged from 155 to 226 grams per capita daily, while rural consumption was 110 to 120 grams per capita daily in milkshed areas and 60 to 70 grams in other rural areas. The major milksheds already accounted for slightly more than 50 percent of milk production. This share would rise during Operation Flood II, as the program's investments in milk production began to pay off. But it was also true that a major national objective was the relief of rural poverty and the achievement of parity between urban and rural incomes. To the extent that this object was achieved, then, milk consumption would rise faster in the countryside than in the cities. In one sense, this presented a paradox the Anand Pattern Cooperatives stimulated rural production by linking milk producers more efficiently to urban demand, but the more successfully they achieved this, the more milk producers would retain milk for their own (and their neighbors') consumption. Thus, too little investment in urban milk marketing could limit the program's impact on milk production while too much investment in processing and marketing could leave the coops saddled with underutilized dairy plant capacity. Ultimately, however, the NDDB's projections indicated that milk production in the milksheds could be expected to rise by some 55 percent during the program, while per capita milk consumption would rise by only 45 percent, allowing for a 60 percent increase in milk marketing for urban consumption. These calculations took into account several additional important factors: other programs than Operation Flood would be working to increase production of other foodstuffs in all rural areas of the country during 1978-85; the culled animals from Operation Flood milksheds would be sold

into the rest of the countryside, where they would contribute to increased milk production; the gap between milk supply and effective demand would continue to increase at least until 1980–81, causing the relative price of milk to rise and stimulating increases in milk production well beyond the confines of the milksheds covered by Operation Flood. For all these reasons, it became clear that the modern cooperative dairies would be wishing to diversify their urban markets, latching on to each milk market they could serve more efficiently than the traditional milk trade. A limitation on this policy would arise, however, if every urban market had to be served via an urban market-milk dairy plant, which would reprocess and package milk for urban consumption. This could double the capital required for processing facilities. (The NDDB had already developed and proven a system for bulk-vending unpackaged, refrigerated milk.) These considerations led to two policy decisions: (1) under Operation Flood II, the modern dairies would aim at obtaining 60 to 80 percent of the liquid milk markets in the country's 145 major cities—and almost all of this market diversification would be achieved by direct supply from rural dairies, in insulated road tankers, to urban bulk-vending units, thereby avoiding the need for capital investment in urban reprocessing and packaging—and (2) since it had been observed that the modern dairies' efficient liquid milk systems caused a decline in the proportion of milk consumed as ready-made, conserved milk products (ghee, curd, etc.), the proportion of milk processing capacity built for conserving milk in the form of products would be decreased from 50 percent of average procurement in 1978 to 30 percent by 1985; this also would decrease the capital required, because dairy processing plants for conserving milk required twice as much capital as dairy plants equipped simply to forward chilled, pasteurized milk for direct urban consumption. In addition to the major city markets (with a total human population of 90 to 95 million by 1985), it was anticipated that the rural cooperatives would rapidly increase their shares of the liquid milk markets in smaller towns (with a total human population of 20 to 25 million in 1985), in and around the milkshed areas, which could readily be served by a low-cost system for bulk-vending milk from cans. This diversification of markets, with little fixed investment in urban processing, was designed to enable the rural cooperatives to walk the tightrope between the milk producers' increasing production and marketing of milk, on the one hand, and the likelihood, on the other hand, that as the rural economy expanded, rural milk consumption would rise—probably unevenly, over both time and also among the widely varying regions of the country. In addition to the flexibility of the urban milk marketing system envisaged, the overall plan for Operation Flood II provided for tight monitoring of milk production and consumption, accompanied by detailed arrangements for opportunities to make annual corrections, if need be, in each cluster federation's planned investments in processing and marketing capacities.

Structure of Investment and Sources of Funds. The estimated investment in

Operation Flood II totaled Rupees 4,835 million (= US$ 604 million i.e. Rs 1:00 = US $.125). This total could most easily be categorized as follows (with cost breakdown shown on Table 6C-2):

1. Investment in rural dairy processing facilities was additional to such facilities constructed under other programs in the cluster milksheds. By the end of Operation Flood II, the total facilities available to the cluster federations would be 14 million liters daily of "feeder" capacity (in dairy plants designed simply to "feed" urban markets with chilled, pasteurized liquid milk) and 6 million liters daily of "balancing" capacity (in plants designed to enable the federations to "balance" seasonal variations in milk supplies by conserving flush-season milk in the form of milk powder, butter, ghee, etc.). Provision was also made for packaging liquid milk aseptically; this milk was termed "long life milk" because it had a life of 3-6 weeks without refrigeration, so it could be transported to urban areas and retailed there as a grocery item.
2. Investment in urban milk marketing facilities was also additional to such facilities constructed in the cities and towns under other programs. By the end of Operation Flood II, the total urban milk marketing facilities in the cities and towns coming under the program would be capable of retailing 15 million liters of liquid milk daily.
3. The National Milk Grid was primarily designed to enable the program to even out seasonal and regional imbalances between supply and demand. It in-

Table 6C-2. Cost Breakdown Operation Flood II

	Rupees (millions)	*Percent*
1. Investment in rural-dairy processing facilities 8.5 million liters daily feeder capacity plus 3.7 million liters daily balancing capacity, including 1.3 million liters long-life	1,593	33
2. Investment in urban milk marketing facilities: 1 million liters daily capacity in four metropolitan cities' dairy plants plus 4.9 million liters daily capacity (bulk vending) in cities plus 2.8 million liters daily capacity (bulk vending) in towns in and around milkshed areas	539	11
3. National Milk Grid: movement and storage	285	6
4. Assistance to cluster federations	1,718	36
5. Infrastructural support	379	8
6. Planning and monitoring	325	7
	4,835	100

Source: National Dairy Board.

cluded provisions for road- and rail-milk tankers, storage facilities for milk powder and conserved milk fat, port-clearance of donated dairy commodities from abroad, extrusion facilities for supplementary infant foods, paper laminate capacity, and an urban marketing demonstration project.

4. Assistance to cluster federations included provisions to cover initial costs of cooperative organization and milk production enhancement in the cluster milksheds. Some 40 to 45 percent of these funds were to provide direct assistance to village milk producers' cooperatives to enable them to become viable within not more than two to three years; 30 to 35 percent was allocated as capital assistance to cluster federations to help them establish veterinary-care and artificial-insemination systems, with training facilities for village cooperatives' staff and 20 to 25 percent was to cover part of the initial recurring costs of artificial insemination, extension, spearhead teams, and the like. Toward these costs, recipient federations were to reserve Rupees 0.07 (= US $0.00875 @ US $1.00 = Rupees 8.00), per liter of milk procured. The balance was to be covered by the funds provided by the program, until the reserved Rupees 0.07-per-liter was sufficient to cover them (projected at the fourth-to-eighth year, according to the stage of each federation's development). These provisions were intended to be used flexibly, according to each milkshed's needs and potential. The yardstick proposed, for appraising federation-wise allocations, was the net cost to the program of adding one improved milch animal for one year to its AI-bred herd during the program: this was expected to vary from Rupees 22 to Rupees 144 per animal-year, according to the nature of the milkshed and the degree to which coops in the milkshed had developed.
5. Infrastructural support covered six financial provisions: to increase the country's production of proven bulls; to establish a foot and mouth disease vaccine plant; to establish a program of research in selection, breeding, feeding, and management of the buffalo, for improved conversion efficiency; to establish buffalo holding farms and improve the marketing system for live buffaloes, and to increase the services available to farmers' organizations from the NDDB and related institutions, especially in such areas as management consultancy and executive development.
6. Planning and monitoring consisted mainly of provisions to cover the costs of developing a management information system for the national milk grid, to provide developmental planning services to cluster federations; to develop a pool of skilled man-power, with practical training in management of dairy cooperatives, dairy technology, and animal husbandry, and to cover the costs of designing, erecting, and commissioning dairy and cattle-feed plants.

In their proposal, NDDB planners calculated that some 16 percent of funds needed could be generated internally by the Indian Dairy Corporation; almost 36 percent were proposed to be provided by the government of India (possibly

using funds loaned through a United Nations agency). For the balance, it was proposed that donated dairy commodities should be received as bilateral aid from the European Economic Community. These commodities (milk powder and butter oil) would be sold into the modern dairy system at prices approximating their value as liquid milk in India. The modern dairies (mainly those in the cluster federations) would recombine them into liquid milk, which would be marketed through the modern-dairy system along with indigenously produced fresh milk. The quantities of commodities to be received were envisaged as increasing during the first the three years of the program, at which point they would account for some 10 percent of milk handled by the modern dairies. Thereafter, the quantities received were to be tapered off and ended in the seventh year.

The "package" of funds thus made available to the Indian Dairy Corporation were to be treated as a single "corpus." In general, it was envisaged that the corporation would disburse them directly to the organizations responsible for each part of the program. Funds used for nonprofit making activities—such as the NDDB's services—were to be provided as outright grants. However, funds to be invested in creation of economically viable institutions (such as cluster federations) were expected to be provided as 30 percent grant/70 percent loan. Interest would be payable on the loan portion at the rate set by the government for developmental loans—currently, 8 to 9 percent. Loans were to be repaid, after a five-year grace period, in twenty equal annual installments, covering interest and principal. NDDB's projections indicated that the main recipients of these funds, the cluster federations, would be capable of making loan repayments as scheduled.

The conventional benefit/cost analyses of the program were also favorable. Using a social discount rate of 12 percent, the benefit/cost ratio was projected as 15:1—and the overall economic rate of the return was 35 percent (nearly three times the social opportunity rate of 12 percent). These valuations of the benefits, to be derived by the country from the program, compared well with the results normally expected from such developmental programs.

Relaxing the Constraints

There are several ways of viewing developmental programs, such as Operation Flood II. Much of the work on evaluation, depends considerably on quantitative analysis of returns on investment. Without denying the usefulness of such an approach, it may be interesting to take a different approach to the National Dairy Development Board's proposal to Operation Flood II.

The designers of the program have stated that they were influenced by their desire to learn from the experience gained in implementing the first Operation Flood. They had identified some things which had worked well—and they had identified some constraints, which had retarded implementation. Evidently, they have tried to build into Operation Flood II some features that are designed to

enable the implementers of Operation Flood II to relax the constraints which delayed some parts of the first Operation Flood. These features can be classified under three headings: (1) physical conversion, (2) human organization, and (3) the relations between funding and structure. Some aspects of these three sets of features are outlined below.

Physical Conversion. Vegetative matter is produced by photosynthesis, the process whereby the sun's energy is used to convert carbon dioxide and water into plant material. Milk production is a subsequent process, whereby mammals convert plant material into a food which uniquely combines certain nutrients required for bodily growth and protection from disease. Some of these nutrients cannot be synthesized by the human system and the combination of them that exists in milk can be obtained from plant material only by devising rather complex mixtures of plant foods.

Agriculture in India has for thousands of years depended on the draught-power of bullocks. Therefore, many Indian farmers keep cows mainly to ensure that they have bullocks. For these farmers, milk is a by-product of draught animals.

Most Indian cows have been selected, over thousand of years, for two sets of characteristics: an ability to produce and suckle their young, especially the male calf and an ability to survive on only a very poor diet, while resisting most varieties of virus and parasite.

It is often said today, however, that man cannot afford the luxury of animal foods any more, that we must live by consuming plant foods directly, thereby avoiding the inefficient double-processing that is involved when animals convert plant material into foods such as milk. If this is so, how can India, with its hungry millions, afford milk? Many people, especially in the West, therefore ask: Should India have a dairy development program such as Operation Flood? The question is, of course, one only Indians can decide—but a close examination of milk production in India can enable any observer to understand why milk production is given high priority there.

The bulk of feedstuffs fed to bovines in India are agricultural by-products (such as straw) and natural herbage inedible to man (such as weeds and leaves), which milk producers and their families garner from the countryside. Only very small amounts, if any, of cultivated green fodder and concentrates are fed to the typical cow and buffalo. Thus, India's milk production is primarily the conversion of waste plant matter and human labor into animal food (and bullocks). This is true even of the improved milch animals (such as crossbred cows) that are being reared to form the National Milch Herd under Operation Flood II.

Nevertheless, it is true that some cultivated fodder and some concentrates are used for milk production. It has been estimated that the land so used might, if it proved suitable, enable India to produce 3 to 6 percent more cereal.

This is not considered a sufficient reason for risking a further deterioration of

the diet for the majority of people in India, whose traditional diets can be balanced nutritionally by consumption of some 180 grams of milk daily. Therefore, a policy of agricultural development that would lead to a "cereals only" diet for the majority has not been adopted. Instead, a National Milch Herd is being developed of bovines that are much more efficient converters than the present stock: these improved animals consume only 27 percent of the total digestible nutrients and only 39 percent of the crude protein that India's current stock consume to produce a liter of milk. Rearing these animals can therefore increase the returns to labor for small-holders and landless families, who otherwise have little remunerative work during most of the year.

Thus, there are conditions that relax the constraint that might be imposed, if increased milk production necessitated a decline in the conversion efficiency of the national food system. In Operation Flood II, this potential constraint is to be relaxed by an institutional structure that enables very poor rural people to breed up their milch animals for more efficient milk production, while ensuring that the improved milch animals can be fed primarily on agricultural by-products and garnered herbage inedible to man.

Human Organization. One major success of the first Operation Flood has been the growth in village milk producers' cooperatives. In its Spearhead Teams, the National Dairy Development Board has created an effective instrument for rural organization. Moreover, when the producers in a milkshed can see how the cooperatives can help them, the movement develops a momentum of its own that the "establishment" cannot retard.

However, it is equally clear that some part or other of the establishment has often succeeded, during the first Operation Flood, in preventing a union of village milk producers cooperatives from obtaining ownership of its own dairy plant. Moreover, in many milksheds, there was effective resistance to the spearhead team approach to cooperative organization. This delayed the program: hence, the small number of coops so far formed in some milkshed districts. These delays also retarded the program to increase milk production by provision of veterinary care and artificial insemination through the cooperatives. Some official promoting organizations, such as publicly owned dairy development corporations, still not only retain ownership of dairy plants built under the first Operation Flood, but they also still retain the veterinary doctors as their employees.

These difficulties delayed the first Operation Flood, which aimed at creating only 18 Anand Pattern Dairy Cooperative Unions. Operation Flood II requires some 150 Unions. This could imply that an intolerable number of difficulties must be expected.

Clearly, the cluster federation's role in Operation Flood II is designed to overcome the organizational constraints described briefly above. The formation of these federations can limit the program's action-centers to a manageable number.

Perhaps it will prove to be of even more importance that the federations are to be "demanders," on behalf of their members, of all the investments and services envisaged under Operation Flood II. And the pressure of their demands is expected to overcome the kinds of resistance that impeded implementation of the first Operation Flood.

True, this still leaves the National Dairy Development Board with the large task of ensuring that each federation can get the skilled man-power it needs. Thousands of young graduates, who have received an urban-oriented education, have to be found and it has to be ensured that they are motivated to want to serve poor farmers. Also, the Indian Dairy Corporation will be deploying public funds, and the investment of these funds has to be monitored and controlled. Nevertheless, it appears that the designers of Operation Flood II are, to a considerable extent, depending on the development of the cluster federations to relax the constraints imposed on the first Operation Flood by difficulties of human organization. Evidently, where there is resistance from traders, bureaucrats or traditional power-holders, it is the federations which are to overcome this resistance. Therefore, the federations' leadership, vigor, professional management, and popular support constitute the conditions that are to relax the constraints of human organization that impeded the first Operation Flood.

Relations between Funding and Structure

Classifications, such as "conversion efficiency" and "human organization" can be useful for analytical purposes. However, certain features of Operation Flood II cut across several areas that are sometimes analyzed separately.

This is particularly evident in those features of the program that involve investments designed to enable rural labor to be more productive, a description that could be applied to all investments envisaged under Operation Flood II. The economic viability of the village cooperatives, the district unions, and the federations of these unions is largely a function of the milk producers' productivity. That productivity, in turn, is largely dependent on the process of conversion efficiency.

The village cooperative/union/federation structure can be viewed merely as a means whereby the milk producers offer to the milk consumer the benefits of their improved productivity. Federation-to-federation relations, to be institutionalized through the National Milk Grid, can be viewed merely as a means of ensuring that the producers' offers to consumers will constitute the best nationwide "fit" to the demand confronting milk supply: hence the emphasis in Operation Flood II on the management information system for the National Milk Grid.

No doubt, the existence of that system will prove to be an important condition for relaxing the complex constraints under discussion here. However, it is also true that the functioning of the National Milk Grid will reflect the millions of very local decisions made daily by farmers, their cooperatives, their profes-

sional managers of dairy plants, and others. An attempt to enforce uniformity, in the name of coordination, would probably paralyze the system, while certainly stifling individual initiative. At the same time, the multitude of local decisionmakers involved—the farmers, the cooperatives' elected boards of directors, the professional managers—will all be to some extent responsible for the Rupees 4,835 million that are to be invested through Operation Flood II. They will have to combine their financial dependence with valid, independent decisionmaking. The implementers of the program will have to combine their role as watchdog over public funds with their role as stimulaters of local initiative.

To some extent, this was sought to be achieved under the first Operation Flood by entrusting these roles to different institutions: the government-owned Indian Dairy Corporation was responsible for the quality of investments made, while the autonomous National Dairy Development Board was responsible for stimulating the development of the cooperatives as independent producers' decisionmaking bodies.

This development, however, was resisted quite successfully in a number of cases, as already noted above. Moreover, the sheer weight of the investment required in Operation Flood II may make it impossible to maintain the separation of roles between the Indian Dairy Corporation and the National Dairy Development Board, a role structure, which—it can be argued—is in any case somewhat artificial.

Thus, it may be that a constraint will be imposed on the development of an autonomous cooperative structure by the fact that the promoters of that structure are also responsible for the public funds involved. Presumably, the designers of Operation Flood II envisage further development of such institutions as the Indian Dairy Corporation and the National Dairy Development Board, in ways that will relax any constraint imposed on cooperative development by the promoters' watchdog role.

APPENDIX D
TATE & LYLE, LTD.*

In April 1976, Saxon Tate, chairman of the Executive Committee of Tate & Lyle, Ltd., was reviewing the company's worldwide involvement in developing countries. Tate & Lyle is a British-based multinational company with 1975 after tax-profits of £22.8 million on sales of £1.3 billion. Its business is to supply, trade, and process commodities, and provide the services necessary for transporting, processing, and warehousing other people's goods. The group has a substantial presence in the worldwide markets for many foods, feedstuffs, fuels and chemicals, and other vital commodities. Besides sugar, its main fields of operation are international commodity trading, bulk liquid storage, shipping, road transport, engineering, and consultancy. Tables 6D-1 and 6D-2 show Tate & Lyle's recent financial performance by type of operation. Table 6D-3 is their most recent balance sheet.

Mr. Tate felt strongly that the group's effort to coordinate commodity systems on a global basis is dependent upon a broad and in-depth involvement in both the developing and developed world. Since many commodities are produced in less developed nations, Tate & Lyle's presence in these locations strengthens its procurement and marketing abilities and creates flexibility in its handling operations. New marketing opportunities also exist in some developing countries as they raise their standard of living; such is now the case in Iran and Saudi Arabia. The group's trading activities benefit from a worldwide communication network, which is constantly feeding information to Tate & Lyle's head offices. For these reasons, Tate & Lyle has made considerable effort to maintain mutually beneficial relationships with the people and governments of the countries within which it operates. The group has initiated creative programs that have transfered ownership of many of its overseas assets to local residents or their governments. Tate & Lyle has also trained nationals to manage these assets and continues to provide management and technical consultancy services to them. As a result of these programs, Tate & Lyle has maintained some type of role in most of its traditional trading areas. It is this presence, and not necessarily the ownership of physical assets, that provides the foundation for the group's coordination activities. Mr. Tate was pleased that the group has been able to avoid the problems of many multinational companies who have essentially been thrown out of developing countries and have had their assets expropriated. He was not, however, content with Tate & Lyle's past actions and was seeking new and innovative strategies that would strengthen the company's practical

*This case was prepared by Robert Dew under the supervision of Ray A. Goldberg, Moffett Professor of Agriculture and Business, as a basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Table 6D-1. Tate & Lyle: History of Turnover and Pretax Profits by Operation, 1968-75 (millions of pounds)

	Turnover							
	1975	*1974*	*1973*	*1972*	*1971*	*1970*	*1969*	*1968*
Sugar Refining:								
United Kingdom	388.6	197.3	161.1	142.9	126.0	120.7	119.2	127.2
Overseas	114.7	80.0	60.1	50.2	39.8	33.6	26.4	23.1
Commodity handling, trading, storage, and distribution	698.9	337.1	206.2	188.0	137.5	61.7	37.2	36.8
Shipping	28.8	37.3	24.2	12.5	12.6	11.3	9.9	11.7
Raw sugar production (including local refining)	32.4	29.1	16.3	21.5	28.7	21.4	25.5	22.3
Engineering, consulting, and miscellaneous	51.7	34.2	24.4	21.7	16.6	19.5	15.8	12.1
Less intergroup turnover	(40.7)	(32.7)	(26.6)	(17.5)	(18.6)	(5.9)	(6.0)	(4.5)
Total turnover	1,274.4	682.3	465.7	419.3	342.6	262.3	228.0	228.7
	Pretax Profits							
Sugar Refining:								
United Kingdom	7.3	2.1	3.3	4.2	2.6	3.8	2.5	3.3
Overseas	4.2	3.7	4.1	3.7	3.9	4.1	3.6	4.0
Commodity handling, trading, storage, and distribution	32.4	18.1	3.6	5.7	3.2	3.3	2.9	1.9
Shipping	.4	13.3	6.8	1.7	4.2	3.2	3.0	3.8
Raw sugar production (including local refining)	4.7	4.5	(.3)	.2	.6	(1.6)	(1.5)	.2
Engineering, consulting and miscellaneous	1.7	1.8	1.4	1.3	(.4)	(.5)	.3	.5
Associate companies	1.9	1.7	1.4	.6	.2	–	–	–
	52.6	45.2	20.3	17.4	14.3	12.3	10.8	13.7
Central expenses	(5.1)	(4.4)	(3.2)	(2.4)	(2.9)	(3.2)	(2.7)	(2.3)
Other adjustments	–	(9.7)	.8	1.2	1.2	–	–	–
Group profit before taxation	47.5	31.1	17.9	16.2	12.6	9.1	8.1	11.4

Source: Tate & Lyle *Annual Reports.*

Table 6D-2. Tate & Lyle: Percentage of Turnover and Pretax Profits Provided by Each Operation, 1968-75 (percentage)

	1975	1974	1973	1972	1971	1970	1969	1968
	Turnover							
Sugar Refining:								
United Kingdom	30	28	33	33	35	45	51	55
Overseas	9	11	12	11	11	13	11	10
Commodity handling, trading, storage, and distribution	53	47	42	43	38	23	16	16
Shipping	2	5	5	3	3	4	4	5
Raw sugar production (including local refining)	2	4	3	5	8	8	11	9
Engineering, consulting and miscellaneous	4	5	5	5	5	7	7	5
Total	100	100	100	100	100	100	100	100
	Pretax Profits							
Sugar Refining:								
United Kingdom	14	5	16	24	18	31	23	24
Overseas	8	8	20	21	27	33	33	29
Commodity handling, trading, storage and distribution	61	40	18	33	22	27	27	14
Shipping	1	29	33	10	30	26	28	28
Raw sugar production (including local refining)	9	10	(1)	1	4	(13)	(14)	1
Engineering, consulting and miscellaneous	3	4	7	8	(3)	(4)	3	4
Associated companies	4	4	7	3	2	–	–	–
Total	100	100	100	100	100	100	100	100

Source: Tate & Lyle *Annual Reports.*

Table 6D-3. Tate & Lyle: Balance Sheet as of Year Ending September 30 (thousands of pounds)

	1975	*1974*	*1973*	*1972*
Cash	36,855	28,133	11,123	9,551
Accounts receivables	111,348	122,484	60,686	52,492
Inventories	94,698	48,877	51,645	38,768
Total current assets	242,901	199,494	123,454	100,811
Deferred assets	6,465	6,759	7,708	8,359
Base inventory stocks	16,181	15,335	– 0 –	– 0 –
Investments	15,394	13,391	11,673	7,757
Fixed assets[a]	117,511	105,656	96,807	107,586
Total assets	398,452	340,635	239,642	224,513
Bank overdrafts	33,818	27,492	23,323	17,869
Accounts payable	115,425	127,558	52,741	36,660
Other current liabilities	19,276	21,852	19,446	14,667
Total current liabilities	168,519	176,902	95,510	69,196
Deferred taxation	36,922	20,056	8,734	11,961
Long-term debt	45,639	37,941	37,678	47,146
Minority interest	14,532	12,658	11,219	13,379
Share capital	56,942	45,692	45,692	45,692
Retained earnings	75,898	47,386	40,809	37,139
Total liabilities and equity	398,452	340,635	239,642	224,513

[a]Net of depreciation and capital grants equalization.

Source: Tate & Lyle's *Annual Reports*.

and profitable involvement in the developing world. To develop a background for formulating these new perspectives, Mr. Tate wanted to review the following areas:

1. Tate & Lyle's overall operations
2. the evolution of the group's strategy in the developing world
3. the group's activities in Belize (Mr. Tate felt that the Belizean operations might serve as a prototype for involvement in a developing country. Not only had Tate & Lyle established favorable relationships with the government and local sugar producers, but its activities had also been profitable to both the company and industry participants.)
4. Tate & Lyle's present involvement in several developing countries and how the group plans to coordinate this involvement with Tate & Lyle's overall strategy.

Background on Tate & Lyle, Ltd.

Tate & Lyle was formed in 1921 by the merging of two family-owned sugar refining companies. This new company served as a foundation for the establish

ment of Tate & Lyle as the major U.K. port refiner. About the same time, the company balanced its U.K. sugar activities by acquiring a number of English sugarbeet refining plants. This avenue of growth was blocked in 1936 when the British government nationalized the U.K. sugarbeet processing industry. Tate & Lyle then turned its expansion activities into raw sugar cane production in the Commonwealth countries, which not only secured a supply of raw materials for Tate & Lyle's U.K. refineries, but also provided the impetus for further integration in sugar operations. Shipping, storage, road transport, trading, and consulting were gradually added to Tate & Lyle's activities until the company had developed a completely integrated network of activities within the sugar system. Recently, the group has expanded its expertise in each functional area into other closely related commodity systems. Following is a description of Tate & Lyle's present activities. Tables 6D-1 and 6D-2 show the financial performance of each activity.

U.K. Sugar Refining. Tate & Lyle Refineries[1] (TLR) is the group's U.K. sugar refining and marketing subsidiary. TLR has three refineries located in London, Liverpool, and Greenock, which refine around 50 percent of the sugar consumed in Britain. Since the U.K. sugar industry is not expanding, TLR has broadened its activities into other sweeteners, such as glucose syrups, and is seeking to expand its base into other areas.

Molasses Production and Trade. United Mollasses (UM) trades, stores, and distributes a substantial and increasing proportion of the world's essential foods, fuels, feedstuffs, and chemicals, including about three million tons of molasses. Together with its U.S. subsidiary, Pacific Molasses, United Molasses is the largest molasses trader, with over 40 percent of the world market. But UM's companies are not merely traders. They offer a complete service from producer to consumer—buying, transporting, storing, processing, and distributing essential commodities. From its base in the trading and handling of molasses, UM has expanded to provide a complete service in the markets for oils, feedstuffs, seeds and other essential commodities.

Sugar Trading. Tate & Lyle International (TLI) participates in the trading of sugar in the world markets, providing a complete service to producers and consumers including handling, refining, transportation, packaging, and financing, depending upon the requirements of the customer. Close, overall control is maintained in its trading position. The company's activities are complementary to the group's overall trading, freighting, and coordinating operations. This subsidiary benefits greatly from the information generated by the group's worldwide activities. Sugar trading accounts for a significant portion of Tate & Lyle's expanding commodity trading profits.

Bulk Liquid Storage. As well as storing its own cargoes, Tate & Lyle serves the needs of third-party customers with a worldwide network of bulk liquid storage terminals, having a capacity of over two million cubic meters. These facilities are located in the United Kingdom, the United States of America, Canada, and Europe, and handle most liquid products—particularly petroleum and chemicals, but also molasses, fats, vegetable, and animal oils.

Road Transport Services. The group offers a variety of transport services. Tate & Lyle Transport operates a fleet of nearly eight hundred vehicles ranging from small vans to road tankers. TLT Distribution provides a multiple distribution service accepting large consignments at its large modern warehouses strategically placed throughout the United Kingdom, storing and breaking bulk for delivery to major retailers. Silver Roadways arranges transport for over two thousand customers using its own vehicles and calling on the vehicles of over four thousand contractors. TLT Truck Services has been developed to provide commercial maintenance and sales service for third-party customers.

Shipping. Developed from the need to transport its own cargoes, Tate & Lyle Shipping, Ltd., owns twenty-two ships, totaling over 500,000 tons deadweight. These ships are supplemented by chartering, giving flexibility and balance in a market that traditionally reacts sharply to world trading cycles. Tate & Lyle Shipping operates Athel Line, with three ocean tankers and three coastal tankers and Sugar Line with eight bulk carriers, for which sugar is a very important base cargo. Furthermore, the group joined early in 1976 with Ocean Transport & Trading to form Panocean-Anco. This new company operates a fleet of twenty-two deep sea parcel tankers. These vessels can carry over thirty different types of liquid cargo ranging from vegetable oil to chemicals and petroleum products. The Panocean-Anco fleet is the most modern and largest of its kind in the world.

Engineering and Consulting. Tate & Lyle has developed skills that enable it to advise others; Tate & Lyle Engineering (TLE) is the company responsible for marketing these skills throughout the world. It covers every aspect of agriculturally based industries, from the improvement of a manufacturing plant to the setting up of a new industry. TLE has already established complete sugar industries in such countries as Zambia and built and improved sugar factories in South Africa, Nigeria, Belize, Mexico, Pakistan, and many other countries. It is at present working on projects in over fifty different countries including Brazil, Bolivia, Indonesia, and Afghanistan. TLE plans and designs complete factories, undertaking turnkey operations from concept to commissioning, and its subsidiaries specialize in the manufacture and supply of machinery and equipment for many of the projects.

Canadian Refining Operations. Tate & Lyle's Canadian subsidiary is that country's leading supplier of sugar, with refineries in Montreal and Toronto. From this base have grown many pioneering developments in the engineering field. Subsidiaries specialize in the design and manufacture of plastic pipes and fittings for the liquid transmission and sewerage industries and have expanded into the United States with the establishment of four factories.

History of Tate & Lyle's Involvement in the Developing World

Tate & Lyle has been working in developing countries for forty years. During this period, the company has been constantly adapting its strategy to meet both the needs of the company and the changing social, political, and economic conditions within the developing world. The group's first efforts were aimed at securing a source of raw materials for its U.K. sugar refineries and resulted in large, expatriate investments. As the developing countries gained their political and economic independence, the emphasis was shifted from outside ownership and management to local ownership and management with strong relationships with the Tate & Lyle group.

The 1936 nationalization of the U.K.'s sugar beet industry provided the impetus for Tate & Lyle's early investment in the developing world. Since much of U.K.'s cane raws were imported from Jamaica and Trinidad, these countries were logical choices for Tate & Lyle's entry into raw sugar production. Sugar had been produced on these islands since the 1700s, when colonial settlers imported slaves from Africa and established large sugar plantations. Most estates also built small sugar factories to process the cane into raw sugar, which was then exported to large port refineries located near the consuming areas. The sugar industries of these islands reached their peak in the early 1800s. Production in 1805 totaled over 100,000 tons in Jamaica, and the island was the world's largest exporter of sugar. When the slave trade was abolished in 1807, and the slaves were freed in 1838, the economics of the industry changed, resulting in substantial declines in production volumes. Jamaica's production had declined to only 19,000 tons by 1854. The sugar industries of both islands remained depressed until the 1900s.

When Tate & Lyle acquired sugar estates on both islands in 1937, two important trends were taking place. First, a consolidation process was reducing the number of factories and increasing the acreage of each estate. The 300 sugar factories that were in operation in Trinidad in 1807 had been reduced to 11 by 1937. As this rationalization process was taking place, production volume also began to expand rapidly. Sugar became extremely important to the economies of the islands. Although both Trinidad and Jamaica were developing other industries—oil in Trinidad and bauxite in Jamaica—sugar production, due to its labor intensive nature, employed a large portion of the country's labor force.

Throughout the 1940s, Tate & Lyle concentrated its expansion of raw sugar

production solely within Jamaica and Trinidad. This expansion, however, took two separate forms. In Jamaica, Tate & Lyle established two estates, Frome and Monymusk. Sugar mills were built at both estates, the Frome mill was completed just before World War II and the Monymusk mill just after. Production in 1940 was about 32,000 tons. As Tate & Lyle gradually expanded the cane acreage of each estate, additional milling capacity was added. By 1963, production had increased to 180,000 tons, and Tate & Lyle's two estates accounted for 40 percent of Jamaica's milling capacity and 60 percent of its cane requirements. Tate & Lyle's expansion in Trinidad took a different form. The consolidation of the number of mills created several sizable sugar estates. Through a series of mergers, Tate & Lyle acquired these other estates. The last major acquisition took place in 1962, giving Tate & Lyle over 90 percent of the raw sugar processing capacity in Trinidad.

In the early 1950s, Tate & Lyle diversified its raw sugar production when it become involved in the sugar industry of Rhodesia.[2] The company purchased two refineries that supplied all of the country's sugar consumption. At that time, raw cane sugar was not produced in the area and had to be imported substantial distances from cane producing areas. This inefficient logistical configuration created a high cost structure for refined sugar and encouraged the development of sugar cane production within Rhodesia. Although Tate & Lyle made only small investments in the sugar estates, the company provided large amounts of management and technical services in their development. These estates, combined with Tate & Lyle's refineries, gave Rhodesia a completely self-sufficient sugar system.

Another African involvement for Tate & Lyle has been in Zambia where it built a refinery in the mid-1950s. Since logistical problems made the procurement of imported raws economically unfeasible, Tate & Lyle established a large sugar estate at Chirundu—a location on the Rhodesian side of the Zambezi River, which separates Zambia and Rhodesia. Just after this new estate began feeding raws to the Zambia refinery, the federation of Rhodesia and Nyasaland fell apart and the border between Zambia (Northern Rhodesia) and Rhodesia (Southern Rhodesia) was closed.[3] This action created two problems for Tate & Lyle. First, the Chirundu estate became uneconomic. The only rail connection between the estate and Tate & Lyle's two Rhodesian refineries was a roundabout route which ran through Zambia. Since there were no other viable methods of transporting the raws to the refineries, the new sugar plantation was eventually abandoned, resulting in a substantial loss for Tate & Lyle. The company's second problem was finding a source of raws for its new Zambian refinery. The company, in cooperation with the Zambian government, built another new estate on a 17,000-acre site at Nakambala, Zambia, which is located across the Zambezi River from the original Chirundu estate. The new Nakambala estate, combined with the refinery, gave Tate & Lyle control of Zambia's entire sugar industry.

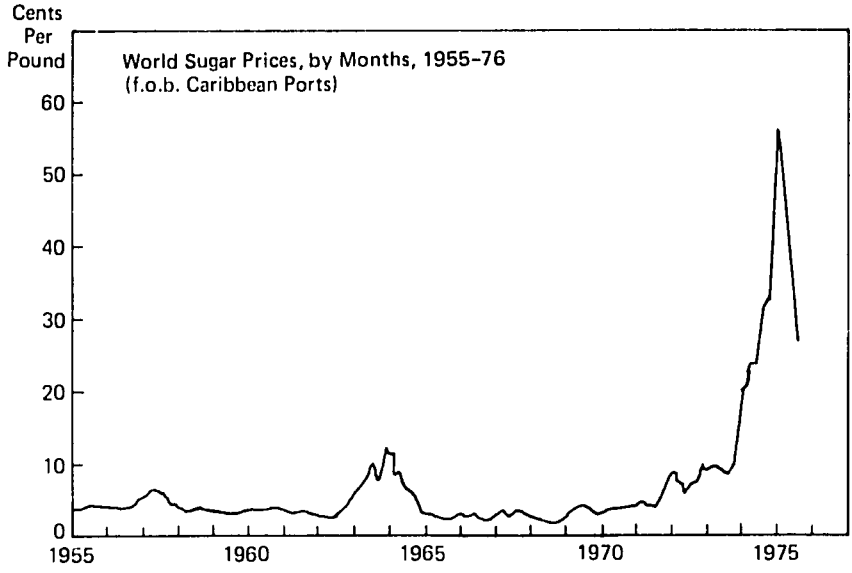
Tate & Lyle's remaining involvement in raw sugar production was in Belize. In 1963, the company purchased 100 percent of what was to become Belize Sugar Industries Limited (BSI), which was producing 28,000 tons of raw sugar. About two-thirds of the cane was grown by local farmers with the remaining one-third being supplied from BSI's own estates. Tate & Lyle increased the capacity of the mill to 40,000 tons and began construction of a second sugar factory with a capacity of 30,000 tons. BSI also expanded its cane acreage so that it produced about 40 percent of the required cane.

By the middle of the 1960s, it appeared that Tate & Lyle's investment in the developing world had been successfully implemented. The group had established operations in several developing areas. More importantly, the company's involvement in raw sugar production had become quite profitable. For example, the group's 1963 pretax profit was £9.5 million, of which £3.3 million came from Trinidad and Jamaica and £.2 million from Rhodesia and Zambia.

In spite of the apparent success of Tate & Lyle's involvement in developing countries, the group's management began to reevaluate the company's strategy. As early as 1966, specific proposals began to circulate within Tate & Lyle calling for the group's disinvestment of its assets in the developing world. The reasons for this uneasy feeling were both political and economic. The wave of nationalism that was sweeping through the developing world in the 1960s was creating a feeling of mistrust towards the companies that had traditionally operated within its borders.[4] Many nationals felt that they and their countries had been exploited by these foreign companies. This feeling of exploitation was especially true in the West Indies, possibly because of their history of slavery. Tate & Lyle was more exposed to these feelings than most companies due to the large size of its expatriate land holdings and the dependence of the economies of these countries on Tate & Lyle's operations. Thus, the fear of expropriation posed a real threat to the company.

The profitability of raw sugar production had also begun to decline. Figure 6D-1 shows the history of world sugar prices. Although prices, and hence profits, were high in 1963 and 1964, by 1965 the world price had declined to only a couple of cents per pound. Rising production costs made this price below the cost of production.[5] Only the higher prices of the Commonwealth Sugar Agreement and the U.S. Sugar Act protected many Caribbean producers. It appeared that the problem of rising cost would not only continue, but even escalate. In order to raise their standards of living, many governments were imposing higher minimum wages. This higher labor input strongly influenced sugar production cost. It was also not possible to avoid the high labor cost by adopting labor-saving mechanization techniques, due to the already high unemployment levels.

Despite the reevaluation process, Tate & Lyle did not make any immediate adjustments in its activities in the developing countries. This reactive strategy was unfortunate because many of the company's misgivings were becoming



Source: Foreign Agricultural Service, USDA.

Figure 6D-1.

realities. This point was made clear in 1970 when the government of Trinidad strongly suggested that Tate & Lyle sell majority ownership of its Trinidadian subsidiary to the government. At that time, the group owned about 75 percent of the stock of Caroni Limited, which possessed a virtual monopoly on Trinidad's sugar industry. A settlement was eventually negotiated that resulted in the government of Trinidad owning 51 percent of Caroni with Tate & Lyle's ownership share declining to 32 percent. The government made an initial cash down-payment to Tate & Lyle with the remainder to be paid in 10 equal annual installments. Although Tate & Lyle's management was pleased with the settlement and felt that under the circumstances the company received adequate compensation for its stock, it was evident that this was the first of what would probably be many take-overs of the group's assets by developing countries. Tate & Lyle would have to develop a strategy for its involvement in the developing world that would be acceptable to local governments and still be consistent with the group's overall activities.

The Trinidad incident served not only as the impetus for change in the group's raw sugar production activities, but also for a general review of the changing nature of Tate & Lyle's overall strategy. In the past, the company had viewed itself as a producer and refiner of sugar. Although it had integrated in a variety of complementary services, such as shipping, trading, distribution, and engineering, these activities were efforts to support the basic business of producing and refining sugar. By 1970, it was evident that this strategy would no longer provide

the group with adequate growth and profit opportunities. Not only was it doubtful whether Tate & Lyle would be allowed to continue to own and operate its large sugar estates, but the profitability of these operations had disappeared. Table 6D-1 shows that the group actually lost money in its sugar producing activities during 1969 and 1970. More important, only small prospects for growth existed in the refining end of its business. The size of the U.K. sugar industry had stagnated, and Tate & Lyle already controlled over 50 percent of the market. In fact, Tate & Lyle's market share would probably decline as the United Kingdom entered the EEC, because of increased competition from the EEC beet industry and the limiting of the amount of raws which can be imported into the EEC.[6]

The strategy that had gradually been emerging emphasized the coordination aspects of commodity systems. Activities such as shipping, trading, distribution, and engineering were expanded until Tate & Lyle became a dominant competitor in each one. It was no longer considered necessary to own physical assets in the developing countries. Instead, the group wanted to provide services to the local sugar industries that were necessary for their profitable operation, but local industries could not provide. The company would control the key links in the system between producer and consumer. If Tate & Lyle could provide these services in an efficient and timely manner such that both producer and consumer were served, the company would not only be allowed to operate in the developing world but, in fact, would be welcomed by the host governments. Once the company became established as a key coordinator of the world's sugar system, this expertise could be expanded into other commodity systems. Tables 6D-1 and 6D-2 show the expansion of Tate & Lyle's shipping, trading, distribution, engineering, and consulting activities.

A new philosophy concerning Tate & Lyle's investments in the developing world evolved from the Trinidad incident. The group felt that to be successful in a developing country, the company has to be wanted, and it is doubtful that they will be wanted if they try to create a business presence in Tate & Lyle's own image. The goal became to create national companies run by local managers but with strong bonds to the Tate & Lyle Group. It was hoped that its subsidiaries' employees would say, "I work for ABC Company, which is associated with the Tate & Lyle Group." Tate & Lyle analyzed each of its subsidiaries and came to the conclusion that each situation had to be treated according to the aspirations of the locals. As a result, the group actively initiated negotiations with key government officials resulting in the following action:

1. In 1971, the government of Jamaica purchased the whole of West Industries Sugar Company's (WISCO) estates of Frome and Monymusk—approximately 60,000 acres—of which 37,000 acres were cane lands. The purchase price was $8,425,000 and payment was in three forms. WISCO received $3 million in cash. A $2.5 million loan of WISCO to Barclays Bank was taken over by the

government. Finally, ten-year debentures were issued by the government for the remaining $2.5 million. At the same time WISCO leased back the cane lands on a temporary basis to ensure the cane supply for its factories until such time as the government had made satisfactory arrangements for the transfer of the lands to Jamaican farmers. In 1974 the lease was terminated and the lands were taken over by a government-owned land company that continued to grow cane itself for sale to the factories and also transferred substantial areas to the newly formed National Sugar Company that would eventually control the remainder of the sugar processing capacity in the country. The consideration for the sale of WISCO shares was partly in cash and partly in shares in the National Sugar Company.

2. In 1971, Tate & Lyle sold controlling interest in Zambia Sugar Company to Indeco, a state-owned corporation. Before the sale, the group owned 77 percent of Zambia Sugar Company's stock; after the sale, its ownership was reduced to 22 percent. Tate & Lyle received £1.1 million for its shares, payable in ten equal annual installments. At the time of the sale, Indeco and Tate & Lyle agreed to a ten-year technical consulting contract.
3. In 1973, Tate & Lyle sold its 9,000 acres of sugar cane land to Belizean farmers, who are paying now for the land over an eight-year period out of future cane revenues. The company maintained all of Belize Sugar Industries (BSI), which processes the entire sugar production of Belize. However, in April 1976, Tate & Lyle agreed to offer a small part of the equity of BSI to a government-owned investment company, which would in turn offer its shares to the Belizean public. In fact, Tate & Lyle was planning to lend this corporation the money to buy BSI's stock.
4. No action has been taken in Rhodesia. Since the Unilateral Declaration of Independence by the Rhodesian government in 1964 and the resulting breakdown in diplomatic relations between the United Kingdom and Rhodesia, Tate & Lyle has found it impossible to come to realistic negotiations in the disposition of its operations.

The above actions were quickly and successfully implemented by the group. The fact that these decisions had been actively considered for three or four years, and contingency plans had actually been developed, aided the company in the rapid implementation of its policies. Also, higher sugar prices created economic conditions that allowed the developing countries to pay for their new assets.

Belize. Belize (formerly British Honduras) is a small country on the east coast of the Central American mainland. It is bounded on the east by the Caribbean Sea, on the north by Mexico, and on the west and south by Guatemala. The total land area is approximately 8,866 square miles, or about the size of New Hampshire, and at its greatest length extends 175 miles north and south and 68 miles east and west (see Figure 6D-2 for a map of Belize). The country's

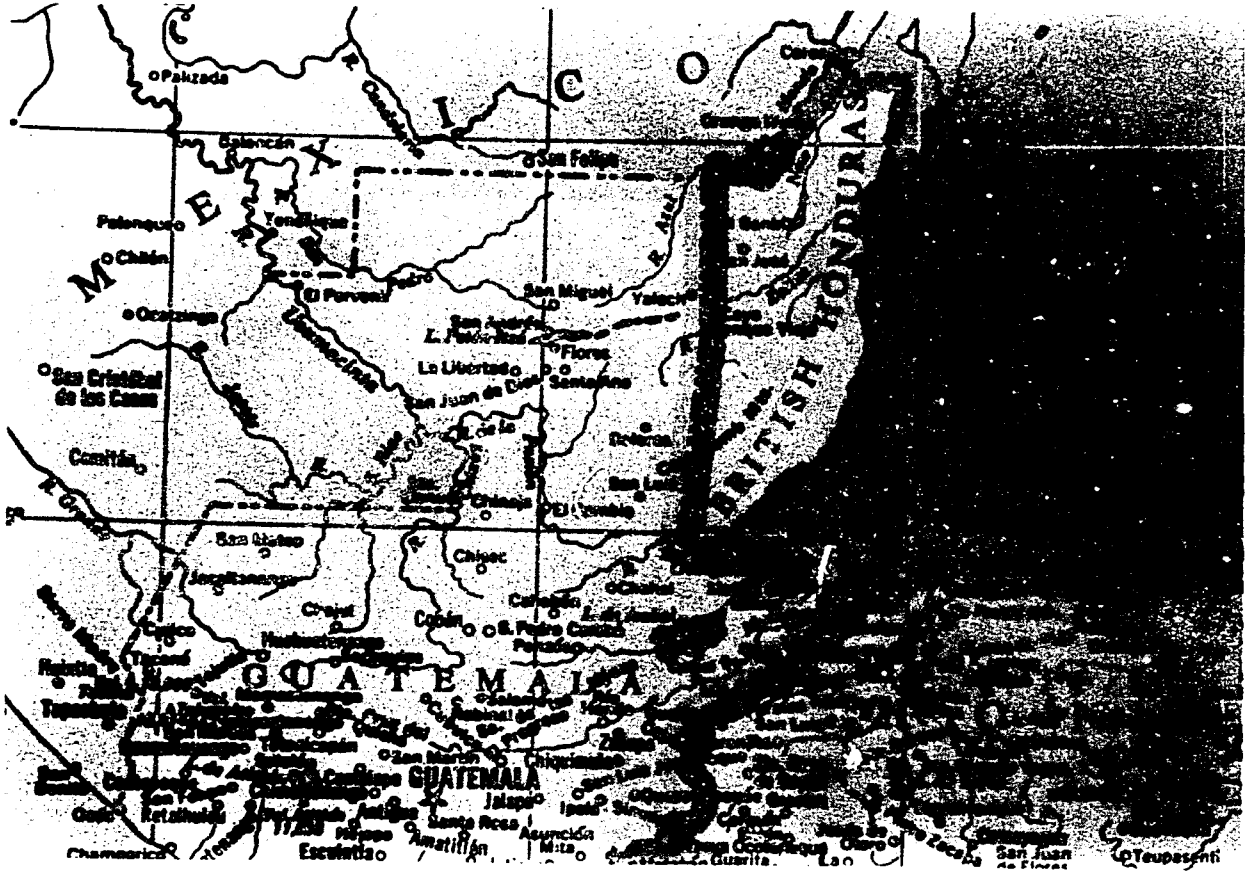


Figure 6D-2. Map of Belize—Formerly, British Honduras

climate is subtropical with temperatures ranging from 50 to 90 degrees Fahrenheit, with a mean temperature of 79 degrees, a mean humidity of 83 percent, and an annual average rainfall of 70 inches.

The population of the country is about 120,000 people. Some 40,000 people live in Belize City, with another 20,000 residing in the country's five towns. The population is composed of several Maya-speaking peoples (Indian), Black Caribs, Spanish-speaking Mestizos, Creoles, and a variety of other ethnic groups. Creoles, who account for over 50 percent of the population, are an ethnic mixture descended from the early settlers—slaves and baymen or British forestry contractors. Indians (20 percent) and people of Spanish descent (20 percent) are the other two major groupings. A more meaningful distinction among the people of Belize is their rural/urban characteristics. The Creoles and Caribs live predominantly in the cities and most have little desire to work the land. A substantial number of these people (some estimates are as high as 10,000 to 15,000) have migrated—legally and illegally—to large U.S. cities and repatriate approximately one million dollars annually to support their families in Belize. The Indians and Spanish people, on the other hand, live primarily on the farm and make their living from agriculture. As a whole, however, the people of Belize get along well with each other and there is almost no racial animosity.

Belize imports over 80 percent of its needs. Table 6D-4 lists the major im-

Table 6D-4. Major Imports and Exports of Belize by Product Group: 1973-75 (millions of U.S. dollars)[a]

Major Imports			
Commodity	*1973*	*1974*	*1975*
Consumer, manufacturers, and building materials	16.7	19.8	24.0
Food	13.1	17.8	24.6
Vehicles and machinery	9.8	12.0	20.7
Minerals, fuels, and lubricants	3.0	9.0	18.7
Chemicals and pharmaceuticals	4.9	7.0	10.6
Major Exports			
Commodity	*1973*	*1974*	*1975*
Sugar and molasses	13.4	35.4	41.4
Clothing	2.0	4.6	4.0
Wood and wood products	1.8	2.4	2.9
Citrus	2.7	3.0	2.2
Fish (including lobster)	1.6	2.2	2.2

[a]The background data for this table was originally expressed in a variety of foreign currencies including U.S. dollars, British pounds, and Belizean dollars. For comparison purposes, all figures have been converted to U.S. dollars at the rate of two U.S. dollars per pound. Since the value of the Belizean dollar is pegged at four per pound, Belize dollars have been converted to U.S. dollars at the rate of two to one.

Source: Company files.

ports by product group in the last few years. Fortunately, the recent increase in the world price of sugar has helped finance these tremendous increases in imports. (Table 6D–4 lists the major exports by product group.)

Belize traditionally runs a negative balance of trade.[8] This deficit for the years 1972–1975 was: 1972: -$14.7 million; 1973: -$18.2 million; 1974: -$6.3 million; and 1975: -$30.7 million. Foreign investment, aid flows, and remittances from Belizeans living abroad usually balanced the trade deficit so that the country does not show a negative balance of payments. The per-capita GDP[9] for the last three years has been $572, $583, and $678. Table 6D-5 shows the major agricultural production for the last four years.

The sugar industry dominates the economy of Belize. In 1975, raw sugar production was 82,875[10] tons and the value of sugar exports totaled U.S. $41 million, representing over three-quarters of Belize's exports. The sugar industry also directly employs about 40 percent of the country's labor force. Belize has around 3,000 independent cane farmers, some of whom employ an estimated 3,000 to 4,000[11] workers during the eight-month harvest season.[12] BSI, the country's only processor of raw sugar, has another 1,000 Belizeans on its payroll. About 750 of these employees work at BSI's two factories, which are located in the northern section of the country on the New River (see map in Figure 6D-2). Once the cane has been converted into raw sugar, it is loaded onto barges and shipped to Belize City where the majority of the sugar is exported to the major world markets.

Sugar has not always played such a significant role in the economy of Belize. In 1960, 500 farmers produced only 13,000 tons of raw sugar, which accounted for 22 percent of the country's total exports. The rapid increase in production was a response to Belize's allocation of quotas, first under the Commonwealth Sugar Agreement and then under the U.S. Sugar Act.[13] Assured markets at a guaranteed price provided the stability necessary to attract farmers to plant cane which, in turn, encouraged BSI to expand processing capacity. The first two columns of Table 6D-6 show the industry's expansion and the proportion supplied by farmers.

The sugar industry is regulated by the Sugar Board, a statutory government agency established in 1960. The board's membership is composed of representatives from the government, the cane producers, and BSI. Its main function is to regulate production, which it does by issuing licenses to producers authorizing each to deliver a given amount of cane. Since BSI can accept cane only from licensed farmers and only at specified volumes, the production quota has become a valuable asset. Unfortunately, the rapid increase in cane production, combined with the scattered and inaccessible location of the cane producing lands has caused uncontrolled growth resulting in many licenses being held by farmers who do not produce cane and, sometimes, by people who do not even own land. An informal market has developed that matches farmers who have cane and no licenses and the people who have quotas but no cane.

Table 6D-5. Major Agricultural Production in Belize: 1972-75 (millions of pounds)

Commodity	*1972*	*1973*	*1974*	*1975*
Sugar	156.3	157.2	199.1	185.6
Citrus	114.2	118.6	132.5	124.3
Corn	32.2	35.5	28.2	28.0
Rice	12.8	18.0	16.0	10.7
Beans	2.5	2.5	2.8	2.5
Fish (export)	1.9	1.6	1.6	1.7
Cattle (dress weight)	1.7	2.3	n.a.	n.a.
Poultry	2.5	2.3	2.4	2.4
Timber	7.7	10.6	11.8	12.0

Source: Company files.

Table 6D-6. Production and Revenue of Belize's Cane Farmers

Year	*Total Cane Delivered in Tons*	*Cane Delivery by Farmers in Tons*	*Approximate Price Per Ton of Cane*	*Gross Revenue to Farmers*
			(British pounds)	
1960	124,129	92,560	2.25	208,260
1961	243,460	170,095	2.45	417,000
1962	213,490	131,681	2.78	366,000
1963	210,362	150,443	3.39	510,000
1964	272,318	189,931	2.89	549,000
1965	325,786	220,831	2.48	547,000
1966	411,353	282,641	2.61	738,000
1967	560,954	313,720	2.36	740,000
1968	642,516	343,162	2.64	906,000
1969	582,720	290,728	3.07	892,000
1970	676,176	394,898	2.90	1,143,000
1971	632,629	364,551	3.33	1,214,000
1972	667,654	409,308	4.40	1,801,000
1973	718,230	695,764	4.52	3,145,000
1974	824,074	800,554	11.51	9,214,000
1975	783,118	761,844	15.51	11,816,000
1976	548,180	533,289	10.00	5,333,000

Source: Belize Sugar Industry's records.

The size of the cane farmers' production units varies substantially. The distribution of quotas shown in Table 6D-7 is probably a good estimate of the relative size of the industry participants. It is difficult to convert these quotas into acres for two reasons. First, some farmers produce more cane than their quotas in hopes of selling this extra cane to other quota holders. Yields also vary between 10 and 25 tons of raw cane per acre, depending upon cultivation practices. The average yield, however, is approximately 18 tons an acre. As production has expanded, the size of the average producer has increased. This increase can be seen by comparing the sizes of quotas in Table 6D-7 for 1969 and 1975.

Table 6D-7. Size Distribution of Quotas in Belize Sugar Industry

Metric Tons	Number of Farmers 1969	Number of Farmers 1975
Under 100	989	693
101-200	848	602
201-300	132	1,082
301-400	76	240
401-500	45	77
501-1,000	38	154
Over 1,000	25	84[a]
Total	2,153	2,932

[a]The 1975 distribution of over 1,000 tons was as follows:

Size	Number
1,001-1,500	28
1,501-2,000	15
2,001-3,000	33
3,001-4,000	3
4,001-5,000	1
5,001-6,000	2
Over 6,000	2
Total	84

Source: Belize Cane Farmers Association.

A substantial number of new farmers, however, replaced some small producers, thus keeping the majority of the producers in the under 400-ton quota category. The Sugar Board estimates that an additional 1,000 new farmers will be issued quotas before the 1977 crop year, in response to BSI's planned expansion of one of its factories. The industry structure, which will evolve from this expansion, wil probably not differ substantially from that of Table 6D-7 with about the same percentage of small, medium, and large farmers.

In 1961, the Cane Farmers Association was formed by the sugar producers. The officials of the association represent the producers on the Sugar Board. The association also helps BSI in coordinating the flow of cane into the sugar factories. Two factors make this coordination process extremely difficult. Given the number of farmers who can deliver cane to the factories on any given day, a detailed delivery schedule has to be established. Farmers can then harvest their cane according to their delivery times. Processing problems, however, can cause changes in this schedule, which have to be communicated quickly to the producers. Since cane has to be processed within seventy-two hours of the time it is burned, any breakdowns in communication can result in substantial losses for the farmer.[14] Timely and accurate communication, therefore, is critical to the producer.

The farmers sell their cane to BSI on a participation basis. Producers receive 65 percent of the net stripped value of sugar and molasses, with BSI retaining the remainder. Net stripped value is equal to the gross proceeds from sugar sales minus all distribution and marketing expenses after the sugar leaves BSI's factories. These costs include ocean freight, local freight and handlings, brokerages, commissions, insurance, government levies, and other miscellaneous expenses. Net stripped value is allocated to the individual producer on the basis of his volume as a percentage of total volume processed. The farmer receives 85 percent of his estimated total payment at the time of delivery, another 10 percent about a month after the processing season ends, and the remainder by the end of the crop year. Table 6D-6 shows the approximate price received by the farmers for the last few years.

BSI is responsible for the marketing of the country's raw sugar but works in close coordination with the Sugar Board. Belize sells 40,000 tons of raw sugar to the United Kingdom under its Lome Agreement quota. These sales are at a fixed price tied to the internal EEC beet price. The formula currently establishes a value of $310 per ton for Belize's raw sugar or about $5 per ton above the formula price. This premium could increase significantly if EEC prices for refined sugar rise substantially. Most of the remainder of the country's sugar is sold into the world market. Finally, a small amount of sugar is consumed domestically. In 1975, 4,500 tons were used by local consumers and 1,500 tons were consumed for industrial purposes. The government regulates the sale price of this sugar at $104 per ton for consumer uses, and $232 per ton for industrial purposes. When bagging and distribution costs are added to this amount, the price to the consumer is less than six cents per pound.

Belize is a low total cost cane producer in spite of the country's low yields per acre. One reason for this is the low cost of land. Only a small portion of the country's land is under cultivation, with vast tracts of unused savannah available for cane production. As a result, land costs are as low as $15 to $20 per acre. Another factor that reduces cost per ton is the adequate level of rainfall in the producing areas. Irrigation expenses are, therefore, unnecessary. Cultivation practices vary with the size of the producers. Some small farmers do all of their plowing and weed control themselves and apply little, if any, fertilizers. Thus, their only cash outlays are for harvesting cost, which are about $5 to $6 per ton. Larger farmers, on the other hand, often use modern mechanization techniques and apply fertilizers intensively, creating substantial cash commitments during each crop year.

The increase in sugar prices has drastically altered the standard of living of most of the cane farmers. The last column of Table 6D-6 shows the flows of revenue to cane farmers for the last few years. Given the large number of farmers and the great variations in size, yields, and cultivation practices, it is difficult to establish farmer profits from this revenue figure. By making some "educated" assumptions, however, a simple calculation will illustrate the effects of increased

sugar prices. A small farmer, who had a 150-ton quota, would have received $4,950 in 1975 for his cane (see Table 6D-6 for cane prices). If harvesting costs were $5 per ton and other costs $2 per ton, his total cash expenses would have been $1,050, giving the farmer a profit of $3,900. This compares to Belize's 1974 per capita GDP of only $678.

The increased standard of living of the cane farmers has not, however, benefited the majority of the population. Most of the increased revenues from sugar production have been drained from the country by the purchase of foreign produced goods. Table 6D-4 shows the tremendous increase in imports of vehicles and the resulting need for imported fuel.[15] Large amounts of food and consumer goods have also been imported. Thus, the cane farmers have chosen to spend their increased incomes on consumer goods instead of retaining their capital and reinvesting it in the Belizean economy. Government officials are afraid that the rapid expansion of the sugar producers's wealth will create animosity among certain segments of the population and upset the current stable relations of the country's various ethnic groups.

Belize Sugar Industries. BSI has been the only processor of sugar cane since Tate & Lyle purchased the Corozal factory in 1963. Corozal's capacity was expanded from 30,000 tons to 45,000 tons during BSI's first year of operation. A new mill was constructed at Tower Hill in 1967 with 30,000 tons of capacity.[16] Small capacity expansions were made in 1973 and 1974, raising Tower Hill's capacity to 45,000 tons. Table 6D-8 shows the volume expansion of BSI's factories since 1963. The company was also involved in the production of raw sugar from 1963 to 1971. As part of the original purchase, BSI acquired 3,000 acres of

Table 6D-8. Expansion of Belize Sugar Industry's Sugar Production in Metric Tons of Raw Sugar

Year	*Corozal Factory*	*Tower Hill Factory*	*Total*
1963	27,840	–	27,840
1964	33,591	–	33,591
1965	35,288	–	35,288
1966	43,454	–	43,454
1967	37,744	20,576	58,320
1968	39,883	23,705	63,588
1969	30,419	21,719	52,138
1970	38,905	27,888	66,793
1971	35,923	28,928	64,851
1972	39,503	30,464	69,967
1973	38,779	31,391	70,170
1974	44,956	43,941	88,897
1975	40,474	42,401	82,875
1976			58,000

Source: Belize Sugar Industry's records.

cane land. Cane production was gradually expanded to 10,000 acres, 3,000 of which required substantial clearing from jungle. This land provided about 40 percent of BSI's cane requirements. The division of cane production between large, company-owned estates and local farmers was a standard policy with most raw sugar processors in the developing world. The processors felt that they had to lock in a substantial portion of their cane supply in order to guarantee an adequate level of throughput. Many industry experts felt that BSI would have procurement problems when it sold its cane producing land to local farmers in 1971, but such has not been the case.

The years 1974 and 1975 were outstanding ones for BSI. The company's after-tax profit was $6.2 million in 1974 and $8.2 million in 1975. Profits, however, have not always been so high. Table 6D-9 shows that BSI lost money in six straight years between 1966 and 1971 and made only small profits in 1972 and 1973. Table 6D-9 also shows balance sheets for the last four years. Due to a

Table 6D-9. Belize Sugar Industry Financial Data (British pounds)

	Balance Sheets			
	30 September 1972	*30 September 1973*	*30 September 1974*	*30 September 1975*
Net current assets	1,119,670	1,263,884	2,321,949	3,878,187
Long-term accounts receivable	490,991	411,745	354,560	292,198
Fixed assets	6,174,954	6,209,925	6,188,307	7,428,877
Total	7,785,615	7,885,554	8,864,816	11,599,262
Long-term debt—Barclays	2,000,000	1,800,000	1,600,000	1,400,000
Long-term debt—Tate & Lyle, Ltd.	3,236,000	3,304,000	1,376,000	–
Share stock	4,000,000	4,000,000	4,000,000	4,000,000
Retained earnings	(1,450,385)	(1,218,446)	1,888,816	6,199,260
Total	7,785,615	7,885,554	8,864,816	11,599,260

Year	*Profit After Tax*
1966	(45,267)
1967	(528,919)
1968	(452,046)
1969	(572,297)
1970	(304,620)
1971	(162,303)
1972	198,454
1973	231,939
1974	3,107,262
1975	4,124,775
1976 (estimated)	675,000

Source: Belize Sugar Industry's records.

drought, which will cut production to about 58,000 tons and lower sugar prices, profits are forecasted to be about $1.2 million in 1976. The high profits of recent years have been used by BSI to strengthen its balance sheet by repaying a large portion of its long-term debt. Substantial funds are also being used in the company's 25,000-ton expansion of its Tower Hill facility. BSI expects to spend over $8 million to have this capacity on-line by the 1977 crop year. BSI has not paid a dividend to its parent company during its fourteen-year history[17] and pays corporate income taxes to the government of Belize at a 48 percent rate.

BSI's 1971 sale of its cane land was consistent with the decision of the parent company to end its ownership of large land holdings in developing countries; 8,800 acres and the accompanying 185,884-ton quota were sold to 216 farmers. The minimum acreage was 20 acres and the maximum was 400. The company gave priority of sale to registered cane farmers with less than 20 acres or a cane delivery license under 400 tons in order to create economically sized production units. Table 6D-10 shows the distribution of BSI's sales by farm size. The price per acre varied between $90 and $125 depending upon the quality and location of the land. The farmers agreed to pay for the land over an eight-year period, with BSI receiving a fixed annual payment from the cane harvested and sold to the factory by each farmer each year. The average annual amortized payment, including interest, is 66¢ to 85¢ per ton of cane or $13.21 to $18.35 per acre. There has not been a single default by farmers since the plan was initiated in 1971.

BSI retained 1,000 acres of its cane land as a research farm. The company hopes its research will increase yields and improve cultivation techniques and that the adoption of these practices will increase returns to the participants in the country's sugar industry. BSI implements the findings of its research through a staff of farm extension agents. These agents not only work closely with the Cane Farmers Association in coordinating the harvesting and transporting of the crop, but also operate on an individual farmer basis providing both technical advice on cane production and farm management and planning services to help farmers diversify their operations and stabilize their incomes.

Table 6D-10. Distribution of Belize Sugar Industry's Sale of Cane Land by Size of Purchaser

Size	*Number of Farmers*	*Total Acreage*	*Average Size*
20–25 Acres	130	2,696	20.7
25–50 Acres	36	1,220	33.9
50–100 Acres	22	1,860	84.5
Over 100 Acres	28	3,024	108.0
	216	8,800	40.7

Source: Belize Sugar Industry's records.

A basic policy of BSI has been to train nationals to manage its operations. Since 1963, thirty-five people have been sent abroad on a short-term basis—one or two years—for technical training, and ten people, for longer periods, to earn undergraduate or graduate degrees. Although the education of these ten nationals was paid for by BSI, the individuals involved had no commitment to return and work for BSI. Nine out of the ten, however, are now employed by BSI. The limiting factor in BSI's overseas training program is finding students who are qualified to enter foreign academic institutions. BSI's management would double or even triple the number of students if qualified applicants existed. This training program has resulted in the gradual elimination of expatriates in BSI's management. In 1968, nineteen expatriates worked in BSI's operations. By 1975, only six foreigners remained, two from the United Kingdom and four from the West Indies.

One thousand Belizeans work in BSI's facilities; 750 of these are classified as mill workers and earn about seventy-five cents an hour. This wage rate is considerably above the going rate for labor. The mill workers average forty-eight hours a week and work about ten months of the year. Although the processing season lasts only about half of the year, BSI uses these workers during the off-season for clean-up and maintenance work. This stable employment, combined with the high hourly rate, has attracted skilled laborers to BSI's factories and has resulted in a productive work force.

Although the company is a subsidiary of Tate & Lyle, BSI maintains an independent stance with the parent company. Since the farmers receive 65 percent of the new stripped value, BSI must sell its raw sugar to the highest bidder. As a result, Tate & Lyle receives no preferential treatment and, in fact, probably has to provide BSI with superior service in order to maintain BSI's independence. However, it is important to point out that BSI has ongoing relationships with TLE, Tate & Lyle Research, and several other subsidiaries definitely perceived as beneficial by all parties concerned.

A variety of levies are made against exported sugar: $ .50 per ton or 2 percent of the f.o.b. price,[18] whichever is higher, is paid to the government as an export tax and $2.50 per ton is paid into a stabilization fund,[19] which will be used to support prices should prices decline substantially. Finally, another $2.50 is paid into the Sugar Welfare Labor Fund, which is used to increase the standard of living of sugar workers mainly by providing housing. Since these levies are deducted in determining net stripped value, farmers bear 65 percent of the cost of these programs and BSI is reponsible for 35 percent. These levies are substantially below those of other sugar producing countries.

BSI's goal is to continue to involve Belizeans in the operations of the company. As of April 1976, negotiations were being completed that would eventually transfer partial ownership of BSI to Belize nationals. The Development Finance Corporation (DFC), which is a statutory corporation established by the government of Belize to increase development within the country and encourage

the local ownership of the country's productive assets, established a subsidiary, DFC Investment Company, to purchase one million shares of newly issued BSI stock at a price of 50¢ per share. The $500,000 required for the purchase will be loaned to DFC Investment Company by BSI on an interest-free basis. DFC will eventually allow the general public to purchase equity in DFC. The proceeds of the sale will go to BSI as repayment of the loan. Although the transaction would transfer only about 3 percent of BSI's equity to the Belize public, BSI hopes to establish a precedent that will allow for future transfers.

BSI has diversified its activities by developing a small cattle herd. In 1967, when the Tower Hill factory was opened, BSI abandoned 2,500 acres of cane and replaced it with equivalent acreage of cane on lands adjacent to the new factory. Instead of allowing the abandoned land to revert to useless brush, BSI decided to find an alternate productive use. Since natural grasses and legumes grow well in the area, BSI decided to establish a pilot cattle scheme to assess the economics under local conditions. Eight imported Charbray[20] bulls were purchased from WISCO's Frome Estate in Jamaica and bred to 100 local cows.

Since 1968, new land has been cleared, fenced, and supplied with piped water, with over 1,000 acres planted to improve pasture grasses. The total herd size is now over 2,000 head and over the next five years BSI plans to double the herd size and bring up to 5,000 acres into improved pasture. Exclusive of land cost, over $500,000 has already been invested in the project, and another $130,000 is scheduled to be invested in the next five years. Although returns from the project have been modest, the asset value is well above BSI's original cost.

The biggest problem associated with the project has been marketing. BSI's expansion, combined with increased production from small farmers, has saturated the local market. Also, the government of Belize controls local prices at the low level of approximately 30 cents per pound liveweight. Export markets do, however, exist and BSI is trying to develop them. The largest potential market is the Caricom countries,[21] of which Belize is a member. A trial shipment of 150 head was recently made to the French West Indies, with BSI supplying a third of the cattle. Mexico, which borders Belize on the north and has one of the world's fastest growing populations, is another potential customer.

In addition to its original sale of 8,800 acres of cane land, BSI has disposed of the majority of its land holdings: 17,000 acres were sold to the government of Belize at $17.50 per acre with the payment to be made in ten equal annual installments. An additional 4,000 acres were sold to individuals. As of April 1976, BSI still owned about 15,000 acres. The company wanted to retain its 1,000-acre research farm, its 5,000-acre cattle ranch, and another 4,000 acres of miscellaneous property and, thus, was attempting to sell an additional 5,000 acres.

The sugar industry's success of the last few years has placed BSI in somewhat of a dilemma. If the company passes through its profits to the parent company, it will appear as if BSI is exploiting its opportunities in Belize at the expense of

the local economy. The country's negative balance of trade accentuates this problem. On the other hand, if BSI continues to plow back its profits into the sugar system of Belize, sugar's dominance of the economy will increase and thus increase BSI's political and social exposure. BSI feels that Belize's sugar industry could continue its rapid expansion. The extensive acreage of cheap land and the favorable climate make Belize's sugar cane competitive in world markets. Diversification, on the other hand, offers BSI other opportunities to invest its profits. The problems here are twofold. First, any agricultural system in which the company could invest would be highly underdeveloped—for example, the cattle project—and BSI does not possess the expertise in other commodity systems that it does in sugar. In spite of its expertise, it still took BSI six years to develop a profitable sugar operation. The second problem with diversification is that although it spreads BSI's activities, it does not decrease the company's role in the Belizean economy. BSI's future strategies will have to consider these factors.

BSI is only one of many examples of how Tate & Lyle is trying to adapt its overseas operations in a way that will benefit both the group and the host country. The following section will highlight several additional specific instances.

Tate & Lyle's Present Involvement in Developing Countries

Strategic planning is very much a part of the management philosophy in the Tate & Lyle Group. Consequently, much thought has been given over the years to the business the group wants to be in. The current understanding of the group's role is that Tate & Lyle will employ an adequate level of fixed assets to grow and prosper by supplying trading and handling commodities and by providing services for handling other people's goods.

The group's relationship with Zambia is a good example of how the company's patience and foresight can be profitable to both the country and Tate & Lyle. When it sold majority ownership of the Zambia Sugar Company to INDECO in 1971, the group negotiated a Technical Consultancy Agreement, which allowed the company to maintain an involvement in the Zambian sugar system. Although this consultancy contract was not significantly profitable, Tate & Lyle was able to keep in close touch with the industry. This awareness of the local conditions was very beneficial when the Zambia Sugar Company decided to expand its Nakambala Estate. Production capacity will be increased by 32,000 tons to a total of 120,000 tons. The factory expansion will cost $30 million and an additional $15 million will be required to expand the production area and accompanying infrastructure. Tate & Lyle will provide a complete turnkey project. Its engineering subsidiary will provide the technical skills and supervise the construction, while several of the group's subsidiaries will provide the necessary equipment. A new distillery is also being constructed by Tate & Lyle at Mazabuka. Also, the group and the Zambian government are studying the feasibility of a completely new estate, which they feel will be necessary to supply domestic consumption by 1980.

In early 1976, a new Technical Consultancy Agreement was negotiated between Tate & Lyle and INDECO. This type of relationship is beneficial to both parties. Zambia Sugar Company's employees have received a high level of training and education. In fact, Zambia Sugar has had problems keeping its personnel because they are so well trained they are needed in other sectors of Zambian industry. The Nakambala project has also provided very valuable training for Tate & Lyle technicians who have been able to get their experience in a well-managed agribusiness development.

Tate & Lyle is also using its engineering abilities as an aid to its sugar trading and marketing activities. A look at its relationship with Swaziland will illustrate this point. Swaziland currently exports about 160,000 tons of raw sugar per year but has contracted with Tate & Lyle to help expand its sugar industry. A unique feature of this expansion is a marketing arrangement whereby Tate & Lyle guarantees Swaziland a fixed price for part of its sugar. Should world sugar prices deviate from this fixed price, a formula has been established that shares the risks and rewards equally between Tate & Lyle and Swaziland. For example, should prices rise to a level four cents above the fixed price, Tate & Lyle would keep two cents and Swaziland would receive the other two cents. The two parties have also agreed to a marketing arrangement for Swaziland's molasses. As of 1978, the group was about to complete a similar marketing arrangement with several African sugar producing countries and was hoping that its leadership role in these types of arrangements would lead to additional relationships.

The group is trying to match its sourcing of cane raws with definite markets. Negotiations are in the final stages between Tate & Lyle and a large Middle Eastern oil country that call for the group to construct a turnkey sugar refinery. Eventually, a full-scale raw sugar producing unit will also be constructed within the country. Until then, however, raws will have to be imported. This captive demand provides an ideal fit with the group's relationship in the producing countries. Tate & Lyle would be involved in the marketing of the refined sugar. Since the factory's throughput would be substantially greater than the country's domestic market, the group would serve as an export agent and utilize its worldwide facilities in the disposition of the refined sugar. When the raw sugar unit is completed, the group would also help the country dispose of its cane raws as well as molasses. Both this agreement and the company's relationships with the producing countries are examples of how Tate & Lyle hopes to position itself as the coordinating link between production in the developing world and consumption in the developed world.

The group is also trying to expand its role as a coordinator of other commodity systems and is already involved in the trading and handling of several agricultural systems. An important link in this coordination strategy is an understanding of the production aspects. Through Tate & Lyle Engineering, the Group hopes to become involved in a variety of agricultural production projects. Since about 90 percent of the financial and managerial resources required to construct a large agricultural project in a developing country is associated with agricultural

engineering, TLE feels that its long history of constructing sugar estates gives it a competitive advantage in negotiating against competitors who have more specific crop knowledge. The group also will rely on its ability to attract outside capital, (commercial banks, governmental aid, etc.) to sell its services in developing countries. In certain circumstances, Tate & Lyle may be willing to invest small amounts of equity—10 percent to 20 percent—in some projects.

Another concept the group is trying to develop is providing developing countries with a stake in the companies that ultimately market the products they produce. Tate & Lyle is formulating plans to sell about 20 percent of the equity of Tate & Lyle Refineries to the forty-six African, Caribbean, and Pacific (ACP) countries that supply its cane raws.[22] This ACP ownership would encourage these countries to continue to deliver on the long-term contracts negotiated under the LOME Agreement and would allow them to participate in the marketing of their products. This type of arrangement would also be beneficial to Tate & Lyle in its efforts to keep EEC raw cane sugar quotas at sufficient levels for the profitable operation of its refineries.

As Mr. Tate reviewed these activities in developing countries, he wanted to make sure that they were consistent with the direction toward which the group should be moving. He realized that many changes were taking place in the relationships between developing and developed countries. Since Tate & Lyle was positioning itself as a link between these two converging entities, a proper understanding of this changing environment would be critical to the group's success. He wondered if Tate & Lyle was combining its financial and managerial resources in such a way as to take advantage of one of the group's biggest assets—a long and favorable involvement in developing countries. He was quite upset with the recent scandal in Iran, where two of Tate & Lyle International's senior executives were charged with forgery and misrepresentation. Iran is one of Tate & Lyle International's most important markets and offers opportunities for substantial future business. Although the accusations were completely unfounded and the company had been able to convince the Iranians of the falsity of the charges, the bad publicity had not been beneficial to the group. Mr. Tate understood that this type of incident was one of the risks that Tate & Lyle was exposed to, but he wanted to make sure that the company avoided these problems whenever possible. He still strongly believed that to be successful in the developing world, Tate & Lyle would have to be not only needed but also wanted.

NOTES

1. For an analysis of Tate & Lyle Refineries, see Tate & Lyle, International Case Clearing House, Number 4-576-036.

2. Rhodesia was then called Southern Rhodesia and Zambia was Northern Rhodesia.

3. Four countries were formed when the federation was disbanded in 1961: Zambia, Rhodesia, Malawi, and Tanganyika.

4. Zambia received its independence in 1961; Jamaica, 1962; Trinidad, 1962.

5. At that time, the cost of production was thirty to thirty-five-pounds per ton and world prices were in the ten- to twenty-pound range.

6. Although the EEC has reached an agreement with forty-six African, Caribbean, and Pacific (ACP) countries to import 1.375 million tons of sugar per year, the U.K. sugar refineries have been cut off from 375,000 tons of raw material that they have traditionally imported from Australia and they face capacity problems.

7. Although Belize is currently under U.K. protection, the country is entirely self-governing. The United Kingdom is in favor of granting Belize independence. However, Guatemala has a historical claim that Belize is actually a part of Guatemala and both Belizeans and the British fear that Guatemala will invade the country if Belize is granted independence.

8. Since some imports and exports have not been listed, the balance of trade data cannot be calculated from the previous tables.

9. GDP is equal to GNP plus net imports and aid flows. Since Belize has substantial net imports and aid flows, the per-capita GNP would be significantly less than per-capita GDP.

10. All tons in this appendix have been expressed in long tons, which equal 2,240 pounds.

11. Some of these cane cutters come across the border from Mexico and Guatemala.

12. The cane harvesting season begins in November and goes through June, a time period that corresponds to the country's dry season.

13. Tate & Lyle's original expansion strategy was based on an expanded U.S. Sugar Act quota.

14. When cane is ready to be harvested, it is set afire in order to burn away the dense undergrowth and kill the large number of snakes that live in the green cane fields. The fire's heat starts a process that hardens the sugar and makes it almost worthless after a seventy-two-hour period.

15. These vehicles are predominantly large cane-hauling trucks and smaller pickups. They are viewed as a status symbol, and the recent expansion in their numbers has been for social reasons and not in response to economic realities.

16. Tower Hill is located about fifteen miles up river from the Corozal facility.

17. Tate & Lyle originally invested $16 million in BSI, $8 million in the form of equity and $8 million in the form of debt. The $8 million of debt has been repaid to Tate & Lyle along with substantial interest payments. No dividends have been paid to Tate & Lyle on the remaining $8 million.

18. This levy amounted to about $6.80 in April 1975, when world prices were about $340.

19. This fund was started in 1975 at the urging of BSI.

20. Charbray is a cross containing on the average, 87.5 percent Charollais and 12.5 percent Brahman.

21. Formerly the British West Indies Territories.

22. Since Tate & Lyle Refineries is a 100 percent-owned subsidiary of Tate & Lyle, Ltd., the sale of a portion of TLR's stock would not be complicated.

APPENDIX E
THE ZAMBIA SUGAR COMPANY, LTD.*

John Ranger, managing director of the Zambia Sugar Company (ZSC), looked at the calendar on his wall. April 15 and the cane harvest had not yet begun; it seemed unlikely that the mill would be operational within the next two weeks. It might take another month before the engineers were completely through with the expansion program and the flow of sugar could commence. A combination of factors (abnormal weather, lower than normal yields, and increasing sugar demand) had resulted in an unusually long harvest the previous season. The expansion work, which in a normal season could have been started in November or December, had had to wait until the mill closed down in February. Now, in April, the cane was ready for harvest but the mill work was not yet completed. It was a relief for Ranger to know that once the mill started up, with its added capacity, there would be no danger of a sugar shortfall at least for the next several years. The mill extension was the major step in bringing production capacity up to 150,000 tons per annum.[1] Minor additional investments would have to be made at the refinery and in the field in order to reach that level of throughput, but most of the work had been completed and production capacity would be sufficient to meet Zambia's sugar needs through 1981. According to market forecasts, even greater production would be needed to meet local demand in 1982, but an incremental 50,000 tons of capacity could then be added at relatively minor cost.[2]

John Ranger knew that the expansion had been well planned; it was being carried out according to schedule. (A few weeks' delay in a planning horizon of five to ten years was temporarily irritating but not critical.) Ranger's main concern centered not on the plant and estate expansions but in ZSC's financial resources. The current expansion project, including estate, mill, and refinery additions was expected to cost a total of K48.5 million over the course of four years (1976–1979).[3] Some of this had already been expended, but additional financing was needed to complete the program and to improve the company's financial position. The company was already overleveraged with short-term debt, the potential for new equity was virtually nonexistent, and ZSC's ability to internally generate funds was limited by the Zambian government's price setting authority. In January a price increase had been approved, but it was only 50 percent of the increase ZSC had requested. The financial results of the fiscal year ending 31 March 1977 reflected this delay in granting the price adjustment. (See Table 6E-1 and 6E-2 for financial statements.) John Ranger wondered if ZSC could continue to grow as rapidly as it had in the past, and as it had

*This case was prepared by Kristin Zimmermann, Research Assistant, under the supervision of Professor Ray A. Goldberg, as the basis of class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Table 6E-1. Zambia Sugar Company, Ltd.: Five-Year Operating Summary

	1976/77	1975/76	1974/75	1973/74	1972/73
Sales Volumes (metric tons)					
Refined sugar	71,272	74,508	75,473	70,851	63,769
Raw sugar	4,407	1,794	1,733	2,798	3,238
Special products	964				
Sugar Imports (metric tons)					
(included in sales volume)					
Refined	–	–	1,001	13,542	14,321
Raw	–	–	8,117		
	Profit and Loss Statements (hundred of Kwacha)				
Gross Turnover	26,534				
Sales and Excise Tax	7,344				
Net Turnover	19,190	17,206	14,752	14,046	12,640
Cost of Goods Sold					
Agriculture and raws production	10,537	7,208	5,301	3,855	2,755
Refining and packing	3,417	3,640	2,510	2,159	1,824
Imported sugar	–	–	1,653	2,327	1,508
Depreciation	1,556	1,168	937	790	677
Inventory adjustments	(1,014)	(763)	1,503	82	581
Gross Profit	4,694	5,963	2,848	4,833	5,295
Operating Expenses					
Central administration	520	574	452	383	472
Selling and distribution	1,512	1,296	1,035	946	880
Management fees	30	96	95	75	73
Other (income) expense	116	(221)	(68)	(344)	(86)
Operating Profit	2,516	4,218	1,334	3,776	3,956
Finance charges	2,491	1,964	1,494	1,227	1,092
Net Profit (Loss)	25	2,254	(164)	2,546	2,864
Dividends	–	–		1,373	1,456
Return on Avg. Capital Employed (percent)		10.26%	(3.86%)	12.61%	15.78%
Net Profit/Equity (percent)		15.93	(1.41)	23.88	31.16
Finance Charges/Operating Profit (percent)	99.01	46.56	111.99	32.52	27.60
Dividend/Net Profit (percent)	–	–	–	53.92	50.83

Source: Zambia Sugar Co. Ltd.

Table 6E-2. Zambia Sugar Company, Ltd.: Balance Sheets, 1973-77 (years ending 31 March) (thousands of Kwacha)

	1973	*1974*	*1975*	*1976*	*1977*
Assets					
Current assets cash	2	5	16	488	145
Receivables and prepayments	840	1037	1593	1961	4247
Stocks and stores	3354	3940	3996	5790	6725
Future crop	710	1091	1341	1610	2231
Total current assets	4906	6073	6946	9849	13348
Fixed Assets					
Gross fixed assets	25701	30563	34714	42383	63341
Less accumulated depreciation	3764	4574	5582	6827	8495
Net fixed assets	21937	25989	29132	35556	54846
Other Assets	441	488	419	253	143
Total assets	27284	32550	36497	45658	68337
Liabilities and Equity					
Current liabilities					
Accounts payable and accruals	1242	1939	3706	5062	7531
Dividends payable	1456	1373	–	–	–
Short term debt	7736	9322	10807	11597	7911
Total current liabilities	10434	12634	14513	16659	15442
Long Term Debt	7660	9257	10375	14851	37631
Total liabilities	18094	21891	24888	31510	53073
Equity					
Share capital	6617	6867	7969	7069	9268
Reserves	2573	3792	3640	6179	5996
Total equity	9190	10659	11609	14148	15264
Total liabilities and equity	27284	32550	36497	45658	68337
Current ratio	0.47	0.48	0.47	.59	.86
Long term debt equity	0.83	0.87	0.89	1.04	2.47
Total liabilities/equity	1.97	2.05	2.14	2.22	3.48
Net working capital	(5528)	(6561)	(7567)	(6810)	(2326)

Source: Zambia Sugar Co. Ltd.

planned for the future, if both internal and external financing remained so constrained.

Background of the Zambia Sugar Company

Zambia is a landlocked country covering 543,000 square kilometers of southeastern Africa, bordered by Zaire, Tanzania, Malawi, Mozambique, Zimbabwe (Rhodesia), Botswana, Namibia (South West Africa), and Angola. Zambia is con-

sidered to have the potential for sustained economic development, based on its mineral resources and large areas of land suitable for agriculture. Although the six years immediately following independence in 1964 witnessed substantial economic growth (real per-capita GDP increased 83 percent), the fluctuations and recent decline of world copper prices had had profound repercussions on the rate and direction of development.[4] Because of its established copper industry and its stable government, Zambian development has progressed further than most other independent African countries.[5] It is by and large a mixed economy with most major industries at least partially owned by government "parastatal corporations."

Seventy percent of Zambia's population of approximately five million is engaged in agriculture, primarily at the subsistence level. Since independence, however, there has been a large-scale migration from the rural areas to the cities and towns in the "copper belt" and along the rail line. Unemployment and underemployment remain serious problems as the number of wage-paying jobs created each year is far below that required to assimilate those seeking employment. Although there has been increasing emphasis placed on agricultural development especially since 1970, these efforts have met with limited success. The agricultural sector contributes only 10 percent of the GDP and perhaps as little as 5 percent of arable land is actually being cultivated. The Second (1972-1976) and Third (1977-1981) National Development Plans identify agricultural development and reform as continuing objectives of utmost importance. The rate at which these goals can be achieved is constrained by the capital available to find investments in agriculture.

The Zambian sugar industry was begun in 1960 with the commissioning of a refinery of 20,000 ton capacity at Ndola (see Figure 6E-1). The refinery procured raw sugar from Rhodesia, which previously had been the source of imports of refined sugar. In 1963 a feasibility study for a sugar estate and raw sugar mill was initiated; in 1964 a suitable site was identified and cane growing was tested at Nakambala on the banks of the Kafue River. Land preparation (of 2,350 hectares) and construction work were begun in 1966. The altitude (3,400 feet) and climate (mild temperatures and approximately 30 inches of rain per year) were not those traditionally associated with cane growing. The fields would require almost continuous irrigation but yields were substantially higher than most other cane growing areas. The Zambia Sugar Company harvested and milled its first cane crop in 1968 according to schedule. Since that date production has increased rapidly and relatively steadily (see Table 6E-3 for production statistics). In 1975 Zambia was, for the first time, self-sufficient in sugar. In 1977 a small exportable surplus was anticipated.

The Zambia Sugar Company was initially established by Tate and Lyle, Ltd., which held 77 percent interest until 1971 when the Zambian government's Industrial Development Corporation (INDECO) purchased additional shares to acquire 51 percent of the equity. Tate and Lyle retained a minority position and

Source: Tate and Lyle Co.

Figure 6E-1. The Zambia Sugar Company, Ltd.

Table 6E-3. Zambia Sugar Company, Ltd.: Production Statistics, 1968-77

	1976/77	*1975/76*	*1974/75*	*1973/74*	*1972/73*	*1971/72*	*1970/71*	*1969/70*	*1968/69*
Raw Sugar Produced (tons)	84,150	85,058	64,550	58,185	51,118	41,546	40,131	30,417	21,503
Percent increase over previous year	(1.21%)	31.77%	10.94%	13.82%	23.00%	3.50%	32.00%	41.50%	–
Cane crushed (tons)	779,611	768,153	570,091	487,693	397,363	330,737	321,652	256,754	183,410
Tons of cane per ton of sugar	9.08	8.81	8.69	8.38	7.77	7.96	8.01	8.44	8.53
Refined Sugar Production									
Ndola refinery (tons)	62,014	74,809	63,154	59,320	50,300	43,796	39,697	36,050	36,932
Nakambala white end (tons)	13,352	13,155	9,157	–	–	–	–	–	–
Total sugar refined (tons)	75,366	87,964	73,311	59,320	50,300	43,796	39,697	36,050	36,932
Percent increase over previous year	-14.35%	+21.65%	+21.90%	+17.89%	+14.85%	+10.33%	+10.12%	-2.40%	+9.68%

Source: Zambia Sugar Co. Ltd.

a technical consultancy agreement was negotiated under which T & L was commissioned to provide technical assistance and specialized management service for ZSC. INDECO appointed four of ZSC's seven-member board of directors while Tate and Lyle appointed three (including the managing director) Table 6E-4 shows principal ZSC shareholders.

ZSC is considered to be one of the most successful agribusiness development projects within Zambia. It has provided rural employment for several thousand workers; it has increased local food production, broadening the country's agricultural base; it has brought new land into cultivation; it has provided for savings in foreign exchange and may soon also supply some foreign exchange earnings. Expansion in sugar production is expected to continue and keep pace with or exceed local demand for sugar. Furthermore, ZSC has provided an example of the successful coordination of ownership and management by a government agency (INDECO) together with a multinational firm (Tate and Lyle). As in any joint venture there have been a multiplicity of perspectives by which to view ZSC's strengths and weaknesses. There have been the occasional conflicts of interest but the tripartite agreement (INDECO, Tate & Lyle, and ZSC) has been both harmonious and operational.

Table 6E-4. Principal Zambia Sugar Company Shareholders (as of November 1976)

	Par Value	
	(hundred of Kwacha)	*(percent)*
Major Zambian Shareholders:		
INDECO, Ltd. (parent company)[a]	4,877	52.61
The Zambia National Provident Fund[b]	750	8.09
The Zambia State Insurance Corporation[b]	753	8.12
Zamanglo Industrial Corporation	350	3.78
Barclays Lusaka Nominees	128	1.38
J.H. Minet (Zambia), Ltd.	13	.14
	6,871	74.12
Major Foreign Shareholders		
Tate & Lyle Investments, Ltd. (associate company)	2,186	23.58
Barclays Overseas Development Corporation	89	.96
	2,275	24.54
Zambia and Foreign Minor Shareholders	124	1.34
	9,270	100.00

[a]Wholly owned subsidiary of Zambia Industrial and Mining Corporation (ZIMCO).
[b]Subsidiaries of FINDECO, which in turn is a wholly owned subsidiary of ZIMCO.
Source: Zambia Sugar Co. Ltd.

Cane Growing and Estate Operation[6]. The Nakambala sugar estate covers 20,250 hectares of land that ZSC has leased from the Zambian government for a 100-year term. Approximately half of the total hectarage is suitable for cane production, and by March 1977 slightly over 9,000 hectares had been planted. An increase to 10,240 hectares of cane is planned for the estate by 1979. This, plus the cane available from adjacent farmers should be sufficient to meet the 1979 expansion goal of 150,000 tons per year (see Table 6E-5 for the expansion program schedule). In order to further expand to 200,000 tons per year, new land would have to be acquired. Additional land suitable for cane growing does exist within the immediate vicinity.

Rainfall, averaging 30 inches per year and occurring predominately from December through February, is not sufficient to meet sugar cane's needs and thus all fields are irrigated. Water is pumped from the Kafue River and transported through a series of canals and pipelines to the fields. Except for 500 hectares that are irrigated by overhead sprinklers, the land and soil is suitable for flood/furrow irrigation. The single and relatively short rainy season, though necessitating irrigation, allows for a longer harvest period than in many other cane growing areas. Although cane requires regular moisture for growth and regeneration, it is the absence of moisture that causes the plant to store sucrose. Thus the cane must be allowed to dry out for a period of six to eight weeks before harvest. Insufficient water prevents growth, and excessive moisture at the wrong time lowers sugar content.

Cane yields at Nakambala have been roughly double the world average. Except for 1971 when a water shortage caused by low river levels and exacerbated by pumping difficulties caused yields to drop, yields have consistently exceeded 100 tons per hecare. Table 6E-6 shows comparative yield data for other areas of the world. The two farmers who produce cane for the Nakambala mill initially had lower yields but now generally match or exceed estate yields.[7] They receive water from the estate's irrigation systems, as well as technical assistance from the estate agronomists. The price they are paid for cane is dependent on the market price of sugar (basically 60 percent of the raw sugar value). In the past they have been willing to expand cane production but ZSC believes that a future "outgrower" scheme should be aimed at small-scale indigenous farmers, and a plan for this development in the early 1980s has been drawn up.

Cane growing and harvesting as practiced at Nakambala is highly labor intensive. ZSC's labor force now numbers over 4,500 employees and as such provides approximately 15 percent of the nation's wage-paying agricultural jobs. The work force, both at the estate and at the refinery is unionized and wages are above the national average for the agricultural sector. Housing, medical services, and various other benefits are provided by ZSC. The company is attempting to limit its social service and landlord role by assisting employees in purchasing homes off the estate and encouraging the local township to build housing units to be leased to the company or directly to employees. Temporary seasonal labor

Table 6E-5. Zambia Sugar Company Expansion Program: 1976-79

As of March 31st	*Existing in 1975*	*Implementation Period*				*Total Increase 1976-79*	*Total on Project Completion*
		1976	*1977*	*1978*	*1979*		
Land Cultivated (hectares)							
Estate	7,082	971	987	875	325	3,158	10,240
Adjacent farmers	546	-	81	-	-	81	627
Total	7,628	971	1,068	875	325	3,239	10,867
Factory Capacity[a]							
To produce raw sugar	100,000		50,000			50,000	150,000
Refinery Capacity[a]							
To produce plain time of raw sugar	125,000				25,000	25,000	150,000

[a]Metric tons.

Source: Zambia Sugar Company.

Table 6E-6. World Sugar Cane Yields and Production

	Area Harvested (thousands of hectares)				Yield (kilograms per hectare)				Production (thousands of metric tons)			
	1961-65	1973	1974	1975	1961-65	1973	1974	1975	1961-65	1973	1974	1975
World	9535	11600	12347	12681	49388	52516	53125	50268	470931	609209	655958	637427
Africa	496	735	759	773	62029	68353	66915	64980	30790	50254	50785	50204
Angola	14	16[a]	16[a]	10[a]	47296	60465	61250	47000	662	967	980[a]	470[a]
Cameroon	24	25[a]	25[a]	26[a]	2297	8920	11640	12148	56	223[a]	291[a]	311[a]
Cape Verde					53333	69231	69231	70769	6	9[a]	9[a]	9[a]
Congo	6	13	16[a]	17[a]	46333	26222	25625	23837	278	342	410	410[a]
Egypt	53	83	87	86[a]	90061	88355	80319	81395	4755	7349	7018	7000[a]
Ethiopia	5	7	7	7[a]	129008	171870	160552	162986	676	1186	1076	1125[a]
Ghana	3	5	6[a]	7[a]	20055	62726	50000	42857	57	330	300[a]	300[a]
Ivory Coast				10[a]			50000	33000			8	330[b]
Kenya	18	24	26[b]	26[a]	36247	71381	72958	76046	659	1720	1919[a]	2000[a]
Madagascar	18	32[b]	34	35[a]	53038	36733	37570	37464	946	1191[b]	1291[b]	1300[b]
Malawi		7[a]	9[a]	9[a]		75029	78556	78556		525[a]	707[a]	707[a]
Mali		2[a]	2[a]	2[a]	56818	53333	53333	50000	25	80[a]	80[a]	80[a]
Mauritius	82	81	80	80	62995	77104	74641	54021	5135	6243	5964	4316[b]
Morocco			2[a]	4			5000	14273			10[b]	63
Mozambique	31	57[a]	58[a]	63[a]	47501	52632	48276	35144	1488	3000[a]	2800[a]	2200[a]
Niger	2	2	2	2	19841	37357	37600	37500	40	78	75	75
Nigeria	9	13[a]	13[a]	14[a]	30159	47538	51538	51852	265	618[a]	670[a]	700[a]
Reunion	36	44	44	45[a]	55816	48426	45714	45016	2009	2119	2000[b]	2026[a]
Rhodesia	9	22[a]	25[a]	25[a]	98075	113636	100000	100000	917	2500[a]	2500[a]	2500[a]
Rwanda						64651	59816	79254		7	3	9
Somalia	1	7[a]	6[a]	6[a]	83096	46154	50000	46667	121	300[a]	300[a]	280[a]
South Africa	120	195[a]	205[a]	206[a]	79036	79250	80970	87506	9454	15454	16599	18000[a]
Sudan	4	15	15	17	29961	74611	78079	83869	116	1097	1148	1409
Swaziland	10	16[a]	16[a]	17[a]	76951	106452	93750	96430	756	1650[a]	1500[a]	1591[a]
Tanzania	22	41[a]	41[a]	41[a]	28218	31588	31978	30732	627	1295[a]	1311[a]	1260[a]
Uganda	18	18[a]	11[a]	7[a]	77654	58333	63636	67385	1390	1050[a]	700[a]	438[a]
Zaire	11	6	7	7	32796	75091	90643	91006	351	456	596	615
Zambia		5[a]	6[a]	6[a]		93000	81250	106250		465[a]	520[a]	680[a]

North and Central America	2376	2991	3090	3001	52998	48451	49139	50423	125923	144901	151820	151334
Antigua	5				44688				207			
Bahamas	1	7[a]	7[a]	7[a]	35714	28571	28571	28571	50	200[a]	200[a]	200[a]
Barbados	20	19[b]	17[b]	17[b]	78578	58512	56998	54632	1565	1089[b]	956[b]	917[b]
Belize	5	15[a]	17	16	53213	49667	44833	43881	262	745[a]	748	710
Costa Rica	24	43[a]	37[a]	39[a]	45139	54449	56903	58921	1082	2341	2105[a]	2298[a]
Cuba	1103	1500[a]	1600[a]	1500[a]	38434	33379	35000	35667	42385	50068	56000[a]	53500[a]
Dominica					33930	20000	20000	20000	7	4[a]	4[a]	4[a]
Dominican Republic	106	145[b]	152[b]	149[b]	69398	64564	64562	63365	7326	9372[b]	9798[b]	9436[b]
El Salvador	25	33	35	38[a]	42422	73492	81503	78947	1060	2398	2953	3000[a]
Grenada					27671	25000	45000	45000	10	5[a]	9[a]	9[a]
Guadeloupe	30	27	27	25	63598	48453	41585	40000	1889	1284	1102	1000[a]
Guatemala	32	53	58	63[a]	60640	76069	75638	77778	1960	4009	4423	4900[a]
Haiti	75	75[a]	75[a]	75[a]	37540	37785	38423	39587	2800	2834[a]	2882[a]	2969[a]
Honduras	33	52[a]	48[a]	50[a]	24019	28846	32292	31400	796	1500[a]	1550[a]	1570[a]
Jamaica	68	58[b]	63[b]	62[b]	67033	62890	61530	60718	4542	3648	3846[b]	3759[b]
Martinique	13	9	8	8[a]	76734	47868	48718	48780	1031	407	380	400[a]
Mexico	409	502	497	490[a]	61530	65186	67336	65306	25178	32721	33466	32000[a]
Nicaragua	21	35	36	40[a]	47423	56554	57310	56250	1010	1987	2054	2250[a]
Panama	17	25	26	30	47111	54695	55657	57207	795	1354	1433	1722
Puerto Rico	120	52	48[a]	47[a]	74123	63286	68053	68189	8917	3285	3252	3205[a]
St Kitts, etc.	5	4[b]	4[b]	3[b]	80368	56289	61306	60250	393	214[b]	221[b]	207[b]
St Lucia					66838				26			
St Vincent					81948				14			
Trinidad, etc.	35	39[b]	38[b]	28[b]	68688	51774	50215	50214	2382	2006	1931	1422[b]
United States of America	226	300	297	313	88765	78134	75768	82605	20091	23430	22509	25854
Virgin Islands (U.S.)	2				68679				146			
South America	2320	2941	3018	3170	49005	51639	52823	48424	113700	151847	159445	153487
Argentina	227	272	298	334	50366	62068	52082	47976	11431	16870	15536	16000
Bolivia	21	44	46	47[a]	36895	45000	44189	49362	775	1998	2050	2320[a]
Brazil	1513	1959	1967	2069	43332	46904	49024	43463	65577	91877	96412	89935
Colombia	311	364[a]	367[a]	371[a]	44507	47093	49095	52307	13846	17142[a]	18018[a]	19411[a]
Ecuador	78	89	101	110	86424	61419	65937	50000	6742	5477	6647	5500
French Guiana					50214	50000	50000	50000	9	5	5[a]	5[a]
Guyana	41	56[b]	57[b]	58[b]	84041	53205	67749	70163	3451	2993	3842	4064[b]
Paraguay	24	28	42	42[a]	32792	39314	37180	33333	795	1101	1576	1400[a]

(continued)

Table 6E-6 continued

	Area Harvested (thousands of hectares)				Yield (kilograms per hectare)				Production (thousands of metric tons)			
	1961-65	*1973*	*1974*	*1975*	*1961-65*	*1973*	*1974*	*1975*	*1961-65*	*1973*	*1974*	*1975*
South America (continued)												
Peru	53	51	54[b]	57[b]	144858	171392	168921	157895	7677	8743	9179[b]	9000[b]
Surinam	2	2	3[a]	3[a]	93631	85729	82000	75926	175	170[a]	205[a]	205[a]
Uruguay	5	5	7	8	35153	42695	36529	40123	163	230[b]	247	325
Venezuela	45	70	77	71[a]	68387	75296	74830	74949	3057	5241	5728	5321[b]
Asia	4117	4644	5169	5406	44902	51596	52345	47563	184843	239638	270593	257129
Afghanistan	2	1	1	1[a]	25109	31714	39692	37857	46	22	52	53[a]
Bangladesh	129	128	147	175	39057	42115	43748	38523	5024	5403	6444	6742
Burma	35	55	57[a]	58[a]	31444	35459	29602	29565	1115	1944	1687	1700[a]
Cambodia	4	4	4[a]	4[a]	66900	56410	55263	55263	268	220[a]	210[a]	210[a]
China	439[a]	582[a]	585[a]	597[a]	56299	68113	70715	70539	24705[a]	39664[a]	41340[a]	42140[a]
India	2393	2452	2752	2771	44535	50933	51163	50590	106563	124867	140805	140196
Indonesia	131	158	170[a]	180[a]	70603	62837	81487	79478	9225	9951[b]	13853[b]	14306[b]
Iran	3	6[a]	6[a]	6[a]	84327	190909	218182	163636	252	1050	1200[a]	900[a]
Iraq		2[a]	3[a]	3[a]		42540	35714	35714		98	100[a]	100[a]
Japan	32	30	30	31	67198	68644	60833	67059	2167	2046	1825	2052
Laos	2	2[a]	2[a]	2[a]	2952	3900	3900	3900	6	8[a]	8[a]	8[a]
Lebanon					39407				2			
Malaysia	1	16	10	12[a]	46986	35010	57993	58333	53	570[a]	600[a]	700[a]
Nepal	8	15	16[a]	17[a]	17248	16400	16129	15152	132	246	250	250[a]
Oman					32000	28571	28571	28571	1	1[a]	1[a]	1[a]
Pakistan	469	533	633	673	33809	37396	37767	31563	15849	19947	23911	21242
Philippines	273	434	445[b]	516[b]	48167	52166	52004	47705	13159	22640	23150[b]	24616[b]
Port Timor												
South Vietnam	32	17	24	24[a]	30901	30454	37541	37605	933	530	914	914[a]
Sri Lanka	5	5[a]	5[a]	6[a]	22836	50000	50000	50000	115	253[b]	240[b]	318[b]
Syria					39389	24563	25000	25000	3			
Thailand	138	180[a]	256[a]	307[a]	32325	52850	52105	55	4465	9513	13339	17
Vietnam	19	22[a]	22[a]	22[a]	36219	30000	30000	30000	704	660[a]	660[a]	660[a]

Yemen	2	2[a]	2[a]	2[a]	2941	2941	2941	2941	5	5[a]	5[a]	5[a]
Europe	6	6	5	5	66022	61601	65088	64585	415	363	344	342
Port Madeira	1	1	1	1[a]	38182	23664	32803	32538	42	31	42	42[a]
Spain	5	5	4	4[a]	71919	72239	75500	75000	373	332	302	300[a]
Oceania	220	284	306	326	69362	78299	75165	76572	15259	22207	22971	24932
Australia	176	231	253	272	73331	83455	80478	81471	12936	19278	20377	22160
Fiji	38	45	45	46[a]	52145	55056	47884	50583	1991	2495	2151	2318[a]
French Polynesia					75625	76000	76923	77778	1	2[a]	2[a]	2[a]
Papua New Guinea	5	7[a]	7[a]	8[a]	61734	59722	59459	59211	330	430[a]	440[a]	450[a]
West Samoa					22714	22388	21739	21127	1	2[a]	2[a]	2[a]
Developed	561	762	791	827	80341	79534	77987	82760	45063	60570	61654	68408
North America	226	300	297	313	86765	78134	75768	82605	20091	23430	22509	25854
Western Europe	6	6	5	5	66022	61601	65088	64585	415	363	344	342
Oceania	176	231	253	272	73331	83455	80478	81471	12936	19278	20377	22160
Other Developed	152	225	235	236	76522	77844	78400	84858	11621	17499	18424	20052
Developing	8516	10235	10950	11235	47023	49666	50438	46839	400459	508314	552304	526220
Africa	320	442	452	464	51437	59580	57583	51271	16465	26354	26020	23795
Latin America	4470	5631	5811	5858	49115	48535	49691	47622	219532	273317	288756	278967
Near East	63	108	113	114	81778	88990	83963	82874	5180	9622	9524	9468
Far East	3619	4000	4521	4745	43366	49021	49853	44517	156958	196091	225410	211217
Other Developing	44	53	52	54	53301	55663	49498	51713	2324	2929	2594	2772
Centrally Planned Developing	458	604	607	619	55447	66726	69238	69099	25409	40324	42000	42800
Asian Centrally Planned Economies	458	604	607	619	55447	66726	69238	69099	25409	40324	42000	42800

[a]Food and Agriculture Organization estimate.

[b]Food and Agriculture Organization estimate.

Source: FAO Production Yearbook 1975.

will continue to be housed and fed on the estate, but the permanent work force will be better integrated into the local community.[8]

Transportation of cane from field to mill has frequently been a serious problem in harvest and mill scheduling. Once the cane field is burnt, it must be harvested immediately. Once cut, the cane loses sugar content quite rapidly and thus must be transported to the mill as soon as possible. Maintaining an adequate fleet of operational tractor-trailers has always been difficult. Virtually all capital equipment and spare parts must be imported. The order and delivery process is long and frequently delayed. Almost all goods entering Zambia must be shipped to the port of Dar es Salaam and then transported by rail or road for nearly 1,500 miles.[9] The port is highly congested and though goods are eventually loaded or unloaded, there is a backlog of materials moving in and out. ZSC's supplies do have somewhat of a priority status when ordered directly by the company, but when buying through local distributors the delays can be very long. Table 6E-7 presents additional statistics on Nakambala cane production and transport.

Sugar Milling and Refining. Raw sugar is produced at Nakambala, and then either refined there or shipped by rail to the refinery at Ndola. The mill at Nakambala has achieved good time efficiency and extraction rates of 94 percent and although these have declined in recent years as throughput was increased over the rated capacity of the equipment (200 tons of cane per hour). With the new equipment at the mill for the 1977-78 crop, efficiency is expected to improve. The extraction rate could be increased if the estate were to switch to lower fiber-content cane varieties, but since the fiber (bagasse) is currently burned to provide fuel such a shift would not necessarily be economic.

The performance at the Ndola refinery has been excellent. Its current 75,000 tons per year capacity will be increased to 100,000 tons in the final stages of the 1976-79 expansion program. The Nakambala refinery (white end on the raw sugar milling process) is designed to produce 48,000 tons per seven-month crop season. There have been some difficulties in achieving this scale of output. The technology of the refining process used at Nakambala is fairly recent in design. It is, however, expected that minor additions to the plant will allow refining to increase according to schedule.[10]

Cane sugar milling and refining is a highly capital-intensive industry. Capacity must be added in large blocks, and it is difficult to balance potential outputs of the various segments. The capital intensity of the sugar production process means high fixed costs and breakeven volumes close to 90 percent of capacity. ZSC calculates that 25 percent or less of its total operating costs are variable (see Table 6E-8 for breakdown of fixed and variable costs). Since ZSC's cost of capital is also largely and increasingly fixed in the form of interest charges, it is critical that the production and sales targets be met if the company is to maintain profitability. Any shortfall in production is immediately reflected on the

Table 6E-7. Nakambala Cane Production

Factory									
Crop Length	308 Days	268 Days	256 Days	217 Days	202 Days	170 Days	166 Days	152 Days	141 Days
Season Started	3.4.76	27.3.75	9.4.74	9.5.73	25.4.72	15.4.71	7.5.70	2.5.69	4.6.68
Season Completed	4.2.77	20.12.75	20.12.74	11.12.73	12.11.72	1.10.71	10.19.70	1.10.69	8.11.68
Field									
Estate hectares harvested	6,602.54	6,655.48	5,114.01	4,021.26	3,420.60	3,316.10	2,660.00	2,289.57	1,379.62
Farmers' hectares harvested	553.00	363.70	214.30	230.00	244.00	257.90	211.98	163.19	77.02
Total hectares	7,155.54	7,019.18	5,328.31	4,251.26	3,664.60	3,574.00	2,871.98	2,452.76	1,456.64
Cane harvested estate (tons)	7,080.87	7,308.07	5,484.66	4,649.93	3,723.28	3,091.66	3,045.73	2,416.51	1,735.14
Cane harvested farmers (tons)	715.24	373.46	217.77	227.00	250.35	215.71	170.13	150.50	76.90
Total cane harvested	7,796.11	7,681.53	5,702.43	4,876.93	3,973.63	3,307.37	3,215.36	2,567.01	1,812.04
Tons of cane per hectare–estate	107.24	109.81	107.25	115.63	108.84	93.23	114.59	105.62	125.86
Tons of cane per hectare–farmers	129.34	102.68	101.61	98.70	102.60	83.64	80.91	92.30	99.92
Overall tons cane per hectare	108.95	109.44	107.02	114.72	108.43	92.54	112.06	104.75	124.46
Tons of sugar per estate hectare	11.74	12.80	12.04	13.80	14.01	11.71	14.31	12.51	14.75
Farmers' percent of crop	9.17	4.85	3.97	4.65	6.70	6.30	5.29	6.00	4.19
Cane cut per cutter per day-tons	4.70	4.81	4.64	4.90	4.80	4.46	4.71	3.46	3.44
Transport									
Tons per shift	1,171	1,458	834	1,121	1,084	951	816	651	556
Tons per tractor/trailer hour	9.9	8.16	9.99	10.55	11.20	13.73	11.73	9.49	9.45
Tons per loader hour	56.36	54.00	56.43	57.34	50.43	43.02	42.30	30.15	25.20
Average tractor units worked	21.85	22.68	14.37	13.00	9.01	9.00	9.70	14.20	13.00
Average hours per tractor per shift	7.50 (2 Shifts)	7.99 (2 Shifts)	6.30 (3 Shifts)	11.41 (2 shifts)	10.01 (2 Shifts)	6.92 (3 shifts)	6.10 (2 shifts)	4.80 (3 shifts)	4.50 (3 shifts)

Source: Zambia Sugar Co.

Table 6E-8. Zambia Sugar Company, Ltd.: Estimated Cost Breakeven, 1976-77

Variable Costs per Ton of Refined Sugar Output		
Cane cutting and transport		K 9.95
Raw sugar production		2.18
Refining (Ndola and Nakambala)		8.84
Rail transport of raws		7.69
Packing materials and sundries		16.60
Distribution		8.67
Variable cost per ton of refined sugar		K 53.93
Fixed Costs (thousands of Kwacha)[a]		
Agriculture and Raw Production		K 9,717
Refining and Packing		1,482
Selling and Distribution		645
Administration and Other		550
Finance charges		2,491
Total fixed cost net of stock movements		K14,885
Sales value net of excise (hundreds of Kwacha)		K19,190
Sales volume (all products equivalent)	76,390 tons	

Computation of Breakeven Performance from above Data Approximately as Follows:

Variable cost	K 4,119,712.70
Fixed cost	14,885,000.00
Total cost	K19,004,712.70

Sales value per ton = 251,210.89
Breakeven profit = 75,652.42 tons or 99 percent of production

Sales	K19,190,000.00
Variable and fixed cost	19,004,712.70
Gross profit	185,287.30

Net consolidated profit of K25,000[b]

[a] 1 Kawacha = $1.25
[b] See Table 6E-1.
Source: Zambia Sugar Company files.

bottom line. Thus the delay in harvest in 1976, which was due to the rains persisting until the end of May, limited capacity at Nakambala, caused 1976-77 profits to drop to almost nil. The control of sugar prices to the consumer plus the heavy burden of fixed costs means that ZSC management has very little leeway in affecting profits. However, it should also be noted that ZSC's monopoly position in the market and the stability in prices allow management to better plan capacity and prevents the exposure to extended periods of loss that can occur in a "free market" sugar industry when excess capacity conditions exist.[11]

The Zambian Sugar Market

Sugar consumption within Zambia has grown rapidly since independence (1964) when annual use was 5 kilograms per person. 1977 per capita consump-

tion is expected to reach 18 kilograms. The rate of growth in demand has declined in recent years and ZSC forecasts that it will average 7.5 percent per year over the next five years. At its present income levels (GNP per capita of $420) Zambia's sugar consumption is low compared to other countries in the same income range as can be seen in Table 6E-9. Of course, several other factors, aside from GNP per capita, can be expected to affect sugar consumption levels. ZSC activities, the government's income and pricing policies, and the public's perception of its own economic welfare may have far more effect on how much sugar is consumed. Its household use is primarily as a sweetener for tea or porridge. Although industrial uses of sugar are expanding (breweries, soft-drink manufacturers, bakers, etc.), these amount to only 25 percent of total consumption.

ZSC has based its production plans on the assumptions that demand for sugar is relatively inelastic with regard to price and consumption can be expected to increase at a relatively steady pace over the next five to ten years. In the past ZSC has almost always had its market potential limited by production constraints. Although substantial expenses have been incurred in expanding ZSC's distribution network and insuring that sugar can be bought throughout the country, ZSC has not had to actively promote increased sugar usage. In fact, sporadic sugar shortages have not been uncommon. When there has been a shortfall in supply, ZSC attempts to ration stocks among the various regions, but a shortage always has a different impact in different locales. Rumors of an impending shortage can empty store shelves of sugar faster than any production problem. Now that the ZSC envisions a surplus for 1977 through 1980, the company will have to place greater emphasis on marketing—either in Zambia or for export.

The price of refined white sugar is controlled by the Zambian government at the producer, wholesaler, and retailer levels. Raw sugar, specialty sugars, and ZSC's special products (jams, marmalade, and syrup) are not subject to price controls.[12] Until 1970, the retail price varied according to the distance of point

Table 6E-9. Relationship Between GNP per Capita and per Capita Consumption of Sugar

Countries with GNP per Capita (U.S. dollars)	*Average Consumption of Sugar per Capita (kilograms)*
up to $200	9
$201 to $350	16
$351 to $500	23
$501 to $1000	33
over $1001	42

Source: Company files.

of sale from the railroad, but since then a single price has been applied nationwide. The price to consumers has been increased six times since 1971 but three of these were increases in taxes (see Table 6E-10).

The most recent price increase, which went into effect in January 1977, was the result of sixteen months of negotiations between ZSC, INDECO, and the relevant government ministries (Finance, Mines and Industry, and Commerce). ZSC had requested a price increase of 12 ngwee per kilogram, and was granted 50 percent of that amount. There is a natural disinclination to increase sugar prices, especially in a period when all consumer prices are rising rapidly. In Zambia, as is true in virtually all countries of the world, the price and availability of sugar are politically sensitive issues. An increase in sugar prices is highly and immediately evident and although consumers continue to purchase, complaints can be highly vociferous.

Sugar is sold in packets of varying sizes (500 grams, 1 kilogram, 2 kilograms, 10 kilograms, and 50 kilograms). No differential in price per kilogram is allowed although ZSC's packing costs are substantially higher for the smaller unit sizes. The incentive is thus for ZSC to offer more larger sized packets wherever possible, though it is uncertain whether this might lead to a decrease in purchases by consumers who either do not have the money or do not want to buy larger volumes. Unfortunately, until now the primary determinant of the size mix of sales has been neither relative cost nor market demand but the supply of package materials. All paper is imported into Zambia and the companies that print and prepare ZSC's sugar packets have had difficulty in obtaining foreign exchange quotas. ZSC is thus put in the position of having to accept whatever package sizes are available.

The prices of raw sugar (sold to INDECO breweries) and specialty products are not directly controlled by the government. The price received from the breweries does, however, tend to follow the allowed price increases. The specialty products (jams, syrups, and special sugars) are aimed at the urban, middle and upper classes and at expatriates. The market for syrups and special sugars is small; jams and marmalades are more popular. Although the higher margins on jams and marmalades make them very attractive to ZSC, the company has not been able to take full advantage of the potential market due to difficulty in ob-

Table 6E-10. Retail Sugar Prices in Zambia: 1971-77

	1971-72	*1973-74*	*1975*	*July 7 1975*	*1976*	*1977*
Ngwee per kilogram	22n	22n	22n	26n	26n	32n
Sales tax	–	2	–	–	–	–
Excise duty	–	–	8	8	10	12
Total price per kilogram	22n	24n	30n	34n	36n	44n

Source: Company files.

taining the quality fruits necessary. ZSC is investigating the feasibility of contracting with farmers for various fruits (strawberries are already procured on this basis) or growing fruit itself at Nakambala. However, other opportunities are of higher priority to ZSC.

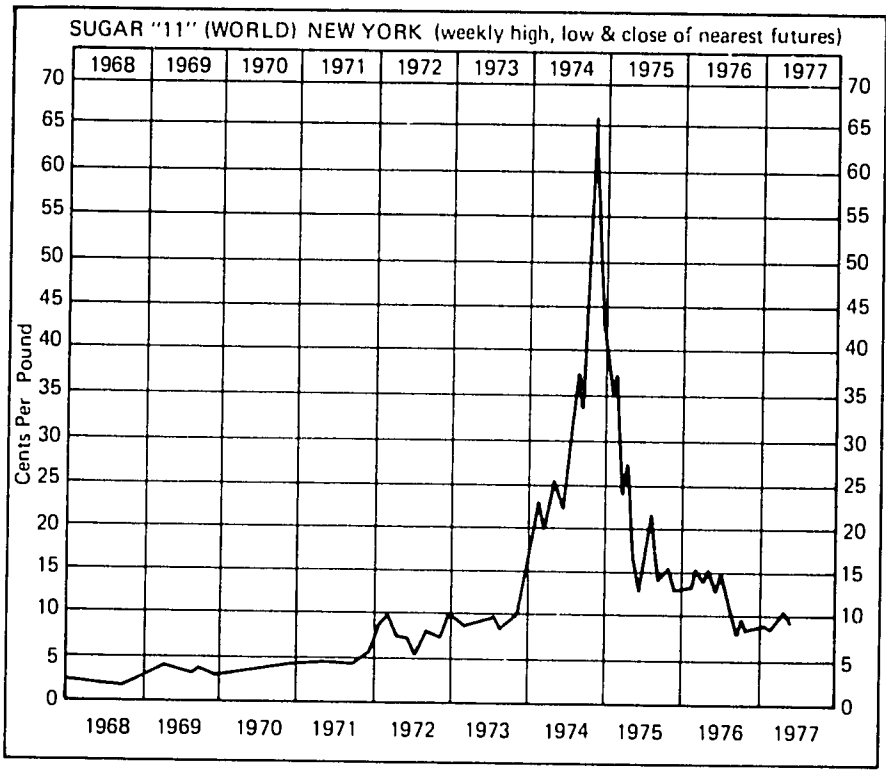
Export Potential.

Sugar. ZSC anticipates an exportable sugar surplus of approximately 20,000 tons per year for the next five years, and is actively looking for a market for it. Due to the currently depressed prices on the world sugar market (see Figure 6E-2), ZSC would prefer to join in some bilateral or multilateral agreement for sugar trade.[13]

Zambia has applied for a sugar quota of 10,000 to 15,000 tons under the Sugar Protocol of the LOME Convention.[14] Although Zambia was not a sugar exporter in 1975 when the LOME Convention was negotiated, and thus did not participate in the Sugar Protocol, Zambia is hoping to obtain a quota. The request has met with unanimous support from the other ACP countries, but the likelihood of receiving in 1977 the quota tonnage requested seems low. However, even if Zambia is granted a zero quota, it could probably export to the EEC should other countries understock on their quotas and would be a participant in the Sugar Agreement when quotas are renegotiated in the future.

ZSC is also attempting to sell some of its anticipated sugar surplus to neighboring countries, several of which are in a sugar deficit position. Agreement thus far has been hampered by political difficulties, logistics problems, and currency limitation within the potential importing countries. Kenya has expressed an interest in buying Zambian sugar to compensate for its own deficit, but the sugar would have to travel through Tanzania and the border between Kenya and Tanzania has been closed since February 1977. Both Zaire and Tanzania appear to need sugar, but do not seem to have the hard currency to purchase it. Botswana is currently purchasing Rhodesian sugar at preferential prices; politically Botswana might prefer to purchase from its only black-ruled neighbor, but the lack of a rail line or paved road makes transportation almost impossible. Angola will probably have to import sugar for several years, until its own production capacity is expanded. Although the establishment of such a trade with Angola could be a politically important maneuver in expanding relations with this newly independent neighbor, the only transportation route available is the railroad through Zaire and at the current moment Zaire and Angola are openly hostile.[15]

From ZSC's perspective, exports to neighboring countries, the EEC, or the world market cannot be expected to yield as high returns as sugar sold within Zambia. Given low world market prices and high transportation costs, ZSC cannot expect a net revenue of much more than K100 per ton for sugar sold on the free world market. Exports to the EEC or neighboring countries could be priced somewhat higher, but not over K200 (per ton for raws), which is less than the



Average "World" Sugar Spot Prices[a] (Raw Can) In Cents per Pound

Year	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*	*Average*
1969	2.95	3.23	3.70	3.76	3.78	3.95	3.72	3.18	3.10	3.12	3.08	2.86	3.37
1970	3.12	3.23	3.44	3.62	3.75	3.82	3.86	3.89	3.93	3.99	4.18	4.16	3.75
1971	4.73	4.83	4.71	4.61	4.35	4.14	4.20	4.37	3.99	4.18	4.20	5.95	4.52
1972	8.25	8.62	8.73	7.29	7.01	6.58	5.58	6.28	7.04	7.42	7.25	9.08	7.43
1973	9.40	9.06	8.89	9.06	9.67	9.77	9.81	9.09	9.01	9.56	10.14	11.83	9.61
1974	15.32	21.28	21.27	21.77	23.65	23.67	25.40	31.45	34.35	39.63	57.17	44.97	29.99
1975	38.32	33.72	26.50	24.06	17.38	13.83	17.06	18.73	15.45	14.09	13.40	13.29	20.49
1976	14.04	13.52	14.92	14.06	14.58	12.99	15.21	9.99	8.16	8.03	7.91	7.54	11.58
1977	8.37	8.56	8.98										

[a]Prices are those under No. 8 contract, which is for bagged sugar f.o.b. and stowed at Greater Caribbean ports (including Brazil) (No. 11 beginning January 1971 bulk sugar). *Source: Agricultural Stabilization and Conservation Service, USDA.*

Source: 1977 Commodity Yearbook, Commodity Research Bureau, Inc., One Liberty Plaza, NY, NY. Reproduced with permission.

Figure 6E-2. World Sugar Prices

domestic Zambian price. Nonetheless, it is essential that ZSC export (if possible) in order to bring in some foreign exchange earnings.

Molasses. Molasses is produced as a by-product of both raw sugar milling and refining. The molasses yield amounts to approximately 3.5 percent (by weight) of the cane crushed. Thus ZSC's molasses production is expected to expand

from its 1976 level of 27,000 tons to over 40,000 tons by the end of the expansion program. Even current production levels are far more than the domestic market can assimilate. The local price is only K10 per ton, but even at this price domestic usage is less than 15,000 tons. A distillery that would convert molasses to industrial alcohol is planned but is not expected to be operational for at least two years. In the meantime it is hoped that the excess molasses can be exported. ZSC has received a 60 percent concession on the cost of freight via rail to Dar es Salaam, which reduces the transport cost to K18 to 20 per ton. At a world market price of $30.00 per ton, exporting is only marginally profitable, but the world price is expected to increase by the end of 1977 and ZSC is willing to export at any price that does not cause a loss. United Molasses (a Tate and Lyle subsidiary that is the world's leading trader and transporter of molasses) has agreed to purchase 3,000 tons over the next four months; ZSC would like to negotiate a two-year contract to sell 20,000 tons a year.

Construction of the distillery is due to commence at the Nakambala estate in 1977. ZSC will not, however, be participating in its ownership or management. It is expected that INDECO will assume as large an equity position as it can reasonably fund (an estimated K800,000 share capital will be required). Tate and Lyle was granted the construction contract and might assume a small minority stock position. The distillery would initially purchase 20,000 tons per year of molasses from ZSC, with the possibility of expanded requirements as production advances. The alcohol produced would be used to satisfy the local demand for industrial spirit and potable alcohol (approximately one million liters per annum) and the balance could be used for blending in petroleum or for the manufacture of zanthate for the copper mines. Alternatively fodder yeast could be produced from molasses and incorporated into animal feeds.

Planning for Small Farmer Coordination

ZSC is already planning a second stage of expansion from 150,000 tons sugar production to 200,000 tons. It is expected that this additional capacity will be required in 1981 or 1982 if consumption continues to grow at forecasted rates. Much of the milling and refining equipment necessary for this second expansion is already in place, and the incremental investment should not be great. Nearly 5,000 hectares of additional lands will have to be developed and of these 1,620 will be set aside for the development of small-scale outgrowers. The site has already been chosen, several sources of financing have been identified, and a timetable for implementation has been drawn up.

Initial estimates of investment requirements for the outgrowers project are in the range of K3 million, including irrigation, land clearing, infrastructure,[16] and a pilot scheme. The project would be established as an independent nonprofit corporation funded by various development institutions. The Commonwealth Development Corporation (CDC), the Development Bank of Zambia (DBZ), the Ministry of Rural Development, and ZSC would share in the limited equity required while CDC and DBZ would provide the bulk of the financing in the form

of long-term loans. Capital work on the project would begin in 1978, the pilot phase in1979,[17] and the first settlement of small holders in 1980. The growers would be charged an amortization of the capital costs as well as any operational costs associated with irrigation, management, or the provision of farm inputs (seed, fertilizer, pesticides). The cane farmers would sell the cane to ZSC, most likely at a price proportional to the value of raw sugar. The large-scale farmers currently supplying ZSC receive K12 per ton of cane, but the company suspects that this might have to be increased for small growers. The project would support between 300 and 400 families with an income considerably above that of an average agricultural worker.

As is frequently the case with small farmer projects, there is a necessary trade-off to be made between providing responsible and experienced management for the scheme as a whole and allowing the individual farmers to operate on their own initiative. Some of ZSC's management would like to see incentives provided such that growers would not only maximize yields, but also that the most successful growers could expand their holdings, and not be limited by a set hectarage allotment.

ZSC Financial Concerns

As mentioned earlier, the current expansion program is expected to cost a total of K48 million. The major investment being the mill extension. The investment costs can be broken down as shown in Table 6E-11. Aside from a K16 million loan for the supply of milling equipment, under a European Community General Development guarantee and secured by the guarantee of the government of Zambia, loans from CDC, DBZ and contributions to the 90 percent debenture stock have been earmarked for the expansion program. By 31 March 1977, approximately K11 million of other long-term funds had been expended on the expansion program and an additional K11 million financing "gap" existed that was being temporarily bridged by funds on short call. These included excess drawings on ZSC's bank overdraft, deferment of payables to T & L, short-dated loans to INDECO, and deferment of payment of excise duties collected. All these measures had been taken with the understanding and at least tempo-

Table 6E-11. Estimated Cost of Zambia Sugar Expansion Program (thousands of Kwacha)

Mill extension (total installation cost)	27,000
Land development, irrigation, etc.	12,750
Other capital costs (transportation, refinery additions, housing, and auxiliary buildings)	4,750
Increase in working capital and contingency reserve	3,500
Total cost of expansion program	48,000

Source: Zambia Sugar Co. Ltd.

rary approval of the institutions involved, yet they were far from satisfactory means of obtaining funds, even for the very short term. ZSC was not only overleveraged, but it was now in a position where it was having to leverage its good name and reputation with its banker, its parent corporations and with the Zambian Ministry of Finance.

ZSC had made an application to the Kreditanstalt Fur Wiederaufbau (KFW—German Development Bank) for a long-term loan of K8 to 9 million, which was approved and disbursed by the third quarter of 1977. All indications were that it would be a good sugar harvest, and capacity would not be constrained. With the KFW loan and if production and sales met targets, most of the short-term bridging monies could be repaid before the close of the fiscal year. It was unlikely, however, that sufficient funds would be available for dividends in 1977–78 or even 1978–79.

Among the goals set for ZSC by its board and management was a 16 percent before tax return or average capital employed.[18] Although ZSC had come very close to meeting this objective in the past, its recurrence did not appear likely for the near future, unless further price increases were allowed on a timely basis. John Ranger was hoping that the Ministry of Mines and Industry, which had recently assumed regulatory authority over prices (this control had previously been exercised by the Ministry of Commerce), would be willing to consider the implementation of formula pricing based on an index of costs. The minister of finance had recently stated that parastatals should be permitted to charge economic prices for their products. ZSC had been one of the most profitable of the parastatals associated with INDECO; John Ranger hoped that this could continue to be true. Unless financing were available and prices allowed to keep pace with increasing costs, the future would remain uncertain. If ZSC remained so dependent on debt capital (which appeared certain given the necessary postponement of dividends) operating leverage would be compounded by financial leverage leaving a perpetually smaller margin of safety in an inherently risky business.

The five-year plans recently completed indicated that production volumes required for breakeven would be well over 90 percent of planned capacity. Agronomic factors alone could cause a ±10 percent variability in throughput. Unless some financial reserves were built up, ZSC would not only be unable to expand, its ability to weather a single poor harvest could be questioned. John Ranger had to admit that during ZSC's current cash squeeze, both parent corporations, several of the debt holders, and even the government's excise tax authorities had provided temporary assistance. In the long run, however, the company would have to achieve a sounder financial base.

NOTES

1. All references are to metric tons (equals 2,204.6 pounds) and hectares (equals 2.471 acres).

2. It is believed that by 1985 or 1986, local demand will have outstripped the expansion potential of the Nakambala estate and mill. A tentative site for a second estate and mill has already been identified in the western region of Zambia. A feasibility study for this site was made in 1978. Since the region is one of the poorest in Zambia the pressures for development of some industry are great. It is uncertain whether this second estate and mill would be merged with ZSC or operated as a second and competing sugar company.

3. The Zambian currency is the Kwacha, which is subdivided into 100 ngwee: K1 equals 100n equals U.S. $1.25.

4. Copper forms 40 percent of Zambia's GDP and close to 90 percent of the country's export earnings. See Table 6E-12 for national accounts.

Table 6E-12. Zambia Sugar Company, Ltd.: Zambia National Accounts (millions of Kwacha)

	1976	*1975*	*1974*	*1973*	*1972*	*1971*	*1970*
Exports	756	575	944	781	586	501	685
Imports	(705)	(844)	(753)	(529)	(565)	(526)	(471)
Balance of trade	51	(269)	191	252	21	(25)	214
Government consumption	480	420	347	327	302	273	199
Private consumption	857	821	736	574	555	529	519
Gross fixed capital formation	510	560	426	381	435	380	358
Increase in stocks	(105)	30	203	83	21	47	(12)
Gross domestic product	1,793	1,562	1,904	1,616	1,335	1,204	1,279
Gross domestic product (1970 prices)	n.a.	1,039	1,331	1,338	1,179	1,113	1,279
Population (mid-year estimate, millions)	5.0	4.90	4.75	4.64	4.42	4.30	4.18

one Kwacha equals $1.25.

Source: Zambia Sugar Co. internal documents.

5. Based on 1972 per-capita GNP data (U.S. $430 per person) the World Bank classified Zambia as among the higher income developing countries.

6. For additional information on cane growing and the world sugar industry see also "Note on the Sugar Industry," Intercollegiate Case Clearing House, Number 9-576-032, Harvard Business School.

7. These are European, large-scale commercial farmers.

8. Seasonal workers live at the estate during harvest season, April–October or November, and return to their local villages and families during the off-season. The average unskilled worker is paid forty to fifty Kwacha per month, which frequently provides the entire wage earnings of large families. The cane is, however, countercyclical to local subsistence crop production.

9. The rail line (built by the Chinese) and road (built by the Americans) to Dar es Salaam were constructed following the closure of the Rhodesian border and have been the major means of surface transportation since. An alternative rail route through southern Zaire and Angola exists, but transport along this has been disrupted almost continually by revolutionary activity within either or both countries.

10. The Nakambala refinery is dependent on mill operation for power. If either field or mill problems force a slowdown or stoppage, it results in inefficiencies at the white end.

11. Because of the massive investment required to establish cane sugar production and the fixed nature of costs, mills and refineries traditionally continue to operate even when market prices are depressed and costs cannot be recovered.

12. Industrial users of refined sugar are charged the controlled price less excise tax and a price rebate amounting to K5.18 per 50 kilogram bag. Soft-drink manufacturers, who account for 20 percent of ZSC's refined sugar sales, also operate under price controls. Their margins have been hurt by the 1977 increase in sugar prices since the cost could not be passed on to consumers.

13. Only 10 percent of the world sugar trade is transacted on the "free" world market.

14. The LOMÉ Convention is an agreement between the nine EEC members and forty-six African, Caribbean, and Pacific countries (ACP), which provides for (1) unreciprocated unilateral trade advantages for the ACPs in regard to all industrial goods and 96 percent of their agricultural products; (2) a revenue stabilization scheme (STABEX) for the ACP's earnings on twelve primary commodities (groundnuts, cocoa, coffee, cotton, coconut products, bananas, leather and hides, timber, tea, sisal, palm products, and iron ore); and (3) the Sugar Protocol by which the EEC allows the import of 1.3 million tons of sugar from ACPs at a price linked to the internal but sugar support price. Each sugar exporting ACP country was granted a quota, which must be filled if it is to be maintained (except for reasons of force majeure). For further information see the note "LOMÉ Convention" (4-576-234). Intercollegiate Case Clearing House, Harvard Business School.

15. It is expected that the western route to the Angola port of Lobito will eventually be Zambia's main access to the sea and world trade. At the moment, however, this is little more than a dirt track.

16. A large part of the capital cost is to build a bridge over the railroad and main Zambian highway that separate the Nakambala Mill from the outgrower scheme site.

17. This trial scheme would provide current lower level supervisors at the Nakambala estate with their own cane plots in order to anticipate any problems that might occur with small-scale individually managed cane holdings.

18. ZSC is subject to the normal Zambian corporate income tax rate of 45 percent (from 1977–78, 50 percent), however, liberal allowances for land development and capital expenditure have and continue to eliminate the company's exposure to taxes on profits. At the end of FY 1977 ZSC's tax loss carry-forward amounted to K15,377,000, which makes any tax liability unlikely for the next 5 or 6 years. K15,377,000 tax losses carried forward (consolidated). However,

group tax relief is not available and

ZSC	tax loss	K15,236,000
NEL	tax loss	141,000
		K15,377,000

Tate and Lyle is considering the winding up of NEL and carrying all tax losses i ZSC.

APPENDIX F
BOOKER AGRICULTURE INTERNATIONAL, LTD.*

Late in the spring of 1978 Mr. Jonathan Taylor, chairman and managing director of Booker Agriculture International, Ltd. (BAI), stared pensively from the conference room window of the company's London headquarters. The meeting just over had been relatively brief. Mr. Antony Haynes, chairman of the Corporate Planning Group of Booker McConnell, Ltd., the parent company, had dropped in on his way back to corporate head office in the city from a visit to another subsidiary company in order to discuss the Mumias sugar scheme. Because BAI had successfully incorporated large numbers of small farmer outgrowers into this Kenyan sugar project as suppliers of cane, Mr. Haynes wanted to know how the overall Mumias experience might affect future BAI company strategy. To try to answer this question, Taylor felt that he should first of all review the project and the lessons BAI had learned about the specifics of managing agricultural projects in developing countries. Only then could the larger strategy question be addressed. Mr. Haynes had asked him to prepare a presentation for the next group senior management meeting in two weeks' time and he wondered what he should say.

Booker Agriculture International

Previously called Bookers Agricultural and Technical Services (BATS), BAI emerged as the repository of all Booker McConnell's agricultural interests following the nationalization in May 1976 of the parent company's large sugar interests in Guyana, which at that time represented more than 40 percent of total corporate assets. The nationalization move had, in fact, been anticipated for a number of years and Booker had been strenuously diversifying, mostly into food distribution and engineering in the United Kingdom, (see Table 6F-1, 6F-2, and 6F-3). Thus, when the blow finally came the company was well prepared and the share price on the London Stock Exchange actually rose. However, the direction of the diversification activity tended to be away from Booker's previous great strength, tropical agriculture. This meant that after the Guyana nationalization, BATS had only a small base upon which to build. For example, in 1975, the last full year of the Guyana operation, the turnover of the agriculture division was £60.6 million. In 1976 the revenue of BAI was £1.9 million. Progress in the past two years, however, had been rapid. BAI now employed over

*This case was prepared by Brian Scott, Research Associate, under the supervision of Professor Ray A. Goldberg, as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Table 6F-1. Booker McConnell: Organizational Chart

This family tree shows the operating businesses within each division at 1 April 1977.

The word *limited* is omitted from the names of all companies.

Unless otherwise shown below the names, the companies are incorporated in the United Kingdom.

U.K. Food Distribution

Chairman: M.W. Jerram, FIGD

Divisional Board

Booker Belmont Wholesale

Food, drink, and tobacco wholesaling, delivered and cash-and-carry; suppliers to caterers; members of the Keencost cash-and-carry group, suppliers to Mace and Wavy Line retailers

trading as:
Alfred Button and Sons
Arthur Richardson & Son
Bray's of Boscombe
Charles Arkcoll
Chefs Larder
French of Chichester
Gardners (Bristol)
James Harper & Son (Edinburgh)
Kinloch (Provision Merchants)
Rusts (Wine Merchants)
S & A Galbraith
W.F. Wilkins

3,850 employees

Delivered-trade Division

Cash-and-carry Division

Booker Belmont Retail

Operating supermarkets, self-service food shops, butchers' shops, hardware stores

trading as:
Budgen
Merit
Murdoch Norton
Rusts
Williams Brothers Butchers

3,350 employees

Booker Health Foods

Health food manufacturing, wholesaling, and agency distribution; health food retailing, publishing of health magazines

trading as:
Associated Health Foods (including Allinson)
Brewhurst Health Food Supplies
Holland & Barrett
Newman Turner Publications

1,000 employees

Booker Pharmaceuticals

Retail chemists, pharmaceutical manufacturing and wholesaling

trading as:
Kingswood (Chemists)
F.E. Russell (Chemists)
Rusco Wholesale
Rusco Pharmaceuticals

550 employees

Honorary President: Lord Campbell of Eskan

Board
Sir George Bishop, CB, OBE Chairman
M.H. Caine - Vice-Chairman and Chief Executive
W.M. Robson
M.C.W. Wildy, FCA Deputy Chief Executive
M.A. Nicolson, MC
D.H. Joss
J.A. Haynes
Rt. Hon. J.B. Godber, MP
J.N.W. Hearder, FCCA, ACIS

Overseas Trading

Chairman: J.N. Hearder, FCCA, ACIS

Divisional Board

Booker Merchants International

Buying, marketing, shipping, and finance services for overseas companies

115 employees

Bookers Sugar Company

Marketing and agency services for commodities

Stephens & Ross including S&R Agencies Trinidad

Department stores, wholesale and retail chemists, agency services

560 employees

Minvielle & Chastanet including Bryden & Partners St. Lucia

Department store and other retailing, wholesaling; distributing and servicing motor vehicles and other equipment; agency services

720 employees

Health Supply Centre Canada
Wholesaling and retailing health foods

30 employees

Bookers (Zambia) Zambia

Holding company; managing agency services

Consumer Buying Corporation of Zambia (33% owned)

Department store and other retailing

National Drug Company (49% owned)

Pharmaceutical manufacturers; wholesale and retail chemists

Eagle Travel (49% owned)
Travel agency

Bookers (Malawi) Malawi

General retailing and representing overseas manufacturers; clothing manufacturing; tea growing, produce processing and packing

1,540 employees

Parrish & Fenn

Specialist food marketing

70 employees

Paterson's Scottish Shortbread

Specialist biscuit manufacturing

125 employees

Source: Booker Agriculture International, Ltd.

Table 6F-1 continued

Executive Committee
M.H. Caine - Chairman
M.C.W. Wildy - Deputy Chairman
J.A. Haynes
M.A. Nicolson
D.H. Joss

Corporate Planning Group
J.A. Haynes - Chairman
F.B. Doyle, BSc, MBA, CEng, MICE
R.K. O'Keeffe, BA, BSc(Econ)

Agriculture

Chairman: J.F. Taylor

Booker Agriculture International

Management and technical services for sugar industry and other agricultural projects; consultancy services for agriculture on worldwide basis; investment in agricultural and agro-industrial projects

170 employees

Highland Trout Company (Scotland)

Fish farming

Alcohol
Chairman:
R.F. Burman, FCA

United Rum Merchants

International marketing of rums, liqueurs, and other alcoholic beverages

115 employees

Estate Industries Jamaica

Manufacturing Tia Maria liqueur

110 employees

Shipping
Chairman:
M.A. Nicolson, MC

Divisional Board [Booker Bros. (Liverpool)]

Booker Line

Shipowning - cargo liner service to the Caribbean

200 employees

Such & Schooley

Shipbrokers - deep and short sea cargo, agency services

S William Coe & Co. and Metcalf Motor Coasters

Shipowning - short sea trades, dry cargo, and tanker

190 employees

Fluid Engineering
Chairman: J.A. Nutt, FCA

Divisional Board

SPP Group

690 employees

Sigmund Pulsometer Pumps
Manufacturing centrifugal pumps and other fluid-handling equipment

Sigmund Pulsometer Projects
Designing and supplying fluid-handling systems

SPP Controls
Manufacturing electrical control systems

SPP Systems
Designing and supplying irrigation systems and equipment

Plenty Group

550 employees

Filter and Separator Division
Manufacturing filters, strainers, and separators

Mixer Division
Manufacturing side-entry mixers for the oil industry

Bescon Division
Designing and supplying fuel treatment plants and packaged fluid-handling systems

Mirrlees Pumps
Manufacturing positive displacement pumps

Plenty Johnson International USA
Marketing and servicing Plenty Group products

Hero Equipamentos Industrias Brazil
Manufacturing fluid-handling

140 employees

(continued)

Table 6F-1 continued

Parent Company Executives

S. Rimmer, FCIS	Company Secretary
D.A. Cowie, FCA	Chief Accountant
R.K. O'Keeffe, BA, BSc(Econ)	Executive Committee Secretary
P.L. Cowley, FCA	Taxation
D.F. Taylor	Investment
P.M. Smith	Public Relations
F.V.C. Millward, APMI	Pensions
J.A. Male	Chief Cashier
A. Riddoch	Publications
P.W. Ryder, MSc, ACIS	Assistant Company Secretary

General Engineering

Chairman: F.B. Doyle, DSc, MBA, CEng, MICI

Divisional Board

Fletcher and Stewart

Manufacturing and marketing sugar machinery and hydraulic presses, contracting for complete sugar factories

780 employees

Fletcher Sutcliffe Wild

Design and manufacture of conveying schemes for mines and steelworks, and of hydraulic roof supports for the coal-mining industry

870 employees

J & T Lawrie

Designing, manufacturing, and installing piping systems; fabricating mild steel and stainless steel vessels

200 employees

Central Wagon Company

1,230 employees

R G Brown and Company

Mild steel stockholding specializing in plates, sheets, bars, and sections

Lamrye

Manufacturing high-pressure hydraulic jacks

Lpco

Manufacturing transport service equipment

Copestick & Farrell

Specialist presswork-ing and fabricating including prefabricated structures

Central Wagon (Services)

Repairing and hiring railway wagons, manufacturing steel pallets

Dracados-CW

Marketing heavy wall tubulars for the oil industry

Authors

Chairman: D.H. Joss

Divisional Board

Agatha Christie

Owner of copyrights of the late Agatha Christie

This division also controls companies that own certain copyrights and/or employ the services of

Robert Bolt
Jane Brane
the late Francis Clifford
the late Ian Fleming
the late Georgette Heyer
Vivien Merchant
Harold Pinter
Ronald Ridout
Dennis Wheatley

Other Companies

Booker McConnell Services

Group services, including property, insurance, security, and shopfitting

60 employees

Bookers Pensions

Trustee of the group's pension schemes

Booker McConnell representative in Guyana
J. Hudson, FCA

Number of employees	
Parent company	60
U.K. food distribution	8,800
Overseas trading	3,160
Agriculture	180
Alcohol	230
Shipping	390
Fluid engineering	1,380
General engineering	3,100
Other companies	70
	17,370

Table 6F-2. Booker McConnell Limited: Summary of Consolidated Figures: 1966–77 (millions of British pounds)

	1966	*1967*	*1968*	*1969*	*1970*	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*	*1977*
Fixed assets	16.7	18.2	28.2[a]	32.3	34.3	35.2	37.8	43.4	49.9	52.7	35.7	47.4
Goodwill			0.4	1.2	2.5	2.6	3.7	7.8	4.7	4.6	4.8	8.4
Trade and other investments	1.5	5.0	5.4	6.5	5.0	3.5	3.9	3.5	3.8	2.8	5.0	13.9
Other noncurrent assets	3.2	1.9	2.9	1.8	1.8	1.8	1.8	1.6	1.2	1.3	2.1	3.0
Current assets less trade creditors	14.6	15.5	17.1	17.8	18.2	21.0	20.8	27.0	24.6	35.5	43.9	49.2
Net trading assets	36.0	40.6	54.0	59.6	61.8	64.1	68.0	83.3	84.2	96.9	103.2[b]	122.6[c]
Representing:												
Ordinary share capital	5.9	5.9	5.9	11.8	11.8	12.6	12.6	12.9	13.8	13.8	14.7	15.4
Reserves	16.0	17.5	30.9	24.9	24.3	24.3	27.1	32.0	32.3	36.8	37.1	45.9
Parent company equity	21.9	23.4	36.8	36.7	36.1	36.9	39.7	44.9	46.1	50.6	51.8	61.3
Preference share capital	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Loan stocks with conversion rights						1.8	1.8	1.8	2.8	2.7	3.6	0.3
Minority interests	3.1	3.4	4.8	5.8	6.1	5.8	5.0	6.0	6.2	6.5	5.5	5.6
Deferred taxation			0.2	0.4	0.9	1.1	1.7	2.4	5.0	10.6	13.8	25.1
Loans and other noncurrent liabilities	3.1	5.0	3.3	4.8	5.4	5.2	8.4	9.4	10.9	10.1	7.8	9.4
Current liabilities excluding trade creditors	7.3	8.2	8.3	11.3	12.7	12.7	10.8	18.2	12.6	15.8	20.0	20.3
Capital employed in financing net trading assets	36.0	40.6	54.0	59.6	61.8	64.1	68.0	83.3	84.2	96.9	103.2	122.6
Profit before taxation	3.2	3.8	4.9	4.3	4.6	6.9	8.9	9.7	13.9	16.1	14.9	25.0
Taxation	1.3	1.7	1.9	2.0	2.1	3.4	4.1	4.8	7.3	9.3	7.0	12.9
Profit after taxation	1.9	2.1	3.0	2.3	2.5	3.5	4.8	4.9	6.6	6.8	7.9	12.1
Minority interests and preference dividends	0.3	0.3	0.5	0.5	0.4	0.6	0.6	0.8	1.0	0.7	1.3	1.5

(continued)

Table 6F-2 continued

	1966	*1967*	*1968*	*1969*	*1970*	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*	*1977*
Profit after tax attributable to parent company ordinary shareholders	1.6	1.8	2.5	1.8	2.1	2.9	4.2	4.1	5.6	6.1	6.6	10.6
Extraordinary items:												
Surplus (deficit)	(0.7)	(0.1)	1.7	(0.4)	(1.5)	(2.1)	–	1.0	(4.8)	(0.1)	0.1	(0.4)
Ordinary dividends:												
Paid to shareholders	0.6	0.6	0.6	0.7	0.8	1.0	1.2	1.3	1.5	1.6	1.8	2.3
Paid to income tax	0.4	0.4	0.5	0.5	0.5	0.6	0.2					
Transfer to (from) reserves	(0.1)	0.7	3.1	0.2	(0.7)	(0.8)	2.8	3.8	(0.7)	4.4	4.9	7.9
Figures in Pence Per Ordinary Share[d]												
Earnings	6.5	7.7	10.5	7.5	8.9	12.0	16.6	16.0	20.6	22.0	24.0	34.8
Dividends												
Including tax credit	4.3	4.4	4.6	5.0	5.5	6.5	6.8	7.2	8.1	8.9		
Excluding tax credit								4.9	5.4	5.8	6.3	7.3

[a] After revaluation of land and buildings.

[b] Includes £11.7 million Guyana assets in course of realization.

[c] Includes £10.7 million Guyana assets in course of realization.

[d] For the years 1966–68, adjusted for a one-for-one capitalization issue in April 1969.

Source: Booker McConnell, Ltd., *Annual Report, 1977*, and company records.

Table 6F-3. Booker McConnell Divisional Profits: 1976-77

Division	*1976 (hundreds of British pounds)*	*Percent of Total*	*1977 (hundreds of British pounds)*	*Percent of Total*	*Percent of Change 1976-77*
Food distribution	1,883	28.4	3,331	31.5	76.9
Fluid engineering	1,650	24.9	1,813	17.2	9.9
General engineering	(558)	0	1,969	18.6	–
Overseas trading	1,056	15.9	812	7.7	(23.1)
Spirits and liqueurs	814	12.3	1,076	10.2	32.2
Shipping	546	8.2	622	5.9	13.9
Agriculture	160	2.4	303	2.9	89.4
Authors	487	7.3	496	4.7	1.8
Parent company	600	9.0	145	1.4	(75.8)
Total	6,638	100.0	10,567	100.0	59.2
U.K. companies	4,671	70.1	8,715	82.5	86.6
Overseas companies	1,967	29.9	1,852	17.5	(5.8)
Total	6,638	100.0	10,567	100.0	59.2

Source: Booker McConnell, Ltd., records.

150 professional staff and in 1977 had revenues of £2.8 million yielding net after-tax profits of £303,000 (see Table 6F-4, note: no figures are available prior to 1976 because of consolidation with the Guyana operation).

BAI activities are concentrated in tropical agriculture consulting and management services, mainly in sugar but also increasingly in general crops. The company also has minority equity interests in the Nigerian Sugar Company, and in the Mumias Sugar Company in Kenya, and a controlling interest in the Highland Trout Company in Scotland, a salmon farming venture. Having worked in forty-five countries during the past eight years, BAI is currently active in sixteen countries throughout the world, with major projects in Nigeria, New Guinea, Kenya, Somalia, Iran, Indonesia, and Belize. With forecasts of rising world sugar consumption, especially in the developing countries, and with a growing demand for the services of companies with proven ability to execute as well as to plan new agricultural development projects, BAI's management believes that prospects for future expansion are very good. A major constraint in growth at present, however, is the shortage of technical and managerial personnel with appropriate experience. Figure 6F-1 is a simplified organizational chart of the company as of January 1978.

Origins of the Mumias Sugar Scheme. Kenya has long been an importer of sugar. Traditionally, mill white sugar for general consumption has come from Uganda while high quality refined sugar for industry has been imported from Europe and the Far East. Self-sufficiency in sugar production is part of the national development plan. This objective has been stressed more in recent years as

Table 6F-4. Booker Agriculture International, Ltd.: Analysis of Financial Results, 1976-78 (thousands of British pounds)

	1976 Actual	1977 Budget	1977 Actual	1978 Budget
Revenue	1,900	2,465	2,827	3,244
Direct costs	(1,107)	(1,053)	(1,572)	(1,255)
Gross contribution	793	1,412	1,255	1,989
Less: Central overheads	(543)	(809)	(861)	(964)
Adjustments of revenue to cash earnings basis[a]	(72)	(58)	(132)	0
Operating profit	178	545	526	1,025
Interest receivable (payable)	0	0	1	12
Investment income	237	156	321	95
Profit before tax	405	701	855	1,108
Tax	(224)	(379)	(459)	(576)
Profit after tax	181	322	396	532
Consolidation adjustments	20	0	0	0
Booker (Nigeria) profit (loss) after tax	0	0	(35)	0
Highland Trout Company Booker share profit (loss) after tax	(40)	(62)	(58)	0
Net profit	161	260	303	532

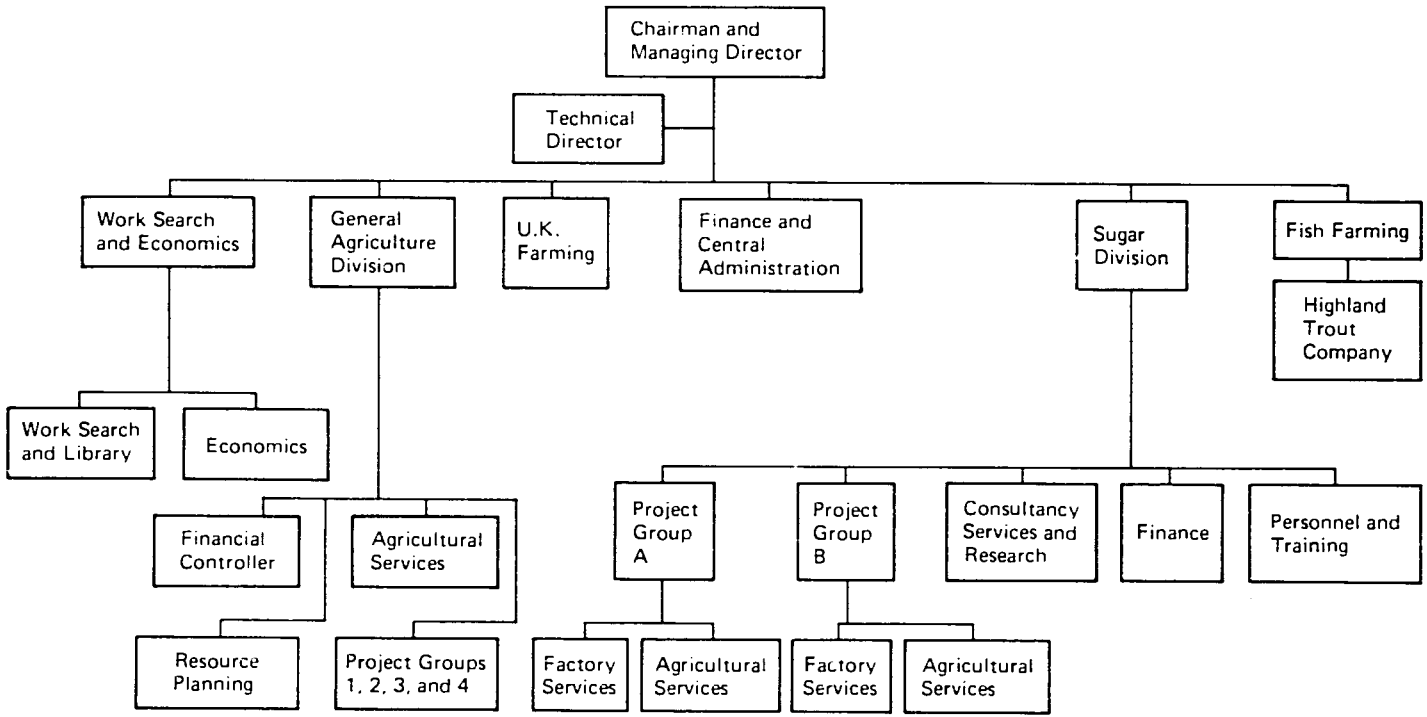
[a]i.e., adjustment of overseas earnings to a "cash received London" basis.

Source: Booker Agriculture International, Ltd., records.

the coherence and sense of common purpose of the East African Community (Kenya, Uganda, and Tanzania) has weakened.

Since the mid-1950s, Kenyan sugar consumption has been increasing by more than 7 percent per year. This has been due to rapid increases in both population and per-capita consumption. As per-capita consumption is still low by developed country standards and the birth rate shows no sign of slackening the rapid growth in demand is likely to continue in the forseeable future. Tables 6F-5 and 6F-6 show the past and projected future relation between domestic production and consumption. On present trends self-sufficiency will not be attained until 1981, and even then it is likely only to last for a few years before internal demand again overtakes production. As sugar is not generally packaged in consumer-sized units, but instead is dispensed at the retail level from large jute sacks, per-capita consumption levels may increase at faster rates as marketing improvements occur.

Prior to the Mumias project, domestic production came from four factories. Ramisi is situated near the coast where cane yields are low and variable due to badly distributed rainfall and poor soils. The factory capacity is 15,000 metric tons annually. The other three projects, Miwani, Muhoroni, and Chemilil are all



Source: Booker Agricultural International, Ltd.

Figure 6F-1. Booker Agriculture International, Ltd.: Simplified Organizational Chart, January 1978

Table 6F-5. Production and Consumption of Sugar in Kenya: 1967-74 (thousands metric tons)

Year	*Production*	*Consumption*	*Deficit*
1967	60.4	121.4	61.0
1968	81.4	132.5	51.1
1969	115.4	142.0	26.6
1970	125.1	155.0	29.9
1971	124.1	185.0	60.9
1972	102.0	195.0	93.0
1973	140.9	220.0	79 1
1974	164.7	224.0	59.3

Source: East African Common Market and Economic Affairs Secretariat.

Table 6F-6. Trends in Consumption, Production, and Shortfalls of Sugar in Kenya, Assuming Mumias Production is Increased to 156,000 Metric Tons Per Year by 1982 (hundreds of metric tons)

Year	*Consumption (assuming 7.4 percent per annum increase)*	*Production*			*(Deficit) Surplus*
		Mumias	*Rest*	*Total*	
1977	263	75	109	184	(79)
1978	282	78	138	216	(66)
1979	302	98	151	249	(53)
1980	324	124	180	304	(20)
1981	347	141	216	357	10
1982	371	156	240	396	25
1983	407	156	253	409	2
1984	437	156	270	426	(11)
1985	468	156	290	446	(22)

Source: Booker's Agricultural and Technical Services, Ltd., Mumias Sugar Company Expansion Project Viability Report, Vol. 1, p. 19, December 1975.

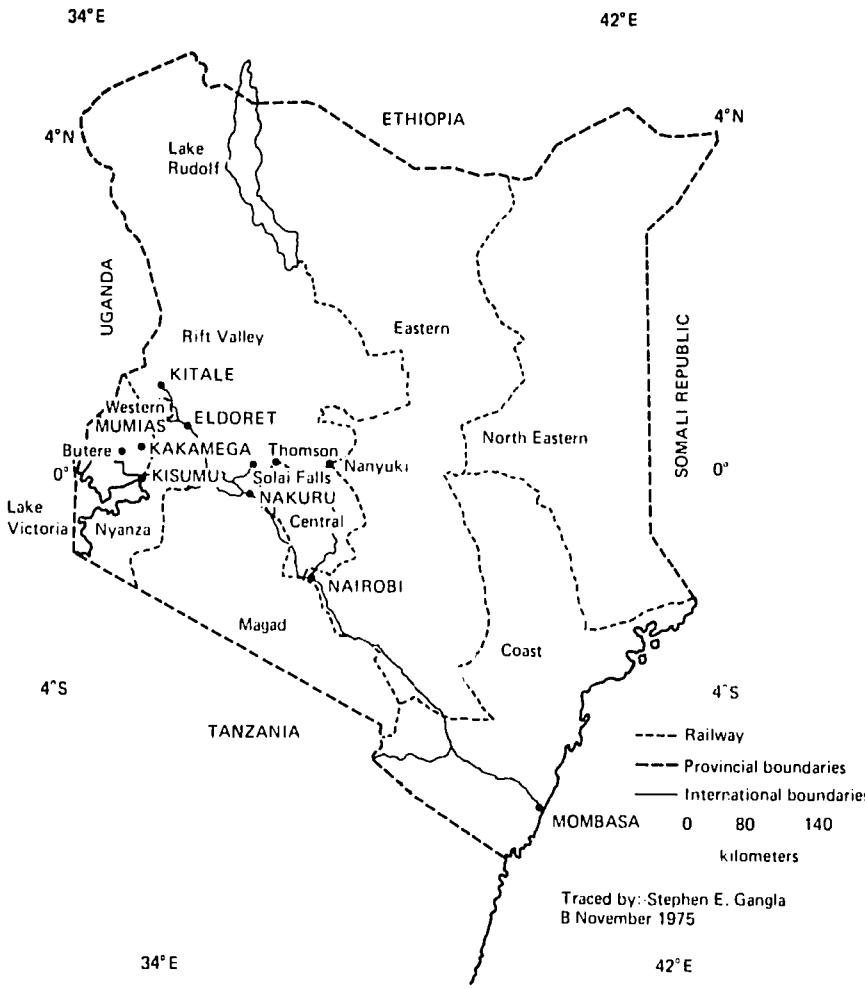
situated on relatively unsuitable heavy black cotton soils in the Nyanza region, and together have a potential production capacity of 120,000 tons of sugar per year. Both Muhoroni and Chemilil have outgrower components. In both instances, however, cane supply has been a problem on occasions. These projects have also had cane transport and factory difficulties partially due to unsuitable equipment.

The retail price of sugar in Kenya is controlled by the government. All wholesaling of sugar is carried out by the parastatal organization, the Kenya National Trading Corporation. In some recent years sugar prices in Kenya have been well below world levels. Currently (May 1978) they are slightly above the world price. Cane prices paid to farmers are also controlled by the government.

The need for more domestic production of sugar and the inadequacies of existing projects having been realized, the Ministry of Agriculture, in 1965, began to prepare the Mumias scheme. The Nzoia river valley in western Kenya (see map, Figure 6F-2) was selected, primarily because of its suitable climate but also because the region was, although quite densely populated (222 people per square mile), very underdeveloped.

The local Abaluhya population are subsistence farmers. A number of earlier attempts to introduce cash crops, including coffee, cotton, and sisal, have all failed. Holdings are small, averaging about ten acres. Soils are generally poor, being either eroded and deficient in phosphates in the upland areas or waterlogged along the Nzoia River and its tributaries. Between 1930 and 1960 rice was grown on the wet riparian soil but has since been virtually abandoned for a variety of reasons including unfavorable prices, and lack of oxen for plowing. Main crops are finger millet, corn, and sorghum, with corn cultivation increasing at the expense of millet. After 1945 the colonial authorities stipulated that cassava had to be cultivated as insurance against famine. Because of the poor soils and the prevalence of striga weed, yields have been low, five to six pound bags to the acre being a maximum for most farmers. After 1955 local varieties of sugar cane were introduced on a modest scale and a number of small jaggery factories were opened. Jaggery is a noncrystallized brown sugar containing molasses used by the Asian community in Kenya for preparing sweetmeats and also used for the manufacture of the illegal spirit *waragi*. The cane was grown in small plots no larger than two acres and without fertilizer. Despite the need for alternative money income to supplement subsistence farming, cane growing for jaggery was not popular. Suggested reasons for this are the fact that many of the early cane plots did not produce a saleable crop, and also that cane prices offered by the mostly noncitizen Asian jaggery mill owners were deemed very low. Thus, by the 1960s the situation in the Mumias region was one of underemployment and underuse of land. In 1969, for example, it was estimated that only one-third of the acreage in the North Wanga district was being cultivated.[1] The rest of the land was in rough grass and bush on which the local people grazed cattle. The cattle population seems, however, to have declined in recent decades. In 1947 there were 46,125 animals while in the period August-December 1971 the Mumias Divisional Agricultural Office reported an average number of only 42,600,[2] despite an increase of 84 percent in the human population in the same period. This decline in cattle numbers, the lack of response to the opportunity to grow cane for jaggery, and the large amount of unused land, all suggest that the economic returns from agriculture, given available market conditions, crops, and technology, were insufficient to provide an incentive for development.

After the completion of the preliminary sugar project studies the government of Kenya approached BAI (BATS as it then was) to develop the scheme. The authorities were anxious to have work begin as quickly as possible because of the rapidly growing national imbalance between sugar consumption and production.



Source: Booker Agricultural International Ltd.

Figure 6F-2. Provinces of Kenya

There were also a number of social and general developmental aims in addition to the sugar production objective. The rate of population growth in this relatively less developed part of Kenya is 4 percent per annum, well above the national average. Also there is considerable out-migration to other parts of the country including the urban areas. The government wanted the sugar project not only to be a cash crop for small farmers, as, for example, are tea and coffee in other parts of Kenya, but also to act as a focal point for more general community and economic development in the region. Exactly how this nonsugar development was to take place remained unspecified, however. No overall development plan, with the sugar project at its center, was drawn up.

BAI's response to the government's proposal was one of caution. While the agronomic features of the Mumias area seemed suitable--sugar cane for jaggery was already being grown in a small way—no field trials had been undertaken to verify that conditions were indeed appropriate. Also, BAI was aware that some form of outgrower component would be required to fulfill the social and general developmental objectives and that such schemes had run into difficulties at both Muhoroni and Chemilil. BAI, therefore, drew up a general plan, which included both an outgrower component and the use of labor-intensive cane harvesting and transport methods appropriate to the local conditions of labor surplus. However, the company also insisted on conducting a pilot project in order to verify the agronomic suitability and also to ensure that the novel details of the project design would, in fact, work.

The company and the Kenya government eventually compromised by combining the pilot project with the first phase of the project. Land was acquired by the government by compulsory purchase (voluntary in almost all cases, in fact). Work began in 1967 and the final feasibility report, with favorable technical and social cost-benefit analysis results, was delivered in 1970. The Mumias Sugar Company was formed in June 1971. The factory began operations on schedule on 1 July 1973, reaching its designed capacity by September the same year. Thereafter, it consistently exceeded its nominal grinding capacity.

Corporate and Capital Structures of the Mumias Project. The project and the Mumias Sugar Company (MSC) were launched using Kenya government funds. In addition, the U.K. government provided a loan to the Kenya government of K£2.5 million (K£1.00 = 20 Kenyan shillings = £0.77 sterling = U.S. $1.40 approximately) at 2 percent for the purchase of the factory (supplied by the British company and Booker McConnell subsidiary, Fletcher and Stewart). Overdraft facilities were arranged with the Kenya Commercial Bank and secured by a debenture under which MSC granted a charge in favor of the bank covering all its stocks of raw materials, stores, finished goods, and book debts.

In August 1972 the Mumias Sugar Company published a prospectus inviting further equity investment. By the end of 1974, the first full calendar year of production, the capital structure of the company was as described in Table

6F-7. The equity:loan ratio was 1.38:1 conservative leveraging that reduced cash requirements. This was especially important during the early start-up years.

Associated with the project was the improvement of road communications in the Mumias region. This was required to facilitate the importation of construction equipment and supplies, fertilizers, and other agricultural requirements into the Mumias area; the transportation of up to 70,000 tons of sugar and 20,000 tons of molasses per year out of the project area; and, finally, the movement of cut cane from outgrowers' plots to the factory within the region. The total cost of upgrading and extending the road network outside the nucleus estate was estimated to be K£767,000 and was met by a World Bank loan to the Kenya government.

While the company built and financed housing for management and supervisory staff, employee housing, estimated to cost K£240,000, was to be provided by the Kenya government through the National Housing Corporation. It was planned to expand Mumias township and other selected existing settlements rather than build a separate company town. This would help integrate the project into the local community and also spread the benefits of new public infrastructure, such as electricity, roads, schools, and medical services, effectively throughout the entire population. Unfortunately as work on the scheme progressed and the housing was not built, the Mumias Sugar Company was forced to step in and construct the necessary dwellings itself.

The costs of both the roads and housing were included in the social cost-

Table 6F-7. Capital Structure of Mumias Sugar Company Ltd.: 31 December 1974

3,500,000 authorized shares of one Kenyan pound[a] per share
2,900,000 shares issued and fully paid as follows:

	(Kenyan pounds)[a]
Kenya Government (69 percent)	2,000,000
Commonwealth Development Corporation (CDC) (12 percent)	348,000
Kenya Commercial Finance Company (9 percent)	262,000
East African Development Bank (5 percent)	145,000
Booker McConnell, Ltd. (5 percent)	145,000
Total share capital	2,900,000

Loans and advances: K£2,401,446 (mostly from Kenya and U.K. governments)

Profit and loss account: K£417,380

Total capital employed: K£5,718,826

[a]K£1.00 approximately equals U.S. $1.40, May 1978.

Source: Mumias Sugar Company records.

benefit analysis. No credit was taken for the benefits that the new road system would bring to the community.

In addition to carrying out the pilot project, performing a major design role, and also holding 5 percent of the equity, BAI had a managing agency agreement with the Mumias Sugar Company. This, along with the contract to supply the sugar factory, was Booker's principal motivation for involvement in the scheme. Indeed, the company had reservations about investment in the project because of the tight control over the Kenyan sugar industry exercised by the government. Both cane and sugar prices are officially set and so BAI did not feel that the project's risks were akin to those of normal commercial undertakings. In spite of these reservations Booker provided 5 percent of the equity capital.

Under the terms of the managing agency agreement, BAI undertook, as executors of board policy, to develop the three major components of the scheme, the factory, the nucleus estate to provide about 20 percent to 25 percent of cane requirements, and the outgrowers' cane plots. They also agreed to manage the project until sufficient Kenyans were trained to take over. This is expected to occur in the mid 1980s (delayed because of the major expansion program begun in 1977) and is designed to increase capacity from 70,000 tons of sugar per year to 180,000 tons.

BAI's remuneration structure consists of three parts:

1. a relatively small fixed fee intended to cover the general manager's salary and BAI's relevant overheads (Other BAI staff were seconded at cost to the project). This fee is indexed to the U.K. retail price index and is paid to BAI quarterly.)
2. a production commission on net MSC revenues (i.e., sales of sugar to Kenya National Trading Corporation less government excise duty. This is arranged on a sliding scale to give BAI an incentive to maximize output. Commission rates are as shown in Table 6F-8. Obviously, when the project expansion comes on-stream and capacity increases to 180,000 tons annually, this formula will have to be adjusted.)

Table 6F-8. Commission Rates on Mumias Sugar Company Revenues

Annual Output	*Percent of Commission on Net Revenues*
Less than 45,000 metric tons	0.0
45,000 to 50,000	0.5
50,000 to 55,000	1.5
55,000 to 60,000	3.0
60,000 to 65,000	4.0
More than 65,000	5.0

Source: Company records of Booker Agriculture International Ltd.

3. two and one-half percent of net profits of the Mumias Sugar Company. (This provides BAI an incentive to operate the project as efficiently as possible.)

Because of the way the remuneration package is structured and also because of the fact that Kenya is insulated from the world sugar market, BAI's earnings from its services rendered to the Mumias Sugar Company are not affected by fluctuations in world sugar prices. Also, because MSC is obliged to sell all its output to the Kenya National Trading Corporation at a price fixed by the government (and KNTC is obliged also to buy all of MSC's production), BAI's earnings are not exposed to any market risks. While this is not an important factor at present, when demand exceeds domestic supply to such an extent, the goal of Kenyan self-sufficiency implies that in some years in the future, as output fluctuates, there will be a surplus for which export markets will have to be found. Thus, BAI's contract with MSC is designed to maximize rewards for good management performance.

The quality of management is of critical importance in this type of scheme. Innovations in project structure are increasingly the norm. Many other management skills are required in addition to those usually associated with running sugar factories, such as the ability to communicate effectively across cultures and at all levels with host country nationals. In addition, agricultural development projects are often situated in remote areas where decisions often have to be made without reference to head office. However, management is an area over which BAI has substantial control.

The risks of weather, crop disease, and pests have always been associated with agricultural projects. None of the Mumias scheme is irrigated so there is no protection against drought, but good management, seed selection, proper timing of crop operations, proper weed control, and insecticide spraying can minimize other agronomic hazards. This area of risk is shared between those providing equity capital for the scheme and those contributing management and technical services.

Any private company's operations in any country are to some extent open to the unfavorable effects of changes in policy or administration regulations by the host government. BAI has minimized these risks not only by entering into a partnership with the Kenya government but also by sharing common economic and developmental goals with it in such a way that both company and government are rewarded if objectives are successfully achieved. The Kenya government, however, still has the power to fix cane and sugar prices and there are pressures acting upon it to narrow the margin between the two in order to increase farmers' incomes on the one hand and to hold down retail price inflation for consumers on the other. BAI'S defenses against this are, ultimately, only informal. The company recognizes this and has not insisted on contractual undertakings by the government which would be both ineffectual and antagonistic. Apart from the government's recognition of the advisability of keeping retail

sugar prices and cane farmer incomes in line with movements in the rest of the economy, BAI's other defense against arbitrary price regulation is the structure of the sugar industry itself. Unlike Zambia or Tanzania, for example, where operational control is centralized, decisionmaking in the Kenya sugar industry is divided among the production units each of which organized as a separate company. Thus, if government guidelines for the industry became unduly restrictive, or detrimental to its long-term health, a vigorous lobbying effort can be expected from the other companies as well as from Mumias.

BAI is, however, also vulnerable to other aspects of government activity. Project operating efficiency could be jeopardized by curtailment of permission to import factory spare parts, for example. The company and the government could disagree over the rate of Kenyanization. Again, BAI's ultimate defense against this risk is the strength of its relationship, through the board of the Mumias Sugar Company, with the government, and the confidence the government has in its integrity and technical and managerial competence.

The Mumias Sugar Company Nucleus Estate and Factory. The land for the factory, nucleus estate, offices, houses for management, laboratories, and nurseries amounts to about 4,400 hectares. About one-third of this land consists of low lying, poorly drainced, little used soils situated near the river. The rest is more fertile, upland soil. The company chose to include the less fertile soil in the nucleus estate area despite the higher costs of developing and cultivating it because it meant displacing fewer people. However part of the estate also had to be of the upland soil type because the waterlogged riparian land could not be cultivated or harvested during wet weather. Without the mix of soil types, field machinery could not have been used throughout the year and a regular supply of cane to the factory would not have been possible.

Acquisition of the necessary land was carried out between 1968 and 1972 by the government through compulsory purchase at preproject market rates. There were only a few isolated instances where compulsion was, in fact, necessary. The government then leased the land to the Mumias Sugar Company. About one thousand families were displaced by the project. Unfortunately, neither the government nor the company kept a record of what happened to these people, but in 1974 A.H. Barclay, Jr., traced a sample of about three hundred of them and discovered that the great majority had found and paid for new plots of land within fifteen miles of their former homes. Only 8.8 percent of the sample, thirty-one persons, did not buy land with their compensation payment. Five of these already owned other land to which they returned. The remaining twenty-six were made up as follows:[3]

- Six were living in Tanzania at the time of the trace.
- Three were living in Uganda at the time of the trace.

- Three were unmarried sons whose father had bought land and settled with them.
- Four were older men who had given their compensation to married sons and were living with them.
- Six were living with relatives.
- Two had been living in town for many years and relatives had claimed their compensation.
- One (a mechanic) had bought a business plot rather than a farm.
- One was said to have gone mad and wandered off.

Thus, unlike other Kenyan land acquisition programs, in the Mumias situation there was very little opposition to the government purchases and almost all displaced people were settled satisfactorily within a short time. Barclay suggests that the reasons for this were the strongly hierarchical nature of the local social structure, which caused people to accept without question the government's right to eminent domain, and the ready availability of other land in the region.

In addition to compensation for land, crops, and dwellings, those people displaced were also given first priority in labor recruitment by MSC.

Development of the nucleus estate started in 1971 and by 1976 was completed (see Table 6F-9). As can be seen from the rate of expansion of the cane cultivation area, growth was rapid over the first three years. This was to enable factory production to attain an economic level of operation as quickly as possible while also allowing plenty of time to expand the area planted by outgrowers and overcome any unexpected problems.

The factory was designed supplied, and constructed by Fletcher and Stewart, a subsidiary of Booker McConnell. Initial capacity was 80 tons of cane per hour with some provision for expansion to 125 tons. Capacity was increased to 125 tons of cane per hour during 1975-76. This is separate from the larger expansion going on at present. Tables 6F-10 and 6F-11 show the sources of cane supply and output of sugar for the period 1973-78. Pan boiling, a critical and highly skilled operation, was made easier by the incorporation of semi-automatic controls. This meant that good results could be obtained even with the relatively inexperienced Kenyan operators.

Table 6F-9. Rate of Development of Mumias Nucleus Estate: 1971-76

Year	*Hectares*
1971	993
1972	2,224
1973	2,844
1974	3,209
1975	3,324
1976	3,376 (development completed)

Source: Mumias Sugar Company records.

The Outgrowers' Scheme. The use of small farmers as producers of cane under contract to MSC is intended to provide cash incomes for as many people as possible in the Mumias community, thus spreading the benefits of development and encouraging the setting up of other businesses in the region. Because the level of capacity utilization is a critical factor in the economics of operating a sugar factory and because cane must be processed as soon as it is cut, managing a conventional sugar project is complex. The essential balance between cane supply and factory capacity is most easily achieved by having a single large estate managed by the same team as that running the factory. Using outgrowers is, therefore, a hazardous undertaking. For example, the outgrowers' schemes at both Chemilil and Muhoroni have encountered severe difficulties that have resulted in financial losses.

The Mumias project was even more ambitious from a management point of view than either Chemilil or Muhoroni because the outgrowers were made up of literally thousands of small farmers who lacked any previous cash crop experience. At the Nyanza projects suppliers were either large farmers or cooperatives.

Table 6F-10. Booker Agriculture International, Ltd.: Sources of Cane Supply, 1973-78

	Outgrowers		*Nucleus Estate*		*Noncontract*		
Year	*(tons)*	*(per-cent)*	*(tons)*	*(per-cent)*	*(tons)*	*(per-cent)*	*Total (tons)*
1973[a]	82,667	42.6	110,691	57.0	859	0.4	194,217
1974	223,146	46.2	242,376	50.1	17,862	3.7	483,384
1975	275,906	53.8	213,997	41.7	23,251	4.5	513,154
1976	366,112	66.8	170,232	31.1	11,592	2.1	547,936
1977	495,354	71.1	195,591	28.1	5,856	0.8	696,801
1978[b]	580,000	76.3	172,000	22.6	8,130	1.1	760,130

[a]One-half year.
[b]Budget.
Source: Mumias Sugar Company records.

Table 6F-11. Mumias Sugar Production: 1973-78

Year	*Metric Tons*
1973[a]	20,891
1974	55,700
1975	59,207
1976	63,699
1977	81,275
1978[b]	87,500

[a]One-half year.
[b]Budget.
Source: Mumias Sugar Company records.

During the pilot project phase cane-growing experiments were conducted on plots throughout the outgrowers area that surrounds the nucleus estate and factory. These established the optimum varieties and cultivation methods to be used on the slightly different conditions prevailing on the outgrowers' farms. They also demonstrated the value and effects of good husbandry to the local farming community. As the outgrowers' farms are small and as it was considered socially desirable to use no more than 50 percent of their area for sugar cane (so that the traditional pattern of subsistence farming could continue relatively undisturbed and food supplies thus be maintained) the company grouped together individual's cane plots to make stands of cane no smaller than 15 acres. In this way machines could be used economically for the deep plowing and other heavy land preparation work, and cane transportation costs could also be kept down. However, the design of the project meant that for a farmer to be able to participate in the outgrowers' scheme at all, not only did his land have to be suitable but his neighbors had to agree to join the scheme and also have suitable land so that a plot of sufficient size could be formed. Table 6F-12 shows the rate of development of the outgrowers' scheme. As the area under outgrowers' cane increased, the proportion of cane coming from the nucleus estate dropped from over 50 percent to 28 percent. This percentage will drop even further in the future, especially when the present expansion is completed.

The way in which the outgrowers' scheme was developed also took potential social effects into consideration. The cheapest method would have been to open up the area one section at a time to keep down transport costs and maximize the use of equipment. However, it was felt that such a procedure could have been interpreted as favoring certain districts and might have led to social tension. Therefore, farmers were incorporated into the scheme evenly throughout the outgrowers' area.

After plots are identified and surveyed the land is cleared by the farmer. MSC then plows, harrows, and furrows the land using tractors. Disease-free planting material and fertilizer are then sold on credit to the farmer. Each

Table 6F-12. Rate of Development of Mumias Sugar Company Outgrowers Scheme: 1971-77

Year	*Hectares*
1971	836
1972	2,276
1973	3,906
1974	5,551
1975	7,794
1976	10,027
1977	14,500

Source: Mumias Sugar Company records.

farmer is responsible for his own planting, weeding, and fertilizing. The company has an outgrower management organization (see Figure 6F-3), which includes an extension capacity. Company representatives visit the plots regularly to advise farmers. If cultivation is not being done properly the company has the right to perform the necessary work and charge the farmer for it. Occasionally a farmer chooses to have weeding and other tasks performed for him by MSC.

Harvesting is carried out by the company. This control is essential to maintain the necessary regular volume of cane flow to the factory. However, the farmer may, if he wishes, make his own arrangements for the timely delivery of his cane to the factory; in practice, the farmers have all elected to use company equipment.

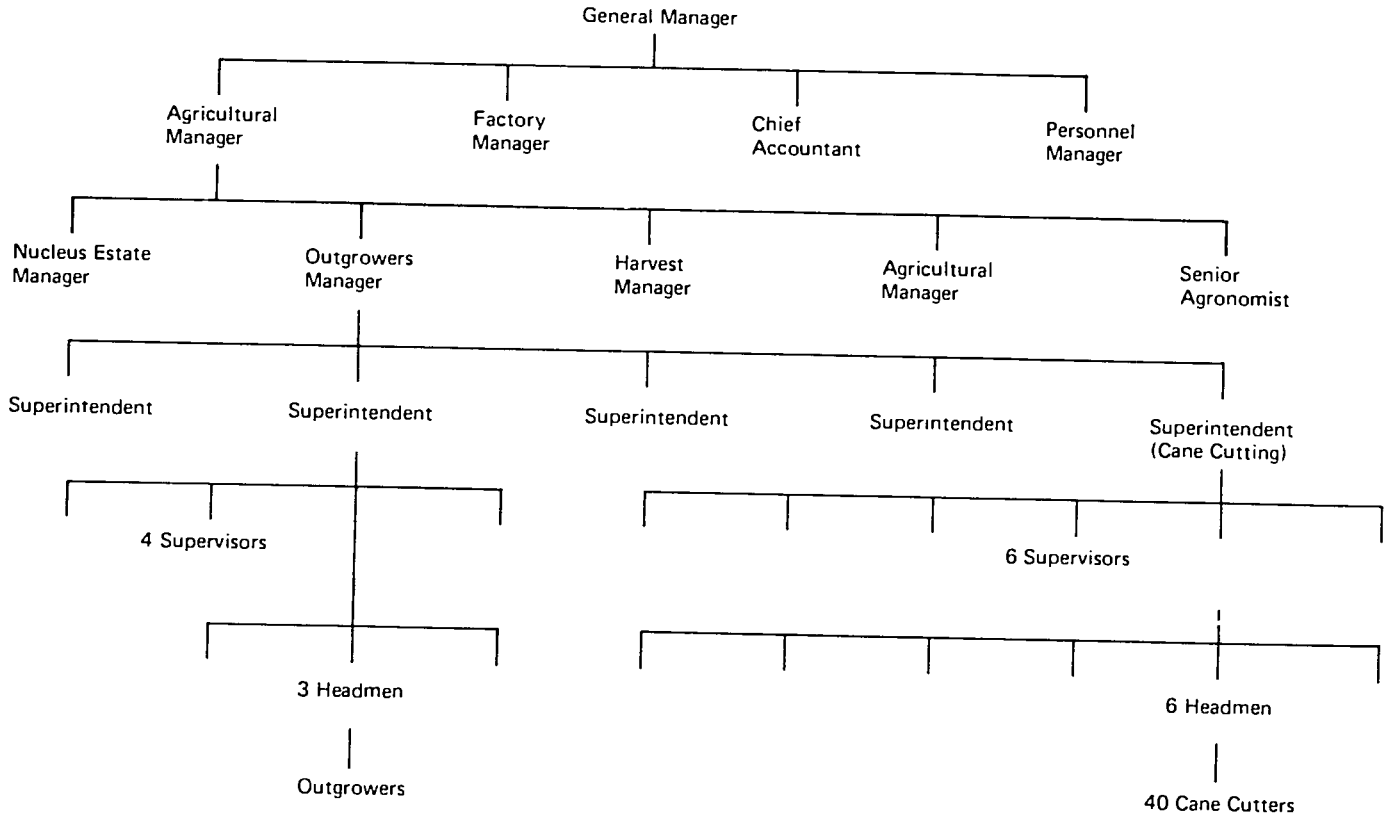
All cane, whether on the nucleus estate or on outgrowers' farms, is cut by hand. This provides more employment than orthodox mechanized methods. MSC maintains a cane-cutter register of about one thousand people to harvest outgrower cane. There is considerable turnover of workers (especially as the work area shifts constantly throughout the outgrower area) and no excess of supply. This means that work is usually available for anyone who wants it. The cane is loaded and transported to the factory mechanically.

The relationship between MSC and individual outgrowers is governed by a contract. The discipline imposed on the farmer is quite rigid. The company insists, for example, on retaining the right to decide when replanting should take place (sugar cane is a perennial but with declining yields each year), which cane variety should be used, the amount and type of fertilizer (although actual application is impossible to check and some leakage on to other crops is suspected), to weed if the farmer does not do this satisfactorily, to harvest the cane, and to arrange for transport to the factory if the farmer does not deliver. These controls are essential, BAI managers argue, if the outgrowers' scheme is to be successful. A major reason for the discipline is not the unreliability of the farmers but the lack of agronomic and technical leeway in the whole sugar production process. Fewer controls would be needed, it is felt, if another crop were being cultivated.

The outgrowers' scheme has been a success. Productivity is only slightly lower than on the nucleus estate. Recent figures are 4.8 tons per hectare per month on the average from outgrowers and 6.1 tons per hectare per month on the estate. The trend is for this gap to close as outgrower cultivation standards continue to improve.

At the end of 1975 the Mumias Outgrowers Company (MOC) was formed. (Both MSC and the Kenya government wished to regularize the outgrowers' situation). The principal objectives of MOC are:[4]

1. to promote and represent the growers of sugar cane supplied to MSC who become members
2. to negotiate on their behalf
3. to provide financial credits for the production of cane



Source: "The Mumias Outgrower Scheme: Visit by C-M Pang in March 1977," Booker Agriculture International internal report, September 1977. Reproduced with permission.

Figure 6F-3. Booker Agriculture International, Ltd.: Outgrowers' Management Structure

4. to provide or procure advice and services and to enter into agreements with MSC
5. to purchase supplies
6. to borrow, lend, and give guarantees for money in connection with cane growing
7. to remunerate for services and to pay out funds for expenses
8. to establish provident funds and associations to benefit members.

Funding for MOC has been provided by the Commonwealth Development Corporation (CDC) and the Kenya government. There are two classes of members of the new company:

1. founder members who comprise the Kenya government, MSC, and the Commonwealth Development Corporation—for as long as CDC's loan is outstanding (Each founder member has 10,000 votes.)
2. grower members (Each outgrower has one vote regardless of the size of his farm. At the end of October 1975, 5,000 farmers had signed contracts with MSC. The expansion project, due to be completed in 1979, will mean that the number of outgrowers will increase to 16,000.)

The Board of MOC is made up as follows:

- four grower directors, elected biannually from the four parts of the outgrowers' area
- three government directors
- one CDC director
- one MSC director.

MOC has begun operations. While MSC continues to control actual cultivation and cane transport operations, MOC concerns itself with farmers' accounts and credits; investigation of farmers' complaints and negotiations between farmers and MSC if required; and publicity aimed at improving outgrower performance.

Individual BAI managers who have worked at Mumias have suggested privately that MOC might be a suitable vehicle for the transmission of sugar cane cultivation skills to traditional crops. Some concern has been expressed at the failure of local production to respond to the increased demand for food caused by the increase in nonfarm employment (about twenty-five hundred new jobs created) and money incomes in the area.

Results of the Mumias Sugar Company Operations. Tables 6F-13 and 6F-14 show the excellent financial record of MSC since its inception in mid 1973. Although it was assumed that there would be an initial period of losses, the company was profitable in the first six months of operation. This was due to higher

Table 6F-13. Mumias Sugar Company Profit and Loss Accounts: 1973-76 (Kenya pounds)

	1973 (Six Months Ending 31 December 1973)	*1974*	*1975*	*1976*	*1977*
Net profit before tax	153,092	751,227	1,291,200	1,701,785	3,019,000
After charging					
Depreciation	211,861	443,463	651,181	741,938	1,114,000
Auditors fees	1,600	4,342	3,632	5,273	[a]
Interest on:					
Loans	28,125	56,250	56,250	17,173	419,000[b]
Overdraft	31,616	43,314	38,647	109,564	
Amortization of preoperating expenses	30,150	60,300	60,000	60,000	60,000
Provision for stores and exchange losses	–	–	–	–	58,000
Finance charges relating to expansion to 156,000 tons per year					
Less tax	0	0	0	295,483	–
	0	0	111,420	605,000	1,330,000
Net profit after tax	153,092	751,227	1,179,780	1,096,785	1,689,000
Add: Balance brought forward from previous year	0	25,153	417,380	1,017,160	1,823,945
		765,380	1,597,160	2,113,945	3,512,945
Deduct: Balance of preliminary expenses written off	11,939	11,000	0	0	0
	141,153	765,380			
Deduct: proposed dividend	116,000	348,000	580,000	290,000	1,279,000
Balance of unappropriated profits carried forward	25,153	417,380	1,017,160	1,823,945	2,233,945

[a] Already charged.

[b] All interest and finance charges including those relating to the expansion of production to 156,000 tons sugar per year.

Source: Mumias Sugar Company records.

Table 6F-14. Mumias Sugar Company Balance Sheets: 1973-77, Plus Notes to 1976 Accounts (Kenyan pounds)

	31 December 1973	*31 December 1974*	*31 December 1975*	*31 December 1976*	*Notes to 1976 Accounts*	*31 December 1977*
Fixed assets	4,940,613	4,924,398	4,851,173	6,459,880	1	8,908,720
Capital works in progress	48,198	160,016	703,536	2,892,855		7,766,208
Preliminary expenses	11,000	–	–	–		–
Net deferred expenditure	572,845	520,501	442,884	445,745		332,545
	5,572,656	5,604,915	5,997,593	9,798,480		17,007,473
Current Assets						
Growing cane at valuation	135,349	266,465	452,578	523,185		596,848
Stocks and stores	354,754	707,986	1,249,664	1,634,927	2	1,624,975
Debtors, deposits, and prepayments	271,603	564,817	596,960	753,578		1,320,961
Recoverable from outgrowers	309,013	348,701	650,189	480,392		612,602
Cash	887	2,949	4,087	2,916		4,497
	1,071,606	1,890,918	2,953,478	3,394,998		4,159,883
Less: Current liabilities and Provisions						
Creditors and accrued charges	459,377	681,798	967,879	1,449,085	6	1,886,175
Bank overdraft	907,541	631,209	688,916	472,082	3	a
Provision for tax	–	–	111,420	716,420	7	1,496,420
Declared and proposed dividends	116,000	464,000	928,000	870,000		959,438
	1,482,918	1,777,007	2,696,215	3,507,587		4,342,033
Net current (liabilities)/assets	(411,312)	113,911	257,263	(112,589)		(182,150)
Total net assets	5,161,344	5,718,826	6,254,856	9,685,891		16,825,323

(continued)

Table 6F-14 continued

	31 December 1973	*31 December 1974*	*31 December 1975*	*31 December 1976*	*Notes to 1976 Accounts*	*31 December 1977*
Representing:						
Share capital						
Shares of Kenyan shillings 20/each authorized	3,500,000	3,500,000	3,500,000	10,000,000		10,000,000
Issued and fully paid	2,900,000	2,900,000	2,900,000	2,900,000		8,450,000
Profit and loss account	25,153	417,380	1,017,160	1,823,945		(213,645)[a] 1,104,394
	2,925,153	3,317,380	3,917,160	4,723,945		9,554,394
Loans and advances	2,236,191	2,401,446	2,337,696	4,961,946	4	7,484,574
Capital employed	5,161,344	5,718,826	6,254,856	9,685,891		16,825,323

[a]Bank overdraft.

Mumias Sugar Company Limited
Notes on and Forming Part of the Accounts for the Year Ended 31 December 1976 (Kenyan pounds)

Note 1: Fixed Assets
Fixed assets are included in the accounts at cost, less depreciation as shown below:

	At 1 January 1975	*Additions*	*Disposals*	*Transfers*	*Totals at 31 December 1976*
Cost					
Land development	227,626	20,958	–	–	248,584
Buildings:					
Industrial	137,256	46,594	–	–	183,850
Factory	908,463	142,440	–	–	1,050,903
Residential and welfare	906,211	300,200	(20,540)	–	1,185,871
Utilities	175,041	87,050	(1,886)	–	260,205

Plant and equipment					
Field	721,050	404,349	(19,583)	(668)	1,105,148
Factory	2,930,265	1,315,039	–	668	4,245,972
Vehicles	169,578	46,659	(10,553)	–	205,684
Office	36,031	8,950	(476)	–	44,505
Residential and welfare	37,179	7,210	–	–	44,389
Miscellaneous	22,972	456	–	–	23,428
	6,271,672	2,379,905	(53,038)	–	8,598,539
Depreciation					
Land development	17,160	11,047	–	–	28,207
Buildings:					
Industrial	17,155	12,569	–	–	29,724
Factory	85,990	48,770	–	–	134,760
Residential and welfare	142,465	79,476	(5,328)	–	216,613
Utilities	20,634	16,124	(354)	–	36,404
Plant and Equipment					
Field	398,063	205,902	(11,587)	(1,238)	591,140
Factory	614,399	296,770	–	1,238	912,407
Vehicles	83,348	45,534	(6,235)	–	122,647
Office	15,875	10,111	(274)	–	25,712
Residential and welfare	17,845	9,320	–	–	27,165
Miscellaneous	7,565	6,315	–	–	13,880
	1,420,499	741,938	(23,778)	–	2,138,659
Net book value	4,851,173				6,459,880

Note 2: Stocks and Stores

Stocks and Stores have been valued as follows:

	Kenyan Pounds
Stores stock–at cost, less provision for deficiencies	1,226,363
Goods in transit–at cost to date	30,365
Sugar in process–at part net realizable value	30,993
Sugar–at net realizable value	255,392
Molasses–at net realizable value (Note 9)	90,232
Unmilled cane–at cost	1,582
	1,634,927

(continued)

Table 6F-14 continued

Note 3: Bank Overdraft
The bank overdraft with Kenya Commercial Bank, Limited, is secured by way of a debenture over the company's assets and uncalled capital, but the debenture to secure the overdraft with Barclays Bank International, Ltd., was in course of preparation at 31 December 1976 and was not effective at that date.

Note 4: Loans and Advances
The loans and advances are made up as follows:

	Kenyan Pounds
(1) Government of Kenya	
Advances	1,710,846
United Kingdom/Kenya Loan–1970[a]	2,453,100
	4,163,946
Less: Converted into shares	2,000,000
Balance converted into soft loan	2,163,946
Add: Accrual for interest capitalized	225,000
	2,388,946
Loan to assist with the financing of the expansion to 156,000 tons sugar per year	1,000,000
	3,388,946
(2) Loan from Kenya Commercial Bank, Ltd., to assist with the financing of the expansion to 156,000 tons sugar per year	1,000,000
(3) Commonwealth Development Corporation–loan of Stg Kenyan pounds 800,000 (secured)[b]	568,000
(4) Bookers Agricultural and Technical Services Limited–loan	5,000
	4,961,946

Note 5: Contingent Liabilities
There are contingent liabilities in respect of guarantees given by the company to the bank for advances to company employees amounting to approximately K£25,428.

Note 6: Foreign Currency
Current liabilities have been converted at rates ruling at the date of the balance sheet.

Note 7: Taxation
The company's unused tax allowances for capital expenditure are again exceeded by the profits for the year adjusted for tax purposes. In consequence, a charge to tax arises on the balance, which has been taken at the ruling rate of 45 percent in order to compute the estimated tax liability.

Note 8: Lease of Agricultural Land
The company has the beneficial occupation of approximately 7,800 acres of agricultural land without a lease document, which is still under preparation by the government of Kenya.

Note 9: Molasses
A change in the basis of accounting for stock of molasses had resulted in an increase in that valuation as at 31 December 1976 of K£19,250, with a corresponding increase in the profit.

Note 10: Interest
A change in the basis of accounting on interest earned on advances to outgrowers but not charged to them at the balance sheet date has resulted in an increase in interest receivable of K£92,794, and a corresponding increase in the profit.

Note 11: Future Capital Expenditure
At the date of the balance sheet, the company had outstanding capital commitments of K£19,041,766 of which K£18,992,900 related to the expansion to 156,000 tons sugar per year.

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[a]The U.K./Kenya loan 1970 of K£2,453,100 is made up of payments made by the Crown Agents in sterling in the United Kingdom against invoices of Fletcher and Stewart Limited relating to construction of the factory, converted at the midmarket exchange rates ruling at the time of payment of each invoice. The amount has still to be agreed with the government of Kenya.

[b]The loan from Commonwealth Development Corporation has been converted into Kenya pounds at the exchange rate prevailing at 31 December 1976 (see Note 6). A provision of K£20,920 has been made against the loss on exchange.

K£ = $1.40 U.S. = 0.77 sterling

Source: Mumias Sugar Company records.

cane yields, higher factory capacity utilization, and lower costs than had been forecast. Similarly, the social cost-benefit analysis has been very much more favorable than anticipated, mainly because of the boom in world sugar prices during the early years of the project. If output is valued at the year's average New York market price, deflated to 1970 prices, then it was K£ 1.17 million in 1973, K£ 11.57 million in 1974, and K£ 4.30 million in 1975.[5] By the end of 1974, a mere eighteen months after production began, the project, based on the opportunity value of sugar at world price levels, had completely paid for itself.

Table 6F-10 shows the output record of the Mumias scheme. Production has quickly risen to provide approximately one-third of the total domestic sugar output. BAI management estimate that Mumias has the lowest production costs of any sugar project in East or West Africa.

At the regional level the project has had a considerable impact. Over 2,500 jobs have been created directly and 6,000 farmers are now receiving cash incomes (both these figures will increase considerably when the expansion scheme is complete). While objections have been made that the opportunity cost of farmer labor was valued at zero in the economic cost-benefit analysis thus overstating farmer rewards, nonetheless the real benefits accruing to this group cannot be overlooked. The keen competition to obtain registration as cane suppliers attests to the fact that farmers value participation in the outgrowers' scheme highly. The indirect economic effects are even more widespread than the direct benefits, spreading the project's impact throughout a population that before 1973 was among the poorest and most disadvantaged in the country.

Within the company, employees have benefited considerably from the training programs. Because skilled labor for upgrading was recruited throughout the country these benefits have not been confined to the Mumias region. Nineteen skilled sugar technicians were brought by BAI from Guyana to assist with training. There are three main training programs. A general apprenticeship scheme for a wide variety of trades was set up based upon Kenyan national standards. Both European and Guyanese expatriates were involved in teaching. The Guyanese also played a major role in training factory process workers. For this, special facilities were built at the Chemilil factory. School certificate holders (high school graduates) received ten to twelve months of formal training followed by one to two years working alongside the Guyanese in the new Mumias factory. The third trainee category was for graduates for management positions. A two-year formal program was designed specially for these employees to be followed by junior and understudy positions. Kenyanization targets set in 1973 have all been met so far—and in many cases ahead of schedule, despite the burden of the major expansion. Early in 1978, out of a total complement of approximately 2,500 employees, of whom 175 held supervisory and management positions, only 9 expatriates would have remained but for the project expansion. There are, at present, over 50 Kenyan managerial staff and 26 expatriate staff. A recent report on Kenyanization by the Kenyan Personnel and Training Manager summed up the situation as follows:

> On the agricultural side of the business, the field in which the company has been operating longest and where there has been a plentiful supply of qualified people, progress in Kenyanization has been excellent. All have been Kenyanized with the exception of the most senior position of Agricultural Manager and managerial posts in the workshops. In the commercial areas, namely those of Personnel and Accounts, reasonable progress is being made with the development of local people. In the factory all operator and supervisory positions are occupied by Kenyans. This reflects great credit on the young Kenyans who have succeeded to these jobs ahead of the planned time schedule. The first and second successful products of the management trainees' scheme have been or are about to be appointed to managerial positions.

Other institutional benefits resulting from the project have been the Mumias Outgrowers Company, described earlier, and a local branch of the Kenya Union of Sugar Plantation Workers. Both of these not only provide valuable experience for their members in the operation of such organizations but may also offer conduits for the entry into the Mumias community of other forces of modernization.

One anticipated result of the project's success has not occurred. The jaggery factories are still operating and still supplying the raw material for the manufacture of illicit spirits. Because of the MSC's refusal to involve itself with very small plots of sugar cane, with low-quality cane, or with poor cane varieties, the pre-project cane cultivation for sale to the jaggery factories has continued largely unaffected. MSC's quality standards have, in effect, created two separate markets for sugar cane.

Potential Concerns of the Project. There have been four main areas of potential concern raised about the project:

Initial Land Acquisition Procedure. Some critics have suggested that the emphasis during the process of acquiring land for the nucleus estate, factory, and other buildings and facilities, was solely on peaceful compliance by the population. No thought was given to what the displaced people would do and nothing was done to assist them in resettling elsewhere. The fact that no official record was kept as to what happened to the one thousand displaced families lends credence to this criticism. However, if Barclay's sample survey of approximately 30 percent of those affected by the land acquisition program accurately reflects the experience of all then only a very few people did not find and purchase land within fifteen miles of their original farms. Those who did not also invariably had a sensible reason for not doing so. Barclay remarks, however, on the feeling prevalent in the Mumias area, which differed from the results of his survey.[6]

> The collective fate of the displaced group was not formally documented . . . . Their current residence, landholding status, and expenditure of com-

> pensation money were matters for rumor and speculation. Informants tended to cite a small number of cases involving well-known individuals in the group, who were said to have squandered all their [compensation] money on such things as "drinks, raha [i.e., self-indulgence], women, and unnecessary journeys."
>
> There was general agreement that most of those who had been required to move were now without any land of their own: they were said to be staying "temporarily" on relatives' land; to be living in company housing camps; or to have gone to look for work in the towns . . . . I suspected, however, that the behavior of those who had bought land and resumed farming activities would have attracted much less public notice and comment than the flamboyant hedonism of a few notorious individuals.

It would seem, therefore, that the displaced population did fare quite well but that this was not due to any official planning or assistance.

Appropriate Technology. In their book "Aid and Inequality in Kenya, (London, Croom Helm, 1976), Holthan and Hazlewood argue that the jaggery manufacturing process can be adapted to produce palatable sugar. A series of small cheap plants could then have been constructed instead of the one large expensive factory at Mumias. Not only would this have been cheaper, it is claimed, but more employment would have been created, and the jobs (and the profits too) would have been spread through a much wider geographical area.

Using figures supplied by a Ghanaian consulting firm, Holthan and Hazlewood suggest that the smaller plants would require K£60 investment for each ton of annual sugar output while the cost of the Mumias factory is K£100 per ton per year. At Mumias the capital per job created is K£2,000 approximately while at the smaller plant only K£630 need be invested per job. Holthan and Hazlewood, therefore, argue that for the cost of the Mumias factory Kenya could have had more than fifty of the smaller plants, which would have produced 1½ times as much sugar as Mumias and have employed nearly three times as many people (of whom fewer would have had to have been skilled)

However, Holthan and Hazlewood do not wholeheartedly advocate the building of the smaller plants. They have a number of doubts. For example, the operating efficiency of the small factories would be much less than a modern facility. (Thirteen to 14 tons of cane would be required to produce 1 ton of sugar as opposed to the 8 to 9 tons of cane needed by Mumias.) Apart from the considerable increase in operating costs that this would mean, the amount of land devoted to sugar cane cultivation would have to be increased by 50 percent. While the Mumias scheme has not curtailed the production of traditional crops by expropriating land, in Kenya, in general, there is a shortage of cultivable land.

Also, the smaller plants would require more imported fuel than Mumias, which uses bagasse (cane after crushing) to run its boilers. Excise duty collection would be more difficult with a large number of scattered plants. The Mumias

factory offers more opportunities for creating industrial skills applicable outside the sugar industry.

There are two other major objections to the alternative technology suggested, which may be more convincing reasons why such factories have not already sprung into existence given their apparent advantages. The quality of the sugar produced is low and would probably encounter much consumer resistance even if sold at a discount (which would, in turn, adversely affect the economics of the idea). Holthan and Hazlewood themselves make this point earlier in their book:[7]

> Sugar is a very important consumer good in Kenya. Variations in its price, color, and texture arouse strong feelings among the Kenyan public . . . . Subsidization is based on its political importance rather than its dietary attributes.

The second objection is the complexity of the management task. Many commentators appear to underestimate the difficulty of creating efficient conventional sugar projects using outgrowers. The manifold problems of Chemilil and Muhoroni are clear evidence that even with skilled and experienced management there are plenty of things that can go wrong. The organization of the large number of Mumias outgrowers was, in itself, sufficiently novel and risky for some of the side effects of the project to be overlooked or ignored as management grappled with unfamiliar problems. If to this had been added the technological innovation of building, manning, and operating more than fifty small-scale factories scattered over a wide area it is quite probable that the whole scheme might have ended in failure. This, of course, is not to say that some sort of move in this direction may not be a possibility to be considered in the future, when more is known about the problems of managing diversified small-scale cane production.

Social Effects. Although jobs and cash incomes for farmers have been created, critics of Mumias have pointed to the growth of unproductive consumption and economic inequality among farmers and to the failure to transmit the modern cultivation techniques acquired with sugar to traditional farming. Unfortunately, as with the case of the displaced farmers, hard evidence concerning these possible effects is almost nonexistent. It would not be surprising if some, or indeed many, farmers, upon receiving lump sums of cash for their sugar crops larger than they had ever experienced in their lives before, did not succumb to the temptation to spend at least some of it on luxury consumption. As time passes and the farmers become more accustomed to this abrupt increase in their disposable income, it would again be natural to expect more careful, planned spending to occur. What is certainly true is that no official effort has been made to help farmers cope with this radical change in their economic circumstances or to find out what, in fact, happened.

Barclay collected data on the spending patterns of eighty-eight outgrowers

during his stay in the Mumias area in 1974-75. This information would probably relate to the first and second cane crops only. Table 6F-15 summarizes Barclay's findings. From these it would appear that the favorite items of expenditure were food, clothing, and school fees. Very little seems to have been spent on farm improvement (except for the purchase of cattle—really a form of saving and a source of enhanced prestige in the community) or on buying new land. While this latter evidence does not support the suggestion that outgrowers are buying up their less fortunate neighbors' land thereby increasing inequality in the community, neither does it point to the productive use of income from the early crops.

If unproductive consumption has occurred it would be difficult to curtail it without unduly curbing the individual freedom of the farmers. Also, by definition, if economic development takes place in an area and the opportunities and rewards depend on individual initiative and work, then some inequality will be produced. However, the opportunity to participate in the outgrower's scheme is, in a number of instances, fortuitous. A farmer's soil type might not be suitable or his neighbors might be unwilling or unable to join him to make up a large

Table 6F-15. Levels of Expenditure in Various Categories by a Sample of Eighty-eight Outgrowers (percentage)

		Reported Expenditure			
Category	*No Expenditure*	*Kenyan Shillings 1-250*	*Kenyan Shillings 251-500*	*Kenyan Shillings 501-1000*	*Over Kenyan Shillings 1000*
Food	26.1	30.7	17.0	20.4	5.7
Clothing	17.0	27.3	28.4	22.7	4.5
School fees	33.0	36.4	13.6	9.1	8.0
Improved house	88.6	1.1	1.1	2.3	6.8
Buying new land	95.5	n.a.	1.1	n.a.	3.4
Farm improvement	92.0	4.5	2.3	1.1	n.a.
Livestock	55.7	2.3	17.0	13.6	11.4
Paying bridewealth	79.5	2.3	4.5	8.0	5.7
Repaying debts	80.7	3.4	3.4	9.1	3.4
Ritual: funerals, *Emisango*, etc.	86.4	3.4	6.8	2.3	1.1
Gifts to relatives	68.2	18.2	5.7	5.7	2.3
Trade or business	90.9	n.a.	n.a.	6.8	2.3
Consumer goods: bicycle, bed, radio, etc.	81.8	4.5	10.2	3.4	n.a.

(Note: Kenyan shillings 20.00 equals K£1.00 equals U.S. $1.40 approximately.)

Source: A.H. Barclay, Jr., "The Mumias Sugar Project: A Study in Rural Development in Western Kenya," Doctoral Thesis (n.p.) Columbia University, 1977, p. 247. Reproduced with permission.

enough plot. In this situation economic opportunity is unrelated to farmer ability or initiative.

The solution to this problem might be to enable those farmers, unable to grow cane for MSC, to cultivate traditional food crops more efficiently, thereby taking advantage of the increased demand for food in the locality. However, because of the lack of official stimulation to upgrade traditional farming methods food production may not have been able to benefit commensurately.

BAI management acknowledge that most of their efforts and those of the government have been concentrated on making the sugar scheme work. They concede that the presence of government extension personnel or community development officers could have enhanced social benefits. However, they point out that, seen from Nairobi, the Mumias region is already receiving plenty of attention and that scarce government resources should be used in other parts of the country that are not in a position to benefit from a large-scale agricultural development project.

Company Control of Farmer Activities. The fourth concern raised is that the organization of the project does not give sufficient freedom to the farmer—that he is, in fact, little more than a hired hand of MSC. There is no doubt, as discussed earlier, that the discipline imposed on the outgrowers is considerable. However, it has been argued that this is not done merely to make life easier for company management. It is, rather, that sugar as a crop demands careful cultivation and timing, and that overall production and harvesting must be planned in detail to ensure the correct flow of cane to the factory. Certain functions, such as harvesting and cane transportation, may be carried out by the farmer if he wishes. A recent BAI report, for example, states that after three crops some farmers have earned enough money to buy small tractors and now do their own plowing.[8] Thus, maximum freedom for outgrowers seems to be attempted, but within an overall framework of discipline imposed for agronomic and technical reasons. It should also be noted that only part of each farm may be used for sugar cane, leaving the outgrower free to use the rest as he wishes.

Review. In reviewing these areas of concern of the Mumias project it is important to consider not only how valid they may be but also who should be responsible for rectifying them. BAI management argue that they were contracted to set up a sugar project using labor-intensive methods where possible; they were not charged with broad rural development responsibilities. Also, as work proceeded and some of the less favorable side effects became apparent, BAI personnel felt it would be inappropriate to interfere. Already under fire for supposed paternalism and overcontrol, BAI management did not feel they ought (or had the right) to try to restrain any outgrowers who, for example, wished to spend their sugar earnings on beer.

However, while not being directly responsible for any lack in community

development BAI, nevertheless, by its very visibility in the running of the project and by its important contribution to its design, may be regarded as having a certain putative responsibility. This certainly is the attitude of the project's critics. It is, therefore, important for BAI management to consider whether their present hands-off policy is adequate, whether their response in the past should have been different, and whether their present and future policies ought to be adjusted. What, in fact, *can* a company in BAI's position do in this area?

Booker's Project Management Lessons. As Jonathan Taylor reviewed the origins and operation of the Mumias scheme and considered the relatively small number of criticisms directed at it, he felt well satisfied with its success. He recalled a special meeting of the Mumias management group during his last visit to Kenya in which he had attempted to identify the project management lessons emerging from the experience. The list developed at the meeting had been:

1. The project design should meet political and social as well as economic objectives of the client and, if different, the host Less Developed Country (LDC) government.
2. Each technical, agronomic, and organizational aspect of the project must be tested as work progresses.
3. Local farmers and community leaders must be involved in the project from the start. Much more local participation, explanation, and communication is required than in a comparable developed country project. A system of preproject trials is very useful in engendering local trust, understanding, and cooperation.
4. Close contact should be maintained with all involved agencies. Agreement should be obtained from each of them before work begins on critical stages of the project.
5. Training is a vital and integral component at all levels and at each stage of the project. There must be an agreed schedule for indigenization and sufficient trust of the management by the host government team for this schedule to be departed from in case it should be considered necessary.
6. The host government must be closely, continuously and discreetly involved in the formulation of policy. This is especially important in labor matters or when problems arise between different commercial groups in the project area.
7. Where possible all project participants should have economic incentives to perform their jobs to the maximum level of effectiveness.
8. The management team should, if possible, be a cohesive unit *before* the start of the project.
9. It is important to gauge the correct level of control and discipline needed to ensure that the outgrowers perform their role properly. Too little control, as at Muhoroni and Chemilil, will result in failures in the flow of cane

to the factory. Too much will be socially destructive. Mumias demonstrates that the necessary level of control for this type of project structure in the sugar industry *is* possible and can be accepted by the farmers.

10. An internal or external market for the project's output must exist, and at economic prices. BAI's remuneration package in the case of Mumias is structured, however, to be viable in conditions where managing a profitable operation is impossible.
11. Personnel procedures and systems, even relatively simple ones, must be rethought afresh for each project (although certain basic models can usually be adapted).

In considering this list of management lessons, the dominant general message that came through to Taylor was that the overall quality of management required was much higher than in the old days of Booker McConnell's operation in Guyana. The rough-and-ready methods of the colonial planter were very definitely no longer appropriate.

Booker's Strategy Lessons. Returning to Antony Haynes' original query, Taylor pondered on the strategy lessons both for BAI and for Booker McConnell as a whole. He was mindful of a recent conversation he had with Michael Caine, chief executive officer of the whole Booker organization, in which Caine had questioned the very role of the capitalist enterprise in developing countries where it seemed less and less possible to be a successful provider of capital. Taylor, however, felt that there remains an undoubted and important role for a company like BAI, especially when backed up by the resources of the rest of the Booker company. On a philosophic level he recalled the words he had used in a talk given at Oxford earlier in the year:

> I hope it does not sound unduly pompous to say that the future trade, stability, and perhaps peace of the world depends on satisfying the minimal needs and expectations of Third World countries and their teeming populations, where some 10,000 people die every day from malnutrition or its results. At best we may share an obligation to improve the circumstances of the less fortunate. At the lowest level, we must recognize that starving people make poor customers.

At an operational level, Taylor agreed that BAI's main contribution to less developed country agriculture was not finance—at least would not be during the current development phase experienced by many countries. Nor was BAI a purveyor of new technology. Agronomic technology is now mostly publicly available and processing technology is mature. The most important contribution which BAI can make, Taylor felt, is competent management. With this, BAI can supply suitable organization structures, both for projects and also to formalize

the company-government relationship; appropriate training systems during a period of efficient project administration; and, finally, marketing services, both to link projects with domestic and foreign markets and also to open up opportunities for the expansion of existing ventures and the identification of new ones. Taylor was, however, concerned that the lack of scope for large-scale investment makes this type of business activity unattractive to Booker McConnell. He wondered what he should do to demonstrate to the main board and its planning committee that BAI represents an optimum deployment of scarce management resources, and, having done so, he wondered, how BAI would train and develop staff for future projects like Mumias.

Conclusion

Clearly, Taylor felt, the Mumias sugar scheme has brought many economic and social benefits to both the Mumias region and to Kenya as a whole. In the process of designing and managing it BAI had learned many valuable lessons. Taylor wondered, however, what, if any, should be the company's response to the few weaknesses in the overall concept. BAI seemed to find itself in the paradoxical situation of being criticized on the one hand for excessive control over people's lives and yet on the other for not doing enough to prevent nonproductive expenditure of farmers' sugar receipts or to encourage more general agricultural improvement in the region. Was a policy of noninvolvement in social and community development affairs realistic or even possible; But could BAI take the initiative in these areas without increasing its already prominent role?

On the strategic level, it seemed clear to Taylor that a company must be strong in order to survive typical agronomic cycles and the peculiar risks of operating in less developed country (LDC) environments. However, does a company like BAI, as part of the larger Booker McConnell, provide a necessary bridge between the developed and developing food economies of the world? If so, what are the key elements to be drawn from the Mumias experience that will enable BAI to continue to play a leadership role within countries such as Kenya (and what might hamper this?) and to further its relationships with governmental, cooperative, and international development agency partners?

NOTES

1. Facts and figures on North Wanga Location memorandum by the Locational Agricultural Assistant, 21 April 1969. Agricultural Office files, Mumias. Quoted in A.H. Barclay, Jr., "The Mumias Sugar Project: A Study in Rural Development in Western Kenya," Doctoral Thesis (n.p.) Columbia University, 1977, p. 42.
2. Quoted in A.H. Barclay, Jr., ibid., p. 38.
3. Ibid., p. 176.
4. Booker's Agricultural and Technical Services, Ltd., Mumias Sugar Company Expansion Project Viability Report, December 1975, vol. 1, p. 53.

5. Quoted in G. Holthan and A. Hazlewood "Aid and Inequality in Kenya," London, Croom Helm, 1976, p. 152.

6. A.H. Barclay, Jr., "The Mumias Sugar Project," p. 147.

7. Gerald Holthan and Arthur Hazlewood "Aid and Inequality," pp. 146–7.

8. The Mumias Outgrowers' Scheme: Visit by C-M Pang in March 1977," (n.p.) Booker Agriculture International, Ltd., document, September 1977, p. 13.

APPENDIX G
MODELS OF THE U.S. CORN SYSTEM

Models of the U.S. corn system can provide useful insights into policy evaluation and decisionmaking. The quantitative implications and facility to experiment with alternative strategies without directly influencing the system are principal benefits of models. Of course, to achieve the potential benefits a decisionmaking orientation must be clearly established. In the context of the U.S. corn system, the decisionmaking orientation presumed here is U.S. government policy. The policies of interest that may be evaluated in the modeling context include: (1) trade policy, including export subsidies, export controls, concessional sales, import tariffs and quotas, and efforts to liberalize trade relations in corn; (2) foreign aid policy, especially corn exports at concessionary rates (Public Law 480); (3) stock-holding policies, which in the past had been operated under the Commodity Credit Corporation (CCC) and were closely linked to production-control policies; (4) production-control policies, which include price controls and acreage allotments. In addition to these policies, it is also valuable to evaluate the quantitative effects of environmental programs, pure food and drug programs, and antitrust activities that influence the economic performance of the system.

Storage policies are of particular concern to all participants in the system. Given the potential for extreme instability in the world corn system and the inability of less developed countries to hold sufficient buffer stocks for their own purposes, the burden for carrying a large portion of the world's corn stocks logically falls on the United States. To be sure, any model must recognize that any new storage program needs to be different than those used prior to 1972. It can no longer be solely concerned with market-insulating commodity supplies and protecting minimum prices. Instead, other considerations such as avoiding an upward spiral in prices resulting from stochastically generated export demand increments must be recognized. In modeling, the appropriate quantity of storage stocks can be statistically determined, be subject to precise rules under which stocks would be augmented or reduced, be announced prior to planting, and be insulated from politics. A secondary purpose of this policy is to protect producers during times of gluts and consumers in times of shortages. Under certain conditions, all the other policies listed above will also have some minor roles to play in achieving a more efficient coordination of the U.S. corn system.

In light of the policies that should be examined for the U.S. corn system, a rather comprehensive model representation of the system is required. The components of such a model are briefly examined in this appendix. Much of the discussion is related to the systems-analysis aspects of model construction and thus is closely related to the descriptive analysis of Chapter 4. The following pages advance the components of the comprehensive model of the U.S. corn system. Subsequent sections present an overview of previous modeling work on the U.S.

corn system, and investigates current efforts in modeling this system. In this latter section, most of the research efforts surveyed are ongoing and thus have not, as yet, been published. Our purpose is to indicate how these efforts might be combined to obtain a more useful representation of the system and what additional work needs to be done before a quantitative representation of the comprehensive model can be advanced. A final section presents some concluding remarks on the structure of a global or world corn model.

Modeling Components of the U.S. Corn System

Although the U.S. corn system is but one part of the world corn system, we shall concentrate on it. This emphasis is justified for a number of reasons: (1) even though U.S. corn acreage represents one-quarter of the total world's corn acreage, it produces almost one-half of the world's corn; (2) in 1972-73, the United States provided approximately two-thirds of the corn exported to world markets, and the year before it was a residual supplier of corn to world markets; and (3) the considerations in modeling the U.S. system are much the same as those that would be faced in developing models for other nations or regions. The qualitative factors affecting price, internal stability, conduct, and performance within the corn systems of countries throughout the world are qualitatively but certainly not quantitatively equivalent to those affecting these aspects of the U.S. system.

The Demand and Supply Structure. The commodity structure of corn has five major components: production inputs, production assembly, processing, distribution, and consumption. These components can also be represented in terms of demand and supply at various levels of the vertical marketing chain for corn. In what follows we shall examine the various modeling components of the U.S. corn system in terms of such a demand and supply structure.

Supply. At the farm level, total available supply is composed of total production and carryover stocks. The production component is composed of two major elements: acreage and yields per acre. Corn acreage equations can be expressed as a function of expected returns from the production of corn, expected returns from the production of other crops that can be grown on the same land, government policies, weather conditions at time of planting, and expected levels of risk in the production of corn compared to the production of other commodities. Once acreage has been allocated to corn, yields per acre are influenced principally by the expected price of corn, weather conditions, and the quality of land, along with the level of applications of such inputs as hybrid seed, fertilizer, machinery, herbicides, and insecticides. Other factors that influence the level of yields are, of course, the managerial expertise of farmers and the availability of the credit that allows these farmers to employ the optimal input levels.

Total Production. The product of the two basic equations for acreage and yields represents total production. A detailed representation of the U.S. corn system will, of course, elaborate these equations for regional differences in acreage and yields, at least for the Midwest, the Southeast, the East, the Southwest, and the West. In addition, to obtain useful results with respect to the distributional effects of various governmental policies, it is of some value to represent these equations in accordance with firm size, as indicated by the net worth of owner/operators or the acreage they control.

Price Expectations. One of the difficult problems of modeling the production component of the U.S. corn sysem along spatial or farm-size lines is to accurately represent the way in which the farmers formulate expectations of future net returns. This forecasting obviously depends upon the costs of production as well as on expected prices. Here a number of formulations are possible. At this stage it is important only to note that to completely model such expectations, we require a detailed representation of the input structure. To make one involves setting out the demand relations for different inputs: labor, hybrid seed, credit, fertilizer, herbicides, insecticides, farm machinery, and land. A comprehensive treatment requires a representation of the availability of each of these inputs and, hence, of their prices. Finally, expected output as well as input prices will generally be specified as some function of past prices, futures prices, and various factors that influence current prices.

Land Components. With regard to the land quality input, a number of factors that should be considered are generally neglected in existing models. In particular, land quality can be improved by summer fallowing, crop rotation, and soil conservation. Failure to incur the cost of these activities will ultimately lead to land erosion, loss of fertility, and thus lower yields. Neglect of such influences can lead to overestimations of crop production based on no longer valid relations. An additional factor that may influence the demand for land quality is environmental policy, which certainly might someday influence the production component. It is clearly possible that large expected increases in prices (along with high levels of risk associated with returns for future production) may lead to intensive cropping and eventually soil erosion. Rampant erosion could lead to the degradation of the nation's soil resources, pollution, the sedimentation of streams, and lower environmental quality in general. Under these circumstances, the government may impose environmental constraints that will increase land quality and thus the cost of production causing the total producing and exporting capacity of the U.S. corn system to suffer.

Stocks and Farm Storage Capacity. Corn stocks held on farms at the beginning of the crop year can be treated as predetermined. However, the capacity to hold corn on farms should be included as one of the input variables for supply. More specifically, the expected benefits and cost of augmenting on-farm storage capacity can be specified to influence the level of that capacity. The amount of corn stocks held on-farm at the end of the crop year should also be included as a variable.

Supply Allocation. Total farm corn supply can be allocated in a number of directions: it can be held on the farm; it can be sold as feed or to feed manufacturers; it can be sold to seed companies; and it can be allocated to governmental stocks, to various units within the assembly component, or directly to processors. Allocations among these six categories will depend upon current and expected prices; livestock numbers on farms growing corn; previous contractual arrangements; the available capacity of various assemblers, feed manufacturers, and seed companies; expected corn prices for the following year; and, of course, total available farm supply. At this first stage of supply allocation within the U.S. corn system, prices are measured at the farm level.

To consider the nature of these allocation equations, consider the supply equation for seed. It should be specified in terms of the expected price of seed relative to expected prices of alternative uses of corn, the levels of risk in seed processing, and the cost of processing seeds. And to complete the representation of seed supply, we must specify a seed inventory equation reflecting the basic motivations for carrying a particular commodity associated with transactional, speculative, and precautionary demands. Carryover levels from the previous year and current seed production will represent the total available supply of seed in any particular crop year.

The length of the period for which the model is constructed will influence stock equations for each of the allocation alternatives. That is, inventory stock equations will have to be developed for CCC or governmental purchases, country elevator inventories, subterminal elevator inventories, terminal elevator inventories, and processors' inventory levels. These stock equations depend upon the same factors listed for on-farm storage. Associated with these equations will be a set of storage-capacity/demand equations for the assembler and processor components. They, too, will depend upon factors similar to those listed for the on-farm storage-capacity/demand equations. Finally, a second set of allocation equations should be constructed to reflect the flows from assemblers to processors (and including export markets). These equations depend upon the same factors, but here prices are measured at the assembler level rather than at the farm level.

Demand. In theory, demand exists at every level of the vertical marketing chain for corn, so demand relations can be measured at the consumer level, the distribution level, the processor level, the assembler level, and the farm level. For modeling, the simplest approach is to measure detailed demand relations at one level of the vertical commodity structure and then compute demand at all other levels on the basis of these measurements. For example, if detailed demand representations at the retail or consumer level are specified, then the relevant explanatory variables will be prices of commodities derived from corn, prices of substitutable commodities, per-capita income, consumer tastes, and levels of advertising. Price-transfer relations are then developed at the processor, assembler, and farm levels. These price-transfer relations can be specified as a function

of input prices, expected output prices, and margins between contiguous levels of the marketing chain. Relations for margins between various levels can be computed or estimated. Given the recent experience in the U.S. corn system, the best approach is to represent such margins as a function of risk levels, cost of operation, and a normal or expected rate of return on invested capital.

Feed Corn Transformation and Other Commodity Systems. This simple representation of the demand and price structure at various levels of the commodity system is complicated by the recognition that corn does not remain unaltered as it moves from one level of the system to another. Corn does not disappear at the consumer level; it flows into many other products that have their own commodity systems.

There are two alternatives for dealing with this complexity in a model. The simplest is to specify the demand equations at the processor level reflecting corn and substitutable commodity prices along with factors influencing the consumption and demand for products that involve corn. This alternative requires the formulation of at least six demand equations: derived-demand equations for wet processors, feed manufacturers, dry processors, alcohol processors, breakfast-food processors, and a derived-export-demand equation principally for terminal elevators. This alternative involves substantial aggregation and subsumes a great deal of interaction within the commodity systems that use corn as an input.

The second alternative involves modeling each of the products that use corn as a major input. This requires modeling the components of the U.S. livestock sector and processed corn sectors (including cornstarch, corn syrups, dextrose, corn oil, corn meal, distilled spirits, and breakfast foods). For a truly comprehensive representation of the U.S. corn system, this second alternative is unavoidable. Hence, we will briefly examine the specifications required for this alternative in terms of the domestic and export markets.

Within the United States, the vast majority of corn production is either fed on the very farm where it is grown or processed into formula feed. Hence, the demand for corn is derived from the final consumer's demand for livestock products. To model these demands endogenously, quantitative representations of the dynamic and cyclical properties of the various livestock commodity systems must be developed. To do so, one must specify relations for consumer demand, livestock producer prices and margins, domestic producer behavior with respect to output levels and inventory stocks of livestock, and the level of beef imports. The principal products included in this submodel are fed beef, nonfed beef, pork, poultry and eggs, and dairy commodities. As before, the first set of consumer demand equations for these products are specified in terms of the prices of livestock products, the prices of substitutable commodities, income, and consumer tastes (particularly those reflecting the desire for convenience foods). The second group of relations are really price-transfer equations that are some functions of the costs, margins, and risks faced by meat packers and milk processors.

The third group of equations concerned with the relation of inventory and production can be specified in terms of expected prices of output, current prices of output, and the risks of livestock production (specified in terms of the variance of livestock and feedgrain prices). Here the dynamic relations must be explicitly recognized and an attempt must be made to reflect the delayed response of livestock producers to current price information. These equations can be transferred into other equations specifying the price of feeder calves and the factors influencing the decision to put cattle on feed. These latter equations should be specified on a regional basis because of the important structural differences among feedlots in the West, Southwest, and Midwest. Of the total cattle available, those not placed on feed are, of couse, grass-fed and lead to nonfed beef products. The allocation between fed and nonfed beef is determined largely by the price of corn relative to the rent structure, the availability of grasslands, and the price of other feedgrains (including the price of silage.)[1] In specifying the relation for cattle placed on feed, the possibility of future technological progress with respect to recycling animal wastes in feedlots should be admitted. Finally, beef imports, which largely relate to nonfed beef products, will be specified as a function of prices in the major exporting countries and in the United States.

A proper model also requires a specification of the inventory of feed stocks. This equation, which can be varied for regions, is determined by current and expected future prices, risk levels, and the various factors associated with the motivations for holding inventories.

Industrial Corn Use. Although direct food demand for corn represents a small percentage of total use (approximately 6 to 10 percent), it accounts for approximately 80 percent of the grains used in food marketing. This observation and the possibility that corn may be increasingly consumed directly make it imperative that a complete representation of the U.S. corn system include quantitative estimates of the demand for processed and industrial corn products. The structures for these products are a great deal simpler than those pertaining to livestock products. This submodel of the U.S. corn system is represented by demand equations for such dry products as breakfast foods, corn meal, and grits; for wet products, such as sugars, starches, oil, and syrup; and finally for alcohol and spirits distilled from corn. These demand equations can be specified in terms of their consumer prices and those of major substitutable products, income levels, consumer tastes, and the evolution of consumer tastes. The submodel also incorporates price-transfer equations to allow movement from the prices at the consumer level to the prices facing wet processors, dry processors, alcohol processors, and breakfast-food processors. As before, these transfer equations reflect distribution and processing costs and the margins influenced by expected rates of return on invested capital.

Export Demand. We earlier specified a supply allocation equation for U.S. corn exports, but we have not as yet discussed the specification of export demand. As in the case of domestic demand, detailed representations of derived

demand for corn from livestock, direct consumption, and industrial uses can be specified for all importing countries. Construction of such submodels for each importing country requires a massive research effort beyond the scope of most organizations. It should also be noted that to properly model export demand for the United States one must specify the supply within each of the major importing countries. A more tractable approach, however, is to specify net import equations for U.S. corn for each importing country. Such equations should take into account the fact that domestic and world prices do not differ solely because of tariff and transportation charges. To assume that this is not true is to imply that the amount imported is merely excess demand in the domestic market (determined by the difference between domestic supply and domestic demand at the domestic or world price). It is not. Hence, net corn imports for each country should be specified as a function of domestic production, per-capita income, population, the border price of U.S. corn, the border price of substitutable commodities (including corn imports from other countries), the value of the dollar, foreign exchange capacity, transport costs (which reflect increasing energy prices), corn stock on hand within the country, inventory facility and distributional networks capacity, aid received in the form of corn and other substitutable commodities, the price of various products that use corn, and the government policies of the importing country (import/export controls, subsidies, price supports for meat, dairy, and poultry products, and so forth).

The sum of the import demand equations for U.S. exports can then be equated with the supply allocation for exports within the United States to determine the world price for U.S. corn exports. The individual import demand equations depend upon a number of factors that simply reflect the domestic production of corn, domestic demand, international prices, stocks, the country's capacity to import (reflected by its foreign exchange position and its inventory and distributional facilities), aid inflows of corn, imports of corn from other countries, and major governmental policies.

Coordinating Mechanisms. A good model recognizes the influence of coordinating mechanisms on the corn system's performance, and especially on its stability. In previous modeling efforts related to the U.S. corn system, the influence of these mechanisms has generally been neglected; thus, the resulting models have been poor representations of reality. Most coordinating institutions or mechanisms were created to assist the corn commodity system in dealing effectively with surplus conditions. They will undergo some change to accommodate recent shortages and the possibility of recurring surpluses.

To illustrate the importance of these mechanisms on the specification and development of a model for the U.S. corn commodity system, consider contractual arrangements. These arrangements clearly have a major influence on the amounts allocated to different types of assemblers and processors. Hence, the possibility of such contracts must be explicitly admitted in the specification of

the supply allocation equations among the producer, assembler, and processor components of the system. Although these contracts occasionally allow flexibility in pricing, the price movements they admit are restricted, and supply allocation will not respond immediately to wide changes in prices among various outlets. Note as well that cooperatives, through their price-transferring arrangements with producer members, have similar influences on the supply allocation equations.

Historically, the principal mechanism influencing behavior of the U.S. corn system has been the U.S. government's intervention in the system. Over the last few years, the government's involvement in the system has been largely eliminated. The system is now more market-oriented. The government cannot currently force market prices towards support prices by selling government stocks because these stocks are less burdensome. With the declining importance of governmental intervention within the system, the emphasis has shifted to other mechanisms. In particular, system participants have entered the futures market and contractual arrangements and developed various forms of vertical integration to mitigate their risks and to increase the stability of their costs and returns.

Previous Modeling Efforts

In our examination of the literature on quantitative representations of various components of the U.S. corn system, we find a number of empirical investigations published in the fifties, a dearth of empirical work in the sixties, and a rekindling of interest in models for both corn supply and demand in the early seventies. This pattern is perhaps largely attributable to the government's accumulation of large stocks until the early seventies. Government stock policies absorbed most of the slack in the system and substantially restricted the amount of movement in market prices. Few empirical studies were conducted between the midfifties and early seventies because few seemed necessary. Most quantitative investigations done during this period concentrated on corn yields and the effects of government policies on corn acreages.

In 1972, modeling activities began again in earnest. Unfortunately, few of these quantitative measurement efforts have been published and most suffer from a failure to model export demand endogenously. That is, they continue to view the U.S. corn system as though it were insulated from the world market except for occasional fluctuations in world demand for U.S. corn.

Models developed prior to the recent upsurge have had a marked influence on current efforts. To achieve a proper perspective it is important that the interested reader become familiar with the specifications advanced, the methods of estimation employed, the degree of validation achieved, the principal results obtained, and the potential uses of these earlier models.

One model concentrates on one or more components of a single commodity; a second type of model examines the relation of one or more components of the U.S. corn system with components of other commodity systems; a third class

models the entire U.S. agricultural sector, including corn as one commodity; and a fourth group is concerned with aggregate food demand and supply relations, one element of which is corn.

In the single-commodity category, perhaps one of the best-known studies on corn prices was conducted by Karl Fox (1953–1958) over twenty years ago. It covered an even earlier period: 1922 to 1941. In this work, Fox argues that current supply is predetermined and thus a demand function can be estimated with price as the dependent variable. He examines three formulations of the demand for corn at the farm level, and on the basis of the results concludes that if total U.S. feedgrain supply were to increase (decrease) by 1 percent, a 1.93 percent decrease (increase) may be expected in the price of corn. His analysis was, however, based only upon U.S. supplies and prices. It assumes no interaction with other countries' supplies and prices. In other words, the Fox study is based on a *closed domestic corn system.*

Another interesting single-commodity study was performed by R.L. Gustafson in 1958. Given a governmental decisionmaking orientation, with stock or carryover levels of feedgrains as the control or decision variable, Gustafson attempted to determine optimal storage rules quantitatively. To accomplish this task, both supply and demand relationships had to be constructed.[2] In the case of demand, Gustafson borrowed heavily from the earlier work of Hildreth and Jarrett (1955), whose results were consistent with those of Foote, Klein, and Clough (1952). On the supply side, he concentrated on yields, arguing that the acreage for feedgrains is largely controlled over the period of analysis.[3] Here, a probability distribution of output is estimated from observations on the variation of yield-per-acre in past years (from 1866 through 1955), making due allowances for yield trends. This yield probability distribution, the specified demand equation, predetermined acreage levels, and a simple inventory stock identity are then employed to determine policies on carryover levels.

In 1972, J.P. Houck and M.E. Ryan provided an analysis of the effect of changing government programs on acres planted to corn.[4] They postulated a general relation, which stated that corn acreage is a function of (1) governmental policy (G), (2) market influences (M), and (3) all other supply determinants and random effects (S). They found, however, on the basis of data covering 1949 through 1969, that G masked M and S. With respect to M, market influences, this result follows even though market prices moved above the loan rate in all but one year, the supply-control features of the programs curtailed output and thus indirectly influenced the levels of, and annual variations in, market prices.

From these estimated equations, Houck and Ryan concluded that a ten-cent increase in effective support prices (PF) results in an increase in planted acreage of from 939,000 to 1,026,000 acres. The effect of a similar increase in effective diversion payment rates (DP), they determined, is approximately four times as great.[5] A similar analysis was performed by Ryan and Abel (1972) to predict corn acreage for 1971 and 1972. The only differences were that the latter analy-

sis went through 1970 (rather than through 1969) and used a dummy variable to account for the post-1965 shift from price supports to diversion payment rates in calculating government payments. The principal limitation of these works is that both emphasize policy influences to the neglect of market influences and thus fail to reflect the structural shifts that occurred in 1972.

The first detailed multicommodity model on the demand side for food and agriculture was constructed by George E. Brandow in 1961. This well known, disaggregated model was a major achievement. It subsumes individual demand relations for twenty-four agricultural commodities at the retail level, from which a total of twenty-nine demands for individual commodities pertaining to domestic food use are derived at the farm level. The farm demand equations are based upon the estimated retail demand equations and on estimated margins between the farm and retail levels. Other portions of the Brandow demand model include (1) export and industrial demands; (2) total demands for foods and cotton at the farm level; and (3) relations among livestock products, feed concentrates, and vegetable oils. The latter relationships provide the basis for obtaining feedgrain demand functions.

The unique feature of Brandow's work is that it relates the demand for any particular commodity to the prices of all agricultural commodities and disposable personal per -capita income. In other words, he constructs a complete matrix of elasticities for farm products. The synthesis of this matrix is based upon previous empirical estimates, original statistical work, and some theoretical computations of consumer demand and direct- and cross-demand elasticities. For our study, the most interesting aspect of Brandow's model pertains to the estimated demand relations for feedgrains at the farm level. These relations, derived from the demand for livestock, are divided into two broad classes: (1) low-protein feeds (corn, oats, barley, sorghum, grain, feed wheat, rye, and by-product feeds other than high-protein products) and (2) high-protein feeds (oilseed meals, animal proteins, gluten feed and meal, brewers' dried grains, and distillers' dried grains). The two separate concentrate equations produce the demand for total concentrates, indicating a price elasticity of -0.22810. That means that a 1 percent increase in farm price will reduce the livestock sector's demand for concentrates by 0.22810 percent. Based upon the sample period 1948-58, a 1 percent increase in the supply of low-protein feeds (including corn) reduces their prices by 4.0605 percent. Moreover, a 1 percent increase in the supply of high-protein feed reduces the price of low-protein feeds by 0.3235 percent. In the case of corn used only for direct food consumption, a price elasticity of only -0.0332 is evidenced in the same sample period. A 1 percent increase in direct-consumption corn prices results in only a 0.0332 percent reduction in the quantity demanded at the farm level.

In this investigation, Brandow attempted to estimate commercial export and industrial demands. Here, however, his empirical results are based on fragmentary evidence. A number of adjustments, many of them arbitrary, are advanced

to separate private export sales from governmental export sales. For example, exports are assumed to move out under private trade arrangements, CCC sales at concession prices, such as under Titles I and II of Public Law 480, International Commodity Agreement transfers, and barter deals. To simplify matters, Brandow assumed that without subsidies of any kind, exports would have amounted to the sum of private exports plus one-third of barter and CCC sales. On this basis, he was able to compute an export price elasticity for feedgrains of -1.3.[6] This value is clearly well above the previously computed domestic price elasticities of demand. When this measurement is separated into low- and high-protein feeds and added to the corresponding domestic livestock demands, direct price elasticities of -0.36 for low-protein and -0.58 for high-protein feeds result. In other words, when export demand is incorporated in the case of low-protein feeds, the direct price elasticity of demand increases from -0.2463 to -0.36.

Other multicommodity investigations involving corn have been more explicit about the relations between the feedgrain and livestock sectors. Among them are the works of Foote (1953a, 1953b),[7] Hildreth and Jarrent (1955), Egbert, and Reutlinger (1965), and Ray and Heady (1972). The most detailed representation of this area published to date is the model constructed by Ray and Heady. In this formulation, submodels are developed for such commodities as livestock, feedgrains, wheat, soybeans, cotton, and tobacco. The general structure of each commodity submodel includes econometric estimates of demands for final product, stocks, and inputs along with estimations based on the theory of production functions. Export and import levels, however, are estimated only as exogenous time trends. As in the case of other models, this approach was justified because governmental export subsidies insulated domestic markets from international markets over the period of the analysis.[8]

The general structure of each of their commodity submodels is as follows:

1. Acreage and resource-demand variables are functions of the previous year's prices, gross incomes of the commodity under consideration and those of related commodities, acreage allotments or diversions, previous-year resource prices, and resource-demand shifters.
2. Commodity production is dependent on the quantity and productivity of resources committed to the commodity.
3. Commodity supply depends on production, carryover, and imports.
4. Commodity prices depend on the price-support level, the discrepancy between current supply and previous-year domestic and foreign use, and other variables.
5. Commodity demands are functions of current-year prices of the commodity and related commodities and demand-shifter variables.
6. Commodity gross income is dependent on the current year commodity price, production, and government payments. (Ray and Heady[1972].)[9]

The model is employed for historical simulations and is not advanced as a comprehensive forecasting model of the agricultural sector. On the basis of these historical simulations, Heady and Ray arrive at a number of conclusions regarding appropriate policies. In particular they find that: (1) price and income supports are effective in maintaining farm prices and farm incomes above the levels that would occur in the absence of such programs; (2) if supports are removed, declines in farm income would dampen investment in inputs; (3) more rather than less labor would be required in agriculture in the absence of these programs because of an increase in acreage and a decrease in capital investment; (4) production response to higher support prices and an increase in the support price results in a small increase in average market prices; (5) and increased farm prices and incomes result in investments in highly productive capital inputs.

As a representation of the current U.S. and world corn system, the principal limitations of the Ray-Heady model are rather obvious. First, the model examines a period when foreign demand did not influence the U.S. corn system in any substantial way. The model does not admit the possibility of structural shifts resulting from consumer prices no longer being held above world prices by means of an export subsidy. Second, the linkages among various commodity submodels of this formulation are weak and do not admit the possibility, for example, that rising prices for corn and other feedgrains might cause a shift from fed to nonfed livestock. A third potential limitation of the model results from the way in which Ray and Heady treat producer behavior. They do not estimate their production functions for the output component on the basis of sample data. Instead, they assume a particular production relation with constant returns to scale and then set the elasticities implied by this function as equal to factor shares. These measurements have not been validated on the basis of available data, and if they are invalid the policy conclusions presented by Heady and Ray are questionable.

Given the growing importance of feedgrain imports in the early 1970s, a number of researchers have turned their attention to modeling export demand. Few of these studies have as yet been published except for the work of Abel and Ryan (1974). These authors developed statistical models for corn, sorghum, barley, feedgrains (the three listed commodities plus oats) to explain changes in feedgrain imports for Japan, Korea, and Taiwan. U.S. exports of feedgrains to each of these countries have grown rapidly over the past decade. This growth reflects increasing population, rising income levels, and national policies designed to upgrade diets through greater consumption of livestock products.

The data base for the estimated equation covers 1960 through 1972, a period over which feedgrain prices remained relatively constant. Partly for this reason, feedgrain imports were not as sensitive to price changes as they might have been. In the case of Japan, most of the growth in corn imports was the result of rising national income, the quantity of rice fed to livestock, and corn import prices.

For Korea, the principal determinant of import demand was government action (represented by simple dummy variables), followed rather weakly by national income and import prices. The effect of government policies in this country is reflected by two events: (1) the expansion of commercial livestock and poultry industries as a result of governmental efforts in 1968, and (2) the credit made available through U.S. sources for feed mills and other needed facilities in 1969. Finally, for Taiwan, the principal determinant of corn imports was national income, followed by government policy (represented by simple dummy variables) and then weakly by corn import price. Here the change in government policy was the removal of the protective tariff on corn.

In the third model category, U.S. agricultural sector representations have been constructed for the purposes of forecasting, policy analysis, and studying the sector's economic structure. For example, Evans (1967) constructed a complete U.S. agricultural sector model comprising commodities that are similar to the subdivisions found in Cromarty (1959), Brandow (1961), and Fox (1965). However the disaggregation is carried a bit further in his models and conforms closely with the level of cash receipts categories found in the U.S.D.A.'s *Farm Income Situation*. This model is composed of sixty equations (fifty-six stochastic and four definitional) constructed on the basis of annual data from 1948 through 1965. It covers demand and supply for all major livestock animals, other livestock and products, feedgrains, edible oils, feed crops, cotton, tobacco, fruits, and vegetables.

The estimated demand equations for feedgrains in the Evans model reveal prices that depend weakly on quantity demanded and strongly on the support price of feedgrains. Neither inventory stocks nor exports are important in this demand equation. These results, which conform with the results of other models we have surveyed, are largely due to the intervention of the U.S. government in private feedgrain markets. For harvested acreage equations of feedgrains, Evans finds that the principal influencing factors were two major farm programs of the postwar period: the soil bank program, which affected feedgrains for the 1956–58 period, and the feedgrains' program that began in 1961. Evans also finds a sizable price response by measuring the price variable as a three-year weighted average of the price of feedgrains relative to fertilizer prices, with the lag beginning in the previous year. To complete the supply response component for feedgrains, his model advances a yield-per-acre equation in terms of fluctuations around a semilog trend. He finds the important determinants of these yield measurements to be a three-year weighted average of relative prices (with weights declining linearly) and July's rainfall in three corn-growing states (Indiana, Illinois, and Iowa). When this yield equation is combined with the acreage equation, total price elasticity of supply over a three-year period is estimated to be 0.4. In addition to these equations, he also specifies a change-in-inventory-stocks equation for feedgrains. This equation is defined as a function

of quantity produced and exports, with the export coefficient having a negative sign of almost exactly unity.

Among aggregate food models we find many research efforts, including the works of Girshick and Haavelmo (1947) and Tobin's (1950) works on aggregate food demand; Fox's (1951) work on aggregate food demand and supply; Griliche's (1960) work on aggregate U.S. food supply functions; and Egbert's (1969) work on aggregate U.S. food supply, aggregate U.S. food consumption, and aggregate U.S. demand for stocks. In addition to these models, a large number of studies project aggregate food demand and supply based on historical trends. Illustrative examples of this approach may be found in Daly's (1956) work on demand projections for farm products and Culver and Chai's (1972) work on aggregate consumption, export and farm food price, food production, and land use projections. Although these and similar efforts are of some value for forecasting and policy deliberation, they are of little use to any modeling effort. It is impossible to ascertain the influence of various factors on elements of the corn demand and supply system from these estimated equations and projected trends.

Since none of the models constructed between 1950 and 1974 explicitly allow for structural change, they are badly outdated. All of these models, unfortunately, rely almost exclusively upon secondary (or published) data, they have no clear decisionmaking orientation, and they concentrate on the producer component of the system. Although they provide a useful starting point for deep study, they fail to quantify the following factors: (1) risk levels faced by participants in all components of the system; (2) the quantitative effect of weather conditions; (3) the dynamics of land quality; (4) the influence of coordinating mechanisms on patterns of expectation-formation, the levels of distribution of risk, and information flows within the system; (5) the appropriate level of disaggregation with respect to input demand, acreage, and yields by region and farm size; (6) supply allocations at all levels of the vertical corn marketing chain; (7) price-transfer and margin relations among various levels of the marketing chain; (8) the specification and estimation of relations associated with alternatives available for feeding livestock, especially beef cattle; and (9) a complete representation of the demand for corn resulting from final consumer demand for such dry products as breakfast foods, corn meal, and grits; wet products such as sugar, starches, oil, and syrup; and alcohol and distilled spirits. Most of the models are based upon a closed U.S. corn system. Although some admirable work was completed in 1974 on estimating the export demand for U.S. corn, additional explanatory variables need to be included.

Current and Future Modeling Efforts

As previously noted, there is a great deal of current research effort concerned with modeling the corn or related commodity systems. This work is taking place

within the Food and Agricultural Organization of the United Nations, the U.S. Department of Agriculture, and at a number of public and private universities.[10] In this section, we briefly survey this work's merits and limitations. Following this review, we shall examine some issues neglected by these modeling efforts, how structural changes can be incorporated into models, and how expanded formulation of current modeling efforts can be empirically implemented. Finally, we briefly outline the potential decisionmaking uses of the reformulated representation along with its implications for a complete world corn model.

Current Efforts to Model the U.S. Corn System. Two public organizations that continue to model the entire food system are the USDA and the FAO. The most recent available projections by FAO are for the years 1975 and 1980.[11] The most recent USDA projections cover the period until 1985.

FAO Forecasts. FAO's methods of projection are probably too simple. Estimates of demand are made on the basis of population growth rates, income growth rates, and income elasticities of demand. Prices are assumed to remain unchanged, and past trends are presumed to continue without change. In particular, supply estimates are based on simple extrapolations of past trends, the assumption being that government policies and prices remain unaltered. Thus, FAO's approach is largely constructed on the basis of past trends. It ignores price behavior and assumes trade accounts for the difference between domestic supply and demand in any particular country.

USDA Forecasts. USDA projections, in contrast, are a more complete representation.[12] Supply equations are constructed with econometric estimates and with the intuition of various investigators. They include own-price and cross-price elasticities as well as exogenous shifts in supply due to technical progress and other trends. Demand equations are constructed in a similar manner and typically include as parameters own-price and cross-price elasticities, income elasticities, and shifts in taste. Finally, stock demand equations are also specified for the United States, Canada, Australia, and New Zealand.

In the USDA formulation, trade flows are estimated by employing a linear programing scheme that takes transportation cost into account. In essence, domestic supply and demand of various countries are brought into equilibrium via a trade flow that minimizes cost for all possible domestic trade flows. The principal limitation of this approach is that it assumes international agricultural commodity markets contain no distortions. To deal with existing distortions in these markets, additional constraints must be imposed a priori. Such constraints imply, for example, that traditional exporters retain certain import markets in spite of efficiency considerations. The approach is generally inadequate to deal with changes in trade behavior resulting from foreign-exchange problems or deliberate neglect of production shortfalls. Other criticisms of the USDA ap-

proach cite its failure to distinguish between long- and short-run price elasticities and its failure to explicitly consider the production inputs or the marketing and distribution components of various commodities.

Blakesley et al. Forecasts. In their *U.S. and World Food Situation*, Blakesley, Heady, and Framingham use methods similar to those employed by the USDA and FAO. Their study, which was done in cooperation with the USDA, provide the basis for the linear programming trade model used in developing the department's projections. The model projects production from past trends and the availability of resources. Its principal value is that it provides a thorough examination of land available for agricultural purposes throughout the world. As with the FAO approach, demand projections are based on population, income growth, and trends assumed to be constant. Moreover, as in the case of the FAO approach, no attempt is made to model price behavior; in effect, the authors assume relative prices will remain as they are.

Each of the above models is still being used to generate projections. Among these three models, the USDA's is probably the most useful. But although that model can answer some of the issues mentioned earlier, its treatment of trade and long- and short-run elasticities prevents analyses of most of those policy issues. The model cannot answer questions concerning the external effects of domestic policies.[13]

The USDA Feedgrain-Livestock Model. The Economic Service Research Branch of the USDA is also developing a major representation of the U.S. feedgrain-livestock sector. In this effort, it has sought the assistance of researchers at the University of Minnesota and Dale Heien.

Heien's work on the U.S. corn system is summarized in an unpublished paper entitled "An Econometric Model of the U.S. Corn Economy." This model attempts to determine ten endogenous variables: total supply, commercial carryover, total production, total demand, food consumption, planted acreage, harvested acreage, feed and seed consumption, exports, and price. The seventeen exogenous variables specified include government corn carryover, the price of fertilizer, the time trend, population, an index price of all other commodities, personal consumption expenditures on nondurables and services, the price of soybean meal, the wage rate in the meat-processing industry, the price of wheat, the farm price of pork, the price of feeder cattle, the wholesale price of broiler chickens, the farm price of turkeys, the farm price of eggs, the effective support rate for corn, the diversion payment for corn, and the wage rate in farming.

The parameters included in this model were estimated on the basis of data covering 1950 through 1968, and the period 1969 through 1972 was used to evaluate the model's predictive performance. On the supply side, four equations summarize the producer component: planted acres of corn, harvested acres of corn, total production of corn, and the total supply of corn (which includes corn

production, commercial corn carryover, and government corn carryover). On the demand side, six equations represent demand at the farm and processing level: the demand for feed, the demand for food use, the commercial carryover of corn, the price of corn, exports of corn, and the total demand of corn. Although Heien implies that exports of corn are modeled endogenously, they are actually specified in a predetermined fashion.

The supply specifications of the Heien model are stated almost entirely in terms of government policy variables. The demand for feed corn is represented in terms of various livestock prices relative to the price of corn, the price of substitutable feed commodities such as soybeans and wheat, and the wage rate in the meat-packing industry. Food consumption of corn is stated simply in terms of a price index of all other goods and services and a measure of personal per-capita consumption expenditures. The price formation equation for corn is another simple representation stated in terms of lagged corn prices, a time trend, government carryover stocks, and commercial carryover stocks. The remaining equations on the demand side are represented as identity relations.

The predetermined representation of export demand and the treatment of supply suggest that this model is of little value in analyzing the current U.S. corn system. It is subject to the same criticisms offered for studies already surveyed in this appendix, especially the Houck and Ryan modeling effort.

In conjunction with the University of Minnesota, the USDA has constructed submodels for three major blocks of the U.S. corn system: farm supply, domestic demand, and export. The supply submodel concentrates on explaining plantings of corn. This formulation is basically equivalent to the earlier study of Ryan and Abel, which was very similar to the analysis of Houck and Ryan. The principal difference between this specification and earlier work is that although the supply-inducing price variable for the period 1949 through 1970 was the effective support rate for corn (along with effective acreage diversion payment rates when applicable), market prices beginning around 1971 became the basis for supply-inducing signals. Hence, a new variable (corn price signal) was constructed that over the years from 1949 to 1970 was the effective support rate. But from 1972 through 1974 this variable was measured as the lag market price of corn received by farmers. In this fashion, the specification is able to take some account of the structural shift that occurred when the U.S. government removed price supports and discontinued the diversion of payments within the system.

A summary of the results obtained for the supply submodel are reproduced in Table 6G-1. Equation 1 is the previously reported Ryan and Abel estimate of corn acreage planting for 1949-70. Equations 2 and 3 in this table cover the same priod along with four additional numbers pertaining to 1971 through 1974. Note that Equation 2 is specified in the same way as Equation 1, while in Equation 3 the corn-soybean price ratio is specified as the supply-inducing variable. As one moves from Equation 1 to 2, a major decrease occurs in the size,

Table 6G-1. USDA—University of Minnesota Regressions Explaining Corn Acreage Planted

Independent Variable / *Equation*	*Constant*	*Corn Price Signal*[a]	*Ratio of Corn Price Signal*	*Corn Effective Diversion Rate (S1 Bushel)*	*Soybean Effective Price Support (S1 bushel)*	*Acreage of Sorghum Planted*	*Dummy Variable (0 for 1950-65 and 1 for 1966-74*[b]	*Linear Trend*	$\bar{R}^2$[d]	*D.W.*[e]
				(U.S. dollars per bushel)						
1. *Ryan-Abel Model—1949-70 Data*										
Coefficient	99,316.9	8,954.9		-48,061.4	-10,010.4	-0.34	7,016.6	-243.8	.986[c]	–
t-value[f]		(3.2)		(5.3)	(4.7)	(3.4)	(7.5)	(2.2)		
Elasticity at mean		.1254		-0.481	-.3003					
Elasticity at 1972-74 mean		.2060		-0.481	-.3103					
2. *1950-74 Data*										
Coefficient	108,796.6	2,361.2		-50,802.6	-8,846.5	-0.455	7,367.3	-472.3	.950	1.536
t-value[f]	(14.4)	(1.33)		(4.83)	(3.20)	(2.93)	(5.37)	(3.57)		
Elasticity at mean		.0331		-.0508	-.2654					
Elasticity at 1972-74 mean		.0543		-.0508	-.2742					
3. *1950-74 Data*										
Coefficient	87,044.1		23,035.6	-46,745.8	-5,272.0	-0.287	6,924.8	-246.8	.965	1.532
t-value[f]	(9.52)		(3.26)	(7.13)	(2.46)	(2.02)	(6.06)	(2.65)		
Elasticity at mean		.1300		-.0672	-.1614					
Elasticity at 1972-74 mean		.1227		-.0904	-.1639					

[a]For the period 1950-71, this explanatory variable is the effective price support for corn and for the period it is the lagged (one year) market price for corn.

[b]Dummy variable accounts for the change beginning in 1966 when support payments were shifted from a loan rate to an acreage diversion basis.

[c]Not adjusted for degrees of freedom.

[d]Measure of "goodness of fit."

[e]Measure of autocorrelation among equation errors.

[f]Measure of the statistical significance of a particular explanatory variable.

Source: USDA.

elasticity, and statistical significance (indicated by the *t*-value) of the estimated coefficient associated with Corn Price Signal. In effect, these equations suggest that producers became less responsive when governmental intervention was largely removed from the system. In particular, the supply elasticity associated with the price signal falls from 0.1254 in the period 1949-70 to 0.0331 when 1971-74 are included in the sample base. It is likely that this substantial reduction in responsiveness reflects the greater degree of risk faced by producers between 1972 and 1974. Unfortunately, neither the influences of risk on producer supply nor acreage planting responses to price signals are incorporated in the analysis conducted by Gallagher and Houck.

Note also that for Equation 3, which includes the corn-soybean price ratio, the elasticity and statistical significance of the estimated coefficient associated with *PIC* (Corn Price Signal) returns to approximately the same level as reported for Equation 1. Here the elasticity at the 1972-74 mean is 0.1227, which is approximately the same as the elasticity reported for Equation 1 pertaining to the mean computed from 1949-70 data (0.1254). But it is quite different from the elasticity Equation 1 produces using the 1972-74 mean. The authors argue that since Equation 3 has a statistically stronger direct-price coefficient, it is the most appropriate equation to employ in analyzing and predicting corn acreages. Hence, they used Equation 3 to predict corn acreage planted for the year 1975. Given two alternative levels for both corn and soybean prices, they concluded that approximately eighty million acres would be planted to corn in 1975.

In the domestic demand submodel under construction by Abner Womack, a total of fifteen equations are represented covering four feedgrains: corn, sorghum, oats, and barley. Eleven of these equations pertain to demand; in particular, domestic feed demand for corn, sorghum, oats, and barley; commercial stocks of corn, sorghum, oats, and barley; and food demand for corn, oats, and barley. Four additional equations in the submodel are specified to reflect supply allocation among various outlets. In contrast to the formulation suggested in our discussion of previous modeling efforts, the supply allocation equations are treated as simple identity relations.

The three demand equations related to corn are reported in Table 6G-2. In the case of both feed and industrial or food allocations of corn, the demand equations are based on annual sample data for 1948-72. The commercial corn stock demand is based on data for 1956-72. The latter equation covers a smaller sample period because data on commercial and government stocks were not reported separately prior to 1955.

U.S. corn feed demand is stated as a function of average price received by U.S. farmers for corn (*PC*); the average U.S. wholesale price of soybean meal (*PM*); a weighted average of prices received by farmers for meat animals, poultry, and eggs, adjusted for crop year (*PLA*); and an aggregate value of net production stated in terms of meat animals slaughtered, poultry, and eggs, adjusted for crop year (*LOA*). U.S. corn food demand is stated as a function of the average price

Table 6G-2. Womack Estimated Equations for U.S. Corn Feed Demand, Commercial Corn Stock Demand, and Corn Food Demand[a]

	Constant	PC_t	PM_t	PLA_t	LOA_t	QCP_t	QCP_t (D_1)	$ECSC_{t-1}$ (D_1)	RI_t	R^2	*D.W.*
U.S. Corn Feed Demand	-22.0625	-30.0204	2.6061	.7431	9.1025					.94	1.33
t-value		-4.13	1.24	4.32	8.47						
Elasticity		-.40	.06	.48	.99						
U.S. Commercial Corn Stock Demand	30.9728	-15.4415				.1731	-.1083	.6654		.83	1.66
t-value		-3.63				5.73	2.82	2.42			
Elasticity		-.89				1.04	.435	.59			
U.S. Corn Food Demand	6.8476	-.6162							.0265	.95	.49
t-value		-1.28							19.90		
Elasticity		-.08							.675		

[a]All coefficients reported here were estimated by two-stage least squares. The variable designations are defined in the text.

Source: U.S.D.A.

of corn received by farmers (*PC*) and real disposable personal income, adjusted for crop year (*RI*). Commercial corn stock demand is specified in a more complicated fashion that allows structural shifts in the effects of various explanatory factors. This latter function is represented in terms of the average price of corn received by U.S. farmers (*PC*); the total U.S. production of corn (*OCP*); and two interaction variables measured as the product of *QCP* and *ECSC* (ending commercial stocks of corn for the previous year); and a dummy variable of 1 for 1948-61 and 0 for 1962-72. The latter two variables simply allow a shift in the slope of ending corn stocks and corn production from 1948-61 to 1962-72.

In essence, the major factors influencing the derived demand for feed corn emanate from the livestock production industry. As the results in Table 6G-2 suggest, high-protein meal is a major source of competition for corn use as a livestock feed. In general, the results obtained for this estimated equation are quite similar to those obtained earlier by Foote (1953). In particular, Womack obtains a direct price elasticity of -0.40, while Foote measured this same elasticity for 1921-42 at -0.47. The responsiveness of corn food demand to changes in livestock prices obtained by Womack is precisely the same as that obtained by Foote (both measurements indicate an elasticity of 0.48), but the elasticity of corn feed demand to livestock populations was estimated at a considerably higher level by Foote (1.7) than by Womack (0.99). This difference reflects, in part, differences in the researchers definitions of livestock population.

As indicated in Table 6G-2, the ending commercial stock of corn (*ECSC*) is specified as a function of the average U.S. price of corn, domestic corn production, and beginning commercial stock. The dummy variable (*DI*) attempts to capture the structural changes in the commercial sector resulting from the government's decision to reduce CCC inventories beginning in 1962. The result reported for this estimated equation indicates partial adjustment in commercial stocks during periods of CCC inventory increases up to 1961 and an immediate adjustment to the decline of CCC inventories. Unfortunately, this specification does not conform to the one suggested in Section 2; it does not separate commercial inventories held by farmers, country elevators, terminal markets, the milling sector, and the mixed feed sector. Since the precautionary, speculative, and transactional demand motives for holding inventories are generally quite different for these participants, a considerable amount of aggregation bias is represented by the results reported in Table 6G-2. Further aggregation biases result from Womack's use of annual data. In other words, given that most corn inventories are built and liquidated in response to market forces within a year, it seems imperative to use quarterly data. When accompanied by an analysis of commercial stock inventories at farm and nonfarm levels of the commodity system, these data would provide far more useful information to decisionmakers than Womack's formulation.

The U.S. corn food demand equation specified by Womack is quite simple. It involves only the U.S. average price of corn (*PC*) and real per-capita income (*RI*).

This simple specification reflects the unavailability of data pertaining to the corn food production industry at the wholesale and retail levels. However, as we shall soon demonstrate, it is possible to surmount such gaps in data and specify more completely the food or industrial component of the U.S. corn commodity system.

The export demand submodel divides U.S. corn exports into three major categories: commercial exports (excluding exports to the Soviet Union and the People's Republic of China); exports to the People's Republic of China and the Soviet Union; and exports under specified government programs. Morrie Breedhal is constructing this submodel. Arguing that the latter two categories are subject more to political determination than economic forces, he determines them outside the model formulation. He makes a formal attempt to model only the first category. This is accomplished by specifying a simple theoretical framework of excess demand (the difference between domestic supply and demand for various importing countries). Most of the data employed to estimate the effects of various factors on excess demand come from the United State's major corn customers: Canada, the United Kingdom, the European Economic Community, and Japan.[14]

The specified explanatory factors of exports include (1) the U.S. season average farm price of corn (as a proxy for export price); (2) the U.S. farm price of soybeans (as a proxy for the price of imported high-protein feeds, which are particularly important in Europe); (3) a livestock price index covering all major importing countries and livestock types (this index does not incorporate price data for Japan since such data is not readily available); (4) the number of animal units in major importing countries (included to capture the general expansion of the livestock industry in these countries); (5) an income index measured as a population-weighted index of per-capita real personal consumption expenditures of all major importing countries; (6) corn production and beginning stocks of principal exporting countries (namely Argentina, the Republic of South Africa, and Thailand); and (7) corn production and beginning stocks in the major importing countries (production and beginning stocks of the EEC Six are used as a proxy for all major importing countries).

U.S. export demand, specified in terms of the seven variables listed above, was estimated on the basis of data for 1956-74. The results of this estimate are reported in Table 6G-3. Note that the signs of all parameters associated with the seven variables conform to our expectations, are statistically significant, and are within acceptable limits of expected magnitudes. The important computed elasticity measures are approximately -1 for the U.S. farm price of corn; about 1.5 for the U.S. farm price of soybeans; -0.77 for the corn production and beginning stocks in competing exporting countries; and approximately -0.82 for corn production plus beginning stocks in the EEC Six. Clearly, the implied elasticity of export demand for U.S. corn is considerably higher than the domestic demand elasticities computed by Womack and others.

Table 6G-3. Breedhal Estimated U.S. Export Demand Equation on the Historical Period 1956/57 to 1973/74

Variable	*Estimated Value*	*t-Statistic*	*Elasticity*
U.S. farm price of corn (dollars per metric ton)	-252.792	-3.26	-1.048
U.S. farm price of soybeans (dollars per metric ton)	178.243	5.46	1.526
Lagged livestock price index (1963=1)	31445.442	2.15	–
Animal units (thousands)	0.437	1.87	–
Income index (1963=1)	18252.031	2.06	–
Corn production plus basic stocks principal competing exporters (thousands of metric tons)	-.628	-3.17	-.774
Production divided by basic stocks EEC-6 (thousands of metric tons)	-.972	-2.68	-.817
R^2 (corrected for degrees of freedom)		.975	
Durbin-Watson statistic		3.16	
Standard error of the estimate		1078.75	

Source: USDA.

The principal limitations of this export demand equation are: (1) its level of aggregation; (2) its concern only with commercial exports to a specified number of countries; (3) its neglect of government policies; (4) its implicit assumption that a constant difference (over time) exists between U.S. farm level prices and export prices; and (5) its complete disregard for structural shifts in the export market between 1956 and 1974.

The Harvard-MIT International Trade Model. An attempt to recognize and correct some of the above limitations has been undertaken in a joint research effort at Harvard University and the Massachusetts Institute of Technology. The researchers do not assume that a constant temporal difference between U.S. farm level and export prices will hold; and they incorporate government policies, disaggregate their representations to individual countries, and explicitly allow for distortions between domestic and international markets. The latter feature is accomplished by operating with a model specification that is similar to the one suggested in this appendix; that is, both world and domestic prices are treated endogenously and they are allowed to differ by more than a constant tariff and transportation charge.

The de facto leader of the joint modeling effort is Philip Abbott. The factors Abbott considers are very similar to those listed here. He specifies net imports of various commodities (wheat, feedgrains, and soybeans by each nation) in terms

of domestic production, per-capita national income, population, the border price of that commodity, the border prices of substitutable commodities, stocks, the country's capacity to import, commodity aid received by the country, and dummy variables to handle policy shifts with regard to this last variable.[15]

These equations are specified not only for importing countries but for exporters of wheat, feedgrains, and soybeans as well. Equations are not specified or estimated for those countries in which the wheat, feedgrain, or soybean trade is so small that it is not recorded.

Due to data limitations and the consequent degrees of freedom problems, some of the explanatory variables specified to explain trade were discarded. For most countries, the data base covered 1955-72. Due to the preliminary nature of the analysis, phasing problems associated with production, which may occur more than once during the year, and long-term trade contracts were neglected. In further work specifying trade relations among countries, these problems should be explicitly recognized.

A number of elasticity measures were computed from the feedgrain relations estimated in this study. These elasticities include the usual trade demand elasticity with respect to price, (E_T), a consumption elasticity in the trade market (E_C), and the change in trade with respect to changes in domestic production (E_P) reported in Table 6G-4. Note that the consumption elasticity will be equal to the domestic price elasticity of demand for a particular country if its domestic market extends into the international market. Moreover, the value E_P measures the extent to which the domestic market does extend into the international market. Note as well in Table 6G-4 that the negative trade demand elasticities reflect exporting countries while the positive trade elasticities of demand reflect importing countries.

The Japanese domestic feedgrain market is heavily extended into the international market and is followed in degree by European Free Trade Association, EEC, Canada, the United Kingdom, Africa, Denmark, Pakistan, Brazil, India, Indonesia, Argentina, the Soviet Union and Eastern Europe, and the United States. In general, the results are far better for importers and small exporters than for major exporters. This performance is not surprising because major exporters often behave like oligopolists in international trade markets.[16] Note also that the magnitudes of the estimated price elasticities are quite reasonable and similar to the estimates used by the USDA in its projection models. For example, if that portion of consumption relevant to the demand elasticity that is revealed in the international market is approximately half of total EEC consumption, and if the estimate of E_C is doubled, then the resulting estimate of the price elasticity of demand is approximately 0.3. That is the value employed by the USDA.[17]

Another interesting feature of this analysis that contrasts with the USDA model is that only a portion of the domestic market extends into international markets.[18] These results also confirm the FAO view that many countries are

Table 6G-4. Green Computed Trade, Consumption, and Production Elasticities, by Country

Country	E_T[a]	σE_T[b]	E_c[c]	σE_c[b]	E_p[d]	σE_p[b]
EEC	0.83	0.40	0.16	0.08	0.57	0.15
EFTA	0.21	0.53	0.04	0.11	0.71	0.20
United Kingdom	0.33	0.80	0.11	0.25	0.48	0.33
Denmark	0.59	0.57	0.05	0.05	0 37	0.06
Japan	0.13	0.64	0.12	0.57	2.35	0.86
Canada	-2.86	2.38	0.91	0.76	0.53	0.54
Argentina	-0.04	0.97	0.02	0.39	0.02	0.40
Brazil	-2.29	12.67	0.02	0.13	0.21	0.14
Pakistan (East & West)	10.2	30.6	0.04	0.12	0.34	0.19
India	42.8	127.9	0.02	0.06	0.17	0.11
Africa	1.74	0.68	-0.12	0.04	0.42	0.10
Indonesia	-0.16	0.29	0.01	0.02	0.07	0.02
United States	-0.03	0.08	0.003	0.008	-0.18	0.13
Soviet Union and Eastern Europe	0.62	0.80	-0.01	0.02	-0.11	0.19

[a] $E_T \equiv -\left(\frac{PF}{PT}\right)\frac{\partial FT}{\partial PF}$; the trade-price elasticity.

[b] σ_x is the standard error of x (a measure of the variability of x) where x refers here to the estimates of E_T, E_C, and E_P.

[c] $E_c \equiv -\left(\frac{PF}{FC}\right)\frac{\partial FT}{\partial PF}$; the consumption-price elasticity.

[d] $E_p \equiv -\frac{\partial FT}{\partial FP}$; the trade-production elasticity.

Source: USDA.

seeking self-sufficiency in food production; aid frequently substitutes directly for trade (this hypothesis was accepted for nine of eleven countries); and the importance of the capacity-to-import on trade demand. With regard to the latter result, two countries for which the capacity-to-import variable is important are Japan and India. During the famine years, India received considerable aid in the form of capital inflows which it presumably earmarked for food purchases. Abbott suggests that this tying of aid may be why capacity-to-import matters in determining import demands for feedgrains. He also suggests that one cause for Japan's economic growth has been its ability to export, and with that growth has come an increased demand for food imports. In any event, the most important quantitative results of Abbott's analysis is that it confirms the model formulation on export demand for the U.S. corn commodity system specified in Appendix G. His results clearly demonstrate that domestic and international markets are disconnected. Thus, model formulations of export demand must be considered separately from estimates of excess demand or supply in the markets of individual countries.[19]

From the standpoint of an analysis of the U.S. corn commodity system, Abbott's useful model formulation imposes severe limitations on the sorts of decision analyses that can be performed. First, the various commodities within the feedgrain sector are not explicitly considered; only aggregate trade relations and feedgrains are estimated. Second, the equations are not specific to U.S. corn and thus do not estimate demand relations facing U.S. corn in international markets. Third, Abbott's formulation relies heavily upon secondary (published) data, and that reliance forced him to discard many influencing factors and led him to generally imprecise estimates of the parameters. Here the use of judgmental information and primary (survey) data, as well as secondary data to estimate export and import demand relations would be of much value. Finally, Abbott's analysis does not take into account structural changes over the period or the possibility of future structural changes that might evolve in a continuous or discrete fashion.

The University of Chicago Developing Country Feedgrain Reserve Model. Other work related to the export demand for feedgrains, particularly in developing countries, is being conducted at the University of Chicago under the direction of D. Gale Johnson. In this work, the principal concern is with the optimal carryover levels of cereal grains for developing countries and regions. These developing countries and regions include India, Pakistan and Bangladesh, the Philippines, Indonesia, other Far East countries (excluding China, North Korea, and North Vietnam), Africa, Latin America, and the Near East.

To determine the optimal feedgrain carryover levels for these countries and regions, Y. Danin, D. Summer, and D. Gale Johnson employ the same framework advanced earlier by Gustafson (1958). For each country, they impose price elasticities of demand obtained from a set of estimates computed by the USDA. These elasticities for the various countries were all between -0.10 to -0.30. In addition, as in the Gustafson analysis, stochastic variability in production over time for each country or region was admitted in the model formulation. The stochastic variability of production was treated in terms of the deviation about simple trend projections. Storage costs, including in and out charges and physical loss, were assumed to be $7.50 per ton, and the long-run real rate of interest was assumed to be 5 percent. Finally, grain prices were approximations for regional or country grain prices as of 1970, and the level of net trade in the base year was assumed to remain a constant proportion of trend production.

On the basis of these assumptions, the size of the carryover stock can be directly related to probabilities that the optional carryover will be equal to or smaller than a given amount. For example, at a probability level of 0.95, a 1.2-million-ton carryover for Indonesia means that 95 percent of the time the carryover will be 2.1 million tons or less; conversely, 5 percent of the time carryover will be 2.1 million tons or more. The principal function of reserves in this model is to offset unexpected variability.

One of the more interesting results of this analysis occurs when the restrictive trade assumption is relaxed. These researchers find that if developing regions had allowed free trade, optimal storage over the historical period analyzed would have fallen to approximately what would be optimal for India itself in the case of no trade. Moreover, treating the entire world as the unit of analysis in the context of the Gustafson model (which is equivalent to the case of free trade), they find that the optimal world carryover of cereal grains would be far less than generally thought.[20]

Since the above study concentrates on cereal production, it is of little value in modeling the U.S. corn system. However, the framework employed is of some interest for those who wish to use a U.S. corn model for decisionmaking. This value is, of course, obvious in the earlier work of Gustafson. In addition, the way in which Danin, Sumner, and Johnson obtained quantitative estimates of production levels and their variability for developing countries should prove of value in modeling the U.S. export demand for corn and in making a complete world model.

The CARD Simulation Model of the U.S. Agricultural Sector. An examination of possible future conditions resulting from changes in export demand for U.S. feedgrains is presently being conducted by Tom Reynolds, Earl Heady, and Don Mitchell of the Center for Agricultural and Rural Development at Iowa State University. This investigation uses, with minor modifications, a model developed by Ray and Heady (1972). The criticisms raised here on an earlier model are equally applicable to this more recent modeling effort. Nevertheless, its detailed equational representations of the input and producer components of the U.S. feedgrain system will be of much value in further modeling efforts. Although they employ wheat, soybean, cotton, and tobacco submodels, these researchers' submodels of particular interest here are those of feedgrains and livestock.

In their feedgrain submodel, the pre-input section represents equations for acreage, ending year commodity stocks on farms, machinery purchases, ending year stock of machinery on farms, a price index of land and buildings per acre, value of farm land and buildings, and the stock of physical assets. The input section of this model is represented by equations for fertilizer and lime expenditures; the percentage of crop acres fertilized; purchased plus homegrown seed for individual crops; man-hour requirements; machinery interest and depreciation; real estate expenses, including interest on land and farm buildings, and depreciation, repairs, and maintenance on farm buildings; machinery, fuel, oil, and equipment-repairs expenses; miscellaneous expenses, including those for pesticides, small hand tools, binding materials, electricity, telephone, and related needs; interest on farm-held commodity inventories; and real estate taxes. In the output section of this submodel, equations are specified to represent crop yield per acre; crop production; feed units and corn equivalent; beginning crop-year

supplies, defined as the sum of production, carry-in stocks, and imports; the average crop-year price received by farmers; seed demand; total domestic crop-year demand for all uses: crop-year demand used for food; total demand (represented as a simple identity); government ending-crop-year inventory; commercial ending-crop-year inventory; and an equation representing producers' cash receipts and payments from government.

One of the desirable features of this formulation is that by allowing a complete representation of the income and expenditures of producers, one can compute the rate of return on equity capital as well as total capital invested. The factors influencing these various equations include government policies and market forces. Government policies are represented by average support-price levels, government payments, acreage allotments, and acreage diverted from production. Market forces are reflected by prices of various inputs and outputs. Technical change is included only in terms of simple trend variables, and various structural shifts are treated by dummy variables. Finally, as in the Ray and Heady model, livestock-sector demand for corn is treated comprehensively while corn demand for other purposes is generally specified as a simple trend projection. In particular, cereal corn and dry-processing corn demand are specified as functions of time; wet-processing corn demand is specified as a function of per-capita disposable income; and per-capita alcohol corn demand is specified as a constant (determined as an average of alcohol use of corn from 1966 to 1969).

Although the Reynolds, Heady, and Mitchell analysis treats exports exogenously, some of the more interesting features of their analysis are their simulated effects of alternative export levels from 1975 to the year 2000. Under policies designed to increase farm efficiency to meet domestic and foreign demands at reasonable prices,[21] these authors analyze the effects of five different export scenarios: (1) export levels needed to maintain market prices at the 1973-legislated target levels; (2) trend exports; (3) export levels 30 percent above trend exports; (4) export levels 50 percent above trend exports; and (5) export levels twice the level of trend exports.

In the first export scenario, to absorb production in excess of domestic demand (with prices at the 1973 target levels) market exports between 1975 and 1985 average 77.6 million tons of feedgrains. (This average level is substantially higher than 1972-73 feedgrain exports.) In scenarios (2) and (3), excess production is purchased and exported through government programs to support prices at $0.90 per bushel for feedgrains. With exports at trend levels (scenario (2)), excess production averages 44.1 million tons of feedgrains from 1980 to 2000. In other words, prices stabilize at minimum support levels in scenarios (2) and (3). The export levels of scenario (3) merely reduce the level of government support required to maintain minimum prices. Even in the case of scenario (4) export demand is insufficient to raise prices above minimum levels over the years 1980 through 1994. However, after 1994 growing domestic and export demands exceed the growth in crop production. This development results in price in-

creases for feedgrains to $1.72 in the year 2000. Finally, in the fifth scenario, prices increase every year because total demand grows faster than increases in production. By the year 2000, a bushel of feedgrains would sell for $2.45.

Neglected Components. When we compare the models surveyed in the preceding paragraphs with the formulation advanced in earlier in the appendix, it is clear that a number of the U.S. corn systems components are neglected or incompletely specified. To facilitate the examination of those aspects of the U.S. corn system that have been neglected by current modeling efforts, we have recorded in Tables 6G-5 and 6G-6 the major endogenous variables and their associated explanatory variables. All together, they comprise the formulation we have discussed generally. Table 6G-5 lists the major endogenous variables by component blocks. Of course, information feeds from one block to another and both short- and long-run interactions are admitted among the five major blocks. In Table 6G-6 the explanatory variables for each of the endogenous variables listed in Table 6G-5 are reported. These explanatory variables include exogenous variables, lagged endogenous variables, and endogenous variables. Note that current endogenous variables appearing as a dependent variable in any one equation influence other endogenous variables.

Among the explanatory variables, the major exogenous variables are related to the price of all inputs used by the farm block, competing crop prices, prices of substitutable consumer products, government policies, population, per-capita income, weather conditions, factors influencing various country import demands for corn, and the user of capital-asset cost of storage capacity across various components of the system. One of the principal features of the specification implied by Tables 6G-5 and 6G-6 is that it involves a level of disaggregation which will admit the influence of coordinating mechanisms through changes in various parameters. This is particularly true in the case of parameters summarizing the effect of different prices on the allocation of supply among different participants within a particular block or component of the system. Instead of averaging all of these prices and operating with a single price at each point of the vertical marketing chain, the model recognizes that these prices will not be equated because of risk and uncertainty, various bottlenecks, and the influence of coordinating mechanisms. When the mechanisms change, the parameters themselves will be altered and the prices the model generates for a component will also move to a different level of correspondence.[22]

The farm block component of the system is reasonably well specified by the USDA Feedgrain-Livestock Model and the CARD Simulation Model. There are, however, certain features of this block that are neglected by these two models. The most important features neglected are the risk levels faced by participants, quantitative representations of weather conditions, factors that influence land quality, a description of expectation formation patterns (particularly in the context of corn held on the farm), and the disaggregation of input demand,

Table 6G-5. Major Endogenous Variables of U.S. Corn Model, by Component Blocks

A. Farm Block

1. Annual regional acreage planted
2. Annual regional yields per acre
3. Annual regional production
4. Annual regional demand for seed
5. Annual regional demand for fertilizer
6. Annual regional demand for credit
7. Annual regional demand for labor
8. Annual regional demand for herbicide and insecticides
9. Annual regional demand for machinery
10. Annual regional demand for storage capacity
11. Quarterly regional carryover of corn stocks
12. Quarterly regional allocation of farm supply to feed manufacturers
13. Quarterly regional allocation of farm supply to wet processors
14. Quarterly regional allocation of farm supply to dry, alcohol, and breakfast-food processors
15. Quarterly regional allocation of farm supply directly to the livestock sector
16. Quarterly regional allocation of farm supply to government
17. Quarterly regional allocation of farm supply to country elevators
18. Quarterly regional allocation of farm supply to subterminal elevators
19. Quarterly regional allocation of farm supply to terminal elevators

B. Assembler Block

1. Quarterly regional demand of country elevator operators
2. Quarterly regional demand of subterminal elevator operators
3. Quarterly regional demand of terminal elevator operators
4. Quarterly regional demand for export market operators
5. Annual demand by government for storage capacity
6. Annual regional demand by country elevator operators for storage capacity
7. Annual regional demand by subterminal elevator operators for storage capacity
8. Annual regional demand by terminal elevator operators for storage capacity
9. Quarterly CCC carryover stocks
10. Quarterly regional carryover stocks of country elevator operators
11. Quarterly regional carryover stocks of subterminal elevator operators
12. Quarterly regional carryover stocks of terminal elevator operators
13. Quarterly allocation of CCC supply to feed manufacturers
14. Quarterly regional allocation of country elevator supply to feed manufacturers
15. Quarterly regional allocation of subterminal elevator supply to feed manufacturers
16. Quarterly regional allocation of terminal elevator supply to feed manufacturers
17. Quarterly allocation of CCC supply to wet processors
18. Quarterly regional allocation of country elevator supply to wet processors
19. Quarterly regional allocation of subterminal elevator supply to wet processors
20. Quarterly regional allocation of terminal elevator supply to wet processors
21. Quarterly allocation of CCC supply to dry, alcohol, and breakfast-food processors
22. Quarterly regional allocation of country elevator supply to dry, alcohol, and breakfast-food processors
23. Quarterly regional allocation of subterminal elevator supply to dry, alcohol, and breakfast-food processors
24. Quarterly regional allocation of terminal elevator supply to dry, alcohol, and breakfast-food processors
25. Quarterly regional allocation of country elevator supply to subterminal elevators
26. Quarterly regional allocation of country elevator supply to terminal elevators
27. Quarterly regional allocation of subterminal elevator supply to terminal elevators
28. Quarterly regional allocation of terminal elevator supply to export

(continued)

Table 6G-5 continued

C. Processing Block

1. Quarterly regional demand of wet processors for corn
2. Quarterly regional demand of feed manufacturers for corn
3. Quarterly regional demand of dry, alcohol, and breakfast-food processors
4. Quarterly regional wet processor carryover stocks of corn
5. Quarterly regional feed manufacturer carryover stocks of corn
6. Quarterly regional dry, alcohol, and breakfast-food processor carryover stocks of corn
7. Quarterly regional allocation of wet processor supply to cornstarch
8. Quarterly regional allocation of wet processor supply to corn sugar
9. Quarterly regional allocation of wet processor supply to corn oil
10. Quarterly regional allocation of wet processor supply to livestock-feed-based products
11. Quarterly regional allocation of feed manufacturer supply to dairy cattle feeds
12. Quarterly regional allocation of feed manufacturer supply to beef cattle feeds
13. Quarterly regional allocation of feed manufacturer supply to hog feeds
14. Quarterly regional allocation of feed manufacturer supply to broiler feeds
15. Quarterly regional allocation of feed manufacturer supply to poultry egg feeds
16. Quarterly regional allocation of dry, alcohol, and breakfast-food processor supply to finished products
17. Quarterly regional wet processor carryover stocks of cornstarch
18. Quarterly regional wet processor carryover stocks of corn sugar
19. Quarterly regional wet processor carryover stocks of corn oil
20. Quarterly regional wet processor carryover stocks of livestock-feed-based products
21. Quarterly regional feed manufacturer carryover stocks of dairy cattle feeds
22. Quarterly regional feed manufacturer carryover stocks of beef cattle feeds
23. Quarterly regional feed manufacturer carryover stocks of hog feeds
24. Quarterly regional feed manufacturer carryover stocks of broiler feeds
25. Quarterly regional feed manufacturer carryover stocks of poultry egg feeds
26. Quarterly regional dry, alcohol, and breakfast-food carryover stocks of finished products
27. Quarterly regional wet processor supply of cornstarch to industry
28. Quarterly regional wet processor supply of cornstarch to distribution component
29. Quarterly regional wet processor supply of corn sugar to industry
30. Quarterly regional wet processor supply of corn sugar to distribution component
31. Quarterly regional wet processor supply of corn oil to industry
32. Quarterly regional wet processor supply of corn oil to distribution component
33. Quarterly regional wet processor supply of feed-based products to livestock industry
34. Quarterly regional feed manufacturer supply of dairy cattle feeds
35. Quarterly regional feed manufacturer supply of beef cattle feeds
36. Quarterly regional feed manufacturer supply of hog feeds
37. Quarterly regional feed manufacturer supply of broiler feeds
38. Quarterly regional feed manufacturer supply of poultry egg feeds
39. Quarterly regional dry processor supply to distribution component
40. Quarterly regional alcohol processor supply to distribution component
41. Quarterly regional breakfast-food processor supply to distribution component
42. Annual regional demand by wet processors for storage capacity
43. Annual regional demand by feed manufacturers for storage capacity
44. Annual regional demand by dry, alcohol, and breakfast-food processors for storage capacity

D. Distribution and Final Demand Block

1. Quarterly industrial demand for cornstarch
2. Quarterly industrial demand for corn sugar
3. Quarterly industrial demand for corn oil
4. Quarterly demand of livestock sector for wet processor feed-based products
5. Quarterly demand of dairy industry for corn-based feeds
6. Quarterly demand of beef industry for corn-based feeds
7. Quarterly demand of hog industry for corn-based feeds

Table 6[illegible]-5 continued

8. Quarterly demand of broiler industry for corn-based feeds
9. Quarterly demand of poultry egg industry for corn-based feeds
10. Quarterly demand by wholesalers and supermarkets for dry corn products
11. Quarterly demand by wholesaler and supermarkets for corn alcohol products
12. Quarterly demand by wholesalers and supermarkets for corn breakfast-food products
13. Quarterly demand by wholesalers and supermarkets for cornstarch
14. Quarterly demand by wholesalers and supermarkets for corn sugar
15. Quarterly demand by wholesalers and supermarkets for corn oil
16. Quarterly consumer demand for dry corn products
17. Quarterly consumer demand for corn alcohol products
18. Quarterly consumer demand for corn breakfast-food products
19. Quarterly consumer demand for cornstarch
20. Quarterly consumer demand for corn sugar
21. Quarterly consumer demand for corn oil

E. Vertical Price Structure and Distribution Margin Generation Block

1. Quarterly regional farm-level feed manufacturer corn price
2. Quarterly regional farm-level wet processor corn price
3. Quarterly regional farm average dry, alcohol, and breakfast-food quarterly processor price
4. Quarterly regional farm-level country elevator price
5. Quarterly regional farm-level subterminal elevator price
6. Quarterly regional farm-level terminal elevator price
7. Quarterly regional assembler-level feed manufacturer price
8. Quarterly regional assembler-level wet processor price
9. Quarterly regional assembler-level average dry, alcohol, and breakfast-food processor price
10. Quarterly regional assembler-level export price
11. Quarterly regional processor-level industrial cornstarch price
12. Quarterly regional processor-level consumer cornstarch price
13. Quarterly regional processor-level industrial corn sugar price
14. Quarterly regional processor-level consumer corn sugar price
15. Quarterly regional processor-level industrial corn oil price
16. Quarterly regional processor-level consumer corn oil price
17. Quarterly regional processor-level average wet livestock-feed product price
18. Quarterly regional processor-level average dairy cattle feed price
19. Quarterly regional processor-level average beef cattle feed price
20. Quarterly regional processor-level average hog feed price
21. Quarterly regional processor-level average broiler feed price
22. Quarterly regional processor-level average poultry egg feed price
23. Quarterly regional processor-level average dry corn price
24. Quarterly regional processor-level average corn alcohol price
25. Quarterly regional processor-level average breakfast-food price
26. Quarterly wholesaler and retailer average margin for dry corn products
27. Quarterly wholesaler and retailer average margin for corn alcohol products
28. Quarterly wholesaler and retailer average margin for corn breakfast-food products
29. Quarterly wholesaler and retailer average margin for cornstarch
30. Quarterly wholesaler and retailer average margin for corn sugar
31. Quarterly wholesaler and retailer average margin for corn oil
32. Quarterly consumer average dry corn products price
33. Quarterly consumer average alcohol products price
34. Quarterly consumer average breakfast-food products price
35. Quarterly consumer average cornstarch price
36. Quarterly consumer average corn sugar price
37. Quarterly consumer average corn oil price

Table 6G-6. Major Explanatory Variables of U.S. Corn Model, by Component Blocks

A. Farm Block

1. Expected returns per acre in the production of corn, expected returns from the production of competing crops, government policies, weather temperatures at the time of planting, expected price risk of corn production, expected production risks of corn production, expected price risks of competing crops, and expected production risks of competing crops
2. Expected price of corn, rainfall during the season, an index of land quality, and prices of all major inputs
3. The product or regional acreage planted and regional yields per acre
4. Acreage planted, expected corn prices, the price of seed, and the prices of all other major inputs
5. Acreage planted, expected corn prices, the price of fertilizer, and the prices of all other major inputs
6. Acreage planted, expected corn prices, interest rate on PCA loans, and the prices of all other major inputs
7. Acreage planted, expected corn prices, farm wage rates, and the prices of all other major inputs
8. Acreage planted, expected corn prices, the average price of herbicides and insecticides, and the prices of all other major inputs
9. Acreage planted, expected corn prices, an index of farm machinery prices, and the prices of all other major inputs
10. Regional corn production, current corn prices, future corn prices for the following year, future corn price risk for the following year, existing storage capacity, and prices of all other major inputs
11. Corn inventories held on farm at the end of the previous quarter, current production (relevant for only the third and fourth quarters of the calendar year), current corn prices, future prices for the following quarter, farm storage capacity
12. Prices available in all major outlets, government support price, number of livestock animal units on corn-producing farms, on-farm inventory at end of previous quarter, corn production
13. Prices available in all major outlets, government support price, number of livestock animal units on corn-producing farms, on-farm inventory at end of previous quarter, corn production
14. Prices available in all major outlets, government support price, number of livestock animal units on corn-producing farms, on-farm inventory at end of previous quarter, corn production
15. Prices available in all major outlets, government support price, number of livestock animal units on corn-producing farms, on-farm inventory at end of previous quarter, corn production
16. Prices available in all major outlets, government support price, number of livestock animal units on corn-producing farms, on-farm inventory at end of previous quarter, corn production
17. Prices available in all major outlets, government support price, number of livestock animal units on corn-producing farms, on-farm inventory at end of previous quarter, corn production
18. Prices available in all major outlets, government support price, number of livestock animal units on corn-producing farms, on-farm inventory at end of previous quarter, corn production
19. Prices available in all major outlets, government support price, number of livestock animal units on corn-producing farms, on-farm inventory at end of previous quarter, corn production

B. Assembler Block

1. Difference between country elevator operator storage capacity and inventories on hand at close of previous quarter, average farm-level country elevator price, expected average assembler-level price

Table 6G-6 continued

2. Difference between subterminal elevator operator storage capacity and inventories on hand at close of previous quarter, average farm-level subterminal elevator price, expected average assembler-level price
3. Difference between terminal elevator operator storage capacity and inventories on hand at close of previous quarter, average farm-level terminal elevator price, expected average assembler-level price
4. Complete submodel generating net import equations for U.S. corn specified in terms of domestic production, per-capita income, population, border price of U.S. corn, border price of competing commodities, foreign exchange capacity, transport costs, corn stocks on hand within the country at the end of the previous quarter, storage capacity, distributional network capacity, aid received in the form of corn and other substitutable commodities, an index price of livestock products, livestock numbers, and government policies of the importing country
5. Existing government storage capacity, rental price of storage capacity from private sector, government purchases of corn, future prices of corn for the following year, and user cost of storage capacity
6. Existing country elevator storage capacity, current country purchases of corn, country elevator farm-level price of corn, current average assembler-level price of corn, future price of corn for the following year, future price risk, and user cost of country elevator storage capacity
7. Existing subterminal elevator storage capacity, current subterminal purchases of corn, subterminal elevator farm-level price of corn, current average assembler-level price of corn, future price of corn for the following year, future price risk, and user cost of subterminal elevator storage capacity
8. Existing terminal elevator storage capacity, current terminal purchases of corn, terminal elevator farm-level price of corn, current average assembler-level price of corn, future price of corn for the following year, future price risk, and user cost of terminal elevator storage capacity
9. CCC inventory at the end of the previous quarter; current quarter CCC purchases; and current quarter allocation of CCC supplies to feed manufacturers, wet processors and to dry, alcohol, and breakfast-food processors
10. Country elevator inventories at the end of the previous quarter; country elevator purchases; and current quarter country elevator allocations to feed manufacturers, wet processors, subterminal elevators, terminal elevators, and to dry, alcohol, and breakfast-food processors
11. Subterminal elevator inventories at the end of the previous quarter; subterminal elevator purchases; and current quarter subterminal elevator allocations to feed manufacturers, wet processors, terminal elevators, and to dry, alcohol, and breakfast-food processors
12. Terminal elevator inventories at the end of the previous quarter; terminal elevator purchases; and current quarter terminal elevator allocations to feed manufacturers, wet processors, exports, and to dry, alcohol, and breakfast-food processors
13. CCC inventories at the end of the previous quarter; current quarter CCC purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; futures price for the following quarter; and futures price risk for the following quarter
14. Country elevator inventories at the end of the previous quarter; current quarter country elevator purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; current quarter subterminal price; current quarter terminal price; futures price for the following quarter; and future price risk for the following quarter
15. Subterminal elevator inventories at the end of the previous quarter; current quarter subterminal elevator CCC purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; current quarter terminal price; futures price for the following quarter; and future price risk for the following quarter

(continued)

Table 6G-6 continued

16. Terminal elevator inventories at the end of the previous quarter; current quarter terminal elevator CCC purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; current quarter export price; futures price for the following quarter; and future price risk for the following quarter
17. CCC inventories at the end of the previous quarter; current quarter CCC purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; futures price for the following quarter; and future price risk for the following quarter
18. Country elevator inventories at the end of the previous quarter; current quarter country elevator purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; current quarter subterminal price; current quarter terminal price; futures price for the following quarter; and futures price risk for the following quarter
19. Subterminal elevator inventories at the end of the previous quarter; current quarter subterminal elevator CCC purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; current quarter terminal price; futures price for the following quarter; and futures price risk for the following quarter
20. Terminal elevator inventories at the end of the previous quarter; current quarter terminal elevator CCC purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; current quarter export price; futures price for the following quarter; and futures price risk for the following quarter
21. CCC inventories at the end of the previous quarter; current quarter CCC purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; futures price for the following quarter; and futures price risk for the following quarter
22. Country elevator inventories at the end of the previous quarter; current quarter country elevator purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; current quarter subterminal price; current quarter terminal price, futures price for the following quarter
23. Subterminal elevator inventories at the end of the previous quarter; current quarter subterminal elevator CCC purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; current quarter terminal price; futures price for the following quarter; and futures price risk for the following quarter
24. Terminal elevator inventories at the end of the previous quarter; current quarter terminal elevator CCC purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; current quarter export price; futures price for the following quarter; futures price risk for the following quarter
25. Country elevator inventories at the end of the previous quarter; current quarter country elevator purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; current quarter subterminal price; current quarter terminal price; futures price for the following quarter; futures price risk for the following quarter
26. Country elevator inventories at the end of the previous quarter; current quarter country elevator purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast-food processor price; current quarter subterminal price; current quarter terminal price; futures price for the following quarter; futures price risk for the following quarter
27. Subterminal elevator inventories at the end of the previous quarter; current quarter subterminal elevator CCC purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and

Table 6G-6 continued

breakfast-food processor price; current quarter terminal price; futures price for the following quarter; futures price risk for the following quarter

28. Terminal elevator inventories at the end of the previous quarter; current quarter terminal elevator CCC purchases; assembler-level feed manufacturer price; assembler-level export price; assembler-level wet processor price; average dry, alcohol, and breakfast food-processor price; current quarter export price; futures price for the following quarter; and future price risk for the following quarter

C. Processing Block

1. Wet processor storage capacity; wet processor corn inventory at end of previous quarter; assembler-level wet processor price; weighted index of expected wet processor prices for cornstarch, corn sugar, and corn oil; and wet processor margin risk
2. Feed manufacturer storage capacity; feed manufacturer corn inventory at end of previous quarter; assembler-level feed manufacturer price; weighted index of expected feed manufacturer prices for dairy cattle, beef cattle, hog, broilers, and poultry and egg feeds; and feed manufacturer margin risk
3. Dry, alcohol, and breakfast-food processor capacity; dry, alcohol, and breakfast-food processor inventory at end of previous quarter; assembler-level dry, alcohol, and breakfast-food processor price; weighted index of expected dry, alcohol, and breakfast-food processor finished product price; and dry, alcohol, and breakfast-food processor margin risk
4. Wet processor inventory of corn on hand at end of previous quarter, wet processor purchases of corn, wet processor allocation of corn to starch, wet processor allocation of corn to sugar, wet processor allocation of corn to oil, wet processor allocation of corn to livestock feed products, current quarter assembler-level wet processor price, futures price for the following quarter and futures price risk
5. Feed manufacture inventory of corn at the end of the previous quarter, feed manufacture purchases of corn, allocation of feed manufacture corn to dairy cattle feeds, allocation of feed manufacture corn to beef cattle feeds, allocation of feed manufacture corn to hog feeds, allocation of manufactured feeds to broiler feeds, allocation of feed manufactured corn to poultry egg feeds, current quarter assembler-level feed manufacture price, futures price for the following quarter, and futures price risk
6. Dry, alcohol, and breakfast-food processor inventories on hand at the end of the previous quarter; dry, alcohol, and breakfast-food processor purchases of corn; allocation of dry, alcohol, and breakfast-processor corn to finished products; current quarter assembler-level average dry, alcohol, and breakfast-food processor price; future price for the following quarter; and futures price risk
7. Wet processor inventories of corn at the end of previous quarter, wet processor inventories of cornstarch at end of previous quarter, current quarter purchases of corn, average processor-level cornstarch price, average processor-level corn sugar price, average processor-level corn oil price, average processor-level wet livestock feed product price, cornstarch price risk, corn sugar price risk, corn oil price risk, and livestock feed products price risk
8. Wet processor inventories at end of previous quarter, wet processor inventories of corn sugar at end of previous quarter, current quarter purchases of corn, average processor-level cornstarch price, average processor-level corn sugar price, average processor level corn oil price, average processor-level wet livestock feed product price, cornstarch price risk, corn sugar price risk, corn sugar price risk, corn oil price risk, and livestock feed products price risk
9. Wet processor inventories at the end of previous quarter, wet processor inventories of corn oil at end of previous quarter, current quarter purchases of corn, average processor-level cornstarch price, average processor-level corn sugar price, average processor-level corn oil price, average processor-level wet livestock feed product price, cornstarch price risk, corn sugar price risk, corn oil price risk, and livestock feed products price risk

(continued)

Table 6G-6 continued

10. Wet processor inventories at the end of previous quarter, wet processor inventories of livestock feed products at end of previous quarter, current quarter purchases of corn, average processor-level cornstarch price, average processor-level corn sugar price, average processor-level corn oil price, average processor-level wet livestock feed product price, cornstarch price risk, corn sugar price risk, corn oil price risk, and livestock feed products price risk
11. Feed manufacturer inventories of dairy cattle feed at the end of the previous quarter, feed manufacturer inventories of corn at the end of the previous quarter, current quarter purchases of corn by feed manufacturers, processor-level dairy feed prices, processor-level beef cattle feed prices, processor-level hog feed prices, processor-level broiler feed prices, processor-level poultry egg feed prices, processor-level dairy cattle feed price risk, processor-level beef cattle price feed price risk, processor-level hog feed price risk, processor-level broiler feed price risk, processor-level poultry egg feed price risk
12. Feed manufacturer inventories of beef cattle feeds at the end of the previous quarter, feed manufacturer inventories of corn at the end of the previous quarter, current quarter purchases of corn by feed manufacturers, processor-level dairy feed prices, processor-level beef cattle feed prices, processor-level hog feed prices, processor-level broiler feed prices, processor-level poultry egg feed prices, processor-level dairy cattle feed price risk, processor-level beef cattle price feed price risk, processor-level hog feed price risk, processor-level broiler feed price risk, processor-level poultry egg feed price risk
13. Feed manufacturer inventories of hog feeds at the end of the previous quarter, feed manufacturer inventories of corn at the end of the previous quarter, current quarter purchases of corn by feed manufacturers, processor-level dairy feed prices, processor-level beef cattle feed prices, processor-level hog feed prices, processor-level broiler feed prices, processor-level poultry egg feed prices, processor-level dairy cattle feed price risk, processor-level beef cattle price feed price risk, processor-level hog feed price risk, processor-level broiler feed price risk, processor-level poultry egg feed price risk
14. Feed manufacturer inventories of broiler feeds at the end of the previous quarter, feed manufacturer inventories of corn at the end of the previous quarter, current quarter purchases of corn by feed manufacturers, processor-level dairy feed prices, processor-level beef cattle feed prices, processor-level hog feed prices, processor-level broiler feed prices, processor-level poultry egg feed prices, processor-level dairy cattle feed price risk, processor-level beef cattle price feed price risk, processor-level hog feed price risk, processor-level broiler feed price risk, processor-level poultry egg feed price risk
15. Feed manufacturer inventories of poultry egg feed at the end of the previous quarter, feed manufacturer inventories of corn at the end of the previous quarter, current quarter purchases of corn by feed manufacturers, processor-level dairy feed prices, processor-level beef cattle feed prices, processor-level hog feed prices, processor-level broiler feed prices, processor-level poultry egg feed prices, processor-level dairy cattle feed price risk, processor-level beef cattle price feed price risk, processor-level hog feed price risk, processor-level broiler feed price risk, processor-level poultry egg feed price risk
16. Dry, alcohol, and breakfast-food processor inventories of finished products at the end of the previous quarter; dry, alcohol, and breakfast-food processor inventories of corn at the end of the previous quarter; dry, alcohol, and breakfast-food processor purchases of corn; average processor-level dry, alcohol, and breakfast-food prices; processor-level dry, alcohol, and breakfast-food price risk
17. Wet processor inventories of cornstarch at the end of the previous quarter, wet processor supply allocation to cornstarch, wet processor industrial sales of cornstarch, wet processor consumer sales of cornstarch, wet processor storage capacity
18. Wet processor inventories of corn sugar at the end of the previous quarter, wet processor supply allocation to corn sugar, wet processor industrial sales of corn sugar, wet processor consumer sales of corn sugar, wet processor storage capacity
19. Wet processor inventories of corn oil at the end of the previous quarter, wet processor supply allocation to corn oil, wet processor industrial sales of corn oil, wet processor consumer sales of corn oil, wet processor storage capacity
20. Wet processor inventories of livestock-feed-based products at the end of the previous

Table 6G-6 continued

quarter, wet processor supply allocation to livestock-feed-based products, wet processor sales of livestock-feed-based products, wet processor storage capacity

21. Feed manufacturer inventories of dairy cattle feeds at the end of previous quarter, current quarter feed manufacturer supply allocation to dairy cattle feeds, current quarter feed manufacturer dairy cattle sales of feeds, feed manufacturer storage capacity
22. Feed manufacturer inventories of beef cattle feeds at the end of previous quarter, current quarter feed manufacturer supply allocation of beef cattle feeds, current quarter feed manufacturer beef cattle sales of feeds, feed manufacturer storage capacity
23. Feed manufacturer inventories of hog feeds at the end of previous quarter, current quarter feed manufacturer supply allocation to hog feeds, current quarter feed manufacturer hog sales of feeds, feed manufacturer storage capacity
24. Feed manufacturer inventories of broiler feeds at the end of previous quarter, current quarter feed manufacturer supply allocation of broiler feeds, current quarter feed manufacturer broiler sales of feeds, feed manufacturer storage capacity
25. Feed manufacturer inventories of poultry egg feeds at the end of previous quarter, current quarter feed manufacturer supply to poultry egg feeds, current quarter feed manufacturer poultry egg sales of feeds, feed manufacturer storage capacity
26. Dry, alcohol, and breakfast-food inventories of finished products at the end of the previous quarter; current quarter dry, alcohol, and breakfast-food supply allocations to finished products; current quarter dry, alcohol, and breakfast-food sales of finished products; dry, alcohol, and breakfast-food storage capacity
27. Wet processor inventories of cornstarch at the end of previous quarter, current quarter supply allocation to cornstarch, processor-level industrial cornstarch price, processor-level consumer cornstarch price, expected (average) cornstarch price for the next quarter, next quarter's average cornstarch price risk
28. Wet processor inventories of cornstarch at the end of previous quarter, current quarter supply allocation to cornstarch, processor-level industrial cornstarch price, processor-level consumer cornstarch price, expected (average) cornstarch price for the next quarter, next quarter's average cornstarch price risk
29. Wet processor inventories of corn sugar at the end of previous quarter, current quarter supply allocation to corn sugar, processor-level industrial corn sugar price, processor-level consumer corn sugar price, expected (average) corn sugar price for the next quarter, next quarter's average corn sugar price risk
30. Wet processor inventories of corn sugar at the end of previous quarter, current quarter supply allocation to corn sugar, processor-level industrial corn sugar price, processor-level consumer corn sugar price, expected (average) corn sugar price for the next quarter, next quarter's average corn sugar price risk
31. Wet processor inventories of corn oil at the end of previous quarter, current quarter supply allocation to corn oil, processor-level industrial corn oil price, processor-level consumer corn oil price, expected (average) corn oil price for the next quarter, next quarter's average corn oil price risk
32. Wet processor inventories of corn oil at the end of previous quarter, current quarter supply allocation to corn oil, processor-level industrial corn oil price, processor-level consumer corn oil price, expected (average) corn oil price for the next quarter, next quarter's average corn oil price risk
33. Wet processor inventories of feed-based products at end of previous quarter, current quarter wet processor supply allocation to feed-based products, processor-level average livestock feed product price, next quarter's expected (average) wet livestock feed product price, next quarter's wet livestock feed product price risk
34. Feed manufacturer inventories of dairy cattle feeds at the end of the previous quarter, current quarter feed manufacturer supply allocation to dairy cattle feeds, processor-level dairy cattle feed price, next quarter's expected processor-level dairy cattle feed price, next quarter's dairy cattle feed price risk
35. Feed manufacturer inventories of beef cattle feeds at the end of the previous quarter, current quarter feed manufacturer supply allocation to beef cattle feeds, processor-level

(continued)

Table 6G-6 continued

beef cattle feed price, next quarter's expected processor-level beef cattle feed price, next quarter's beef cattle feed price risk

36. Feed manufacturer inventories of hog feeds at the end of the previous quarter, current quarter feed manufacturer supply allocation to hog feeds, processor-level hog feed price next quarter's expected processor-level hog feed price, next quarter's hog feed price risk
37. Feed manufacturer inventories of broiler feeds at the end of the previous quarter, current quarter feed manufacturer supply allocation to broiler feeds, processor-level broiler feed price, next quarter's expected processor-level broiler feed price, next quarter's broiler feed price risk
38. Feed manufacturer inventories of poultry egg feeds at the end of the previous quarter, current quarter feed manufacturer supply allocation of poultry egg feeds, processor-level poultry egg feed price, next quarter's expected processor-level poultry egg feed price, next quarter's poultry egg feed price risk
39. Inventories of dry process products at the end of the previous quarter, current quarter's supply allocations to dry process products, current quarter's average dry process price, next quarter's expected (average) dried corn products price, next quarter's dried corn products price risk
40. Inventories of alcohol processor products at the end of the previous quarter, current quarter's supply allocation of alcohol processor products, current quarter's average alcohol processor price, next quarter's expected (average) alcohol corn products price, next quarter's dried corn products price risk
41. Inventories of breakfast-food products at the end of the previous quarter, current quarter's supply allocation of breakfast-food products, current quarter's average breakfast-food prices, next quarter's expected (average) breakfast-food products price, next quarter's breakfast-foods products price risk
42. Wet processor storage capacity at the end of the previous calendar year, current year's average wet processor prices, next year's expected wet processor price, next year's wet processor price risk, user cost of wet processor storage capacity
43. Feed manufacturer storage capacity at the end of the previous calendar year, current year's average feed manufacturer price, next year's expected feed manufacturer price, next year's feed manufacturer price risk, user cost of feed manufacturer storage capacity
44. Dry, alcohol, and breakfast-food processor storage capacity at the end of the previous calendar year; current year's average dry, alcohol, and breakfast-food processor price; next year's expected dry, alcohol, and breakfast-food processor price; next year's dry, alcohol, and breakfast-food processor price risk; and user cost of dry, alcohol, and breakfast-food storage capacity

D. Distribution and Final Demand Block

1. Industrial cornstarch processing capacity, current quarter's processor-level industrial cornstarch price, expected industrial cornstarch margins, prices of substitutable products
2. Industrial corn sugar processing capacity, current quarter's processor-level industrial corn sugar price, expected industrial corn sugar margins, prices of substitutable products
3. Industrial corn oil processing capacity, current quarter's processor-level industrial corn oil price, expected industrial corn oil margins, prices of substitutable products
4. Current quarter's processor-level average wet livestock feed product price; weighted index of expected livestock feed product prices, index of livestock product price risks, net production of meat animals slaughtered, prices of major competing feed inputs
5. Processor-level dairy cattle feed price, weighted index of expected fresh milk and manufactured milk prices, weighted index of fresh and manufactured milk price risk, number of dairy cattle two years and over, prices of major competing feed inputs
6. Processor-level beef cattle feed price, expected beef slaughter price, beef slaughter price risk, number of beef cattle placed in feedlots, number of beef cattle on rangeland, prices of major competing feed inputs
7. Processor-level hog feed price, expected hog slaughter price, hog slaughter price risk, number of hogs, prices of major competing feed inputs
8. Processor-level broiler feed price, expected broiler slaughter prices, broiler slaughter price risk, number of broilers on feed, prices of major competing feed inputs

Table 6G-6 continued

9. Processor-level poultry egg feed price, expected egg price, egg price risk, number of laying hens, prices of major competing feed inputs
10. Wholesaler and retailer average margin for dried corn products, consumer average dried corn products price, proxy measure for supermarket dried corn product shelf space, index of expected margins on competing shelf space products
11. Wholesaler and retailer average margin for corn alcohol products, consumer average alcohol products price, proxy measure for liquor store and supermarket alcohol shelf space, index of expected margins on competing shelf space products
12. Wholesaler and retailer average margin for corn breakfast-food products, consumer average corn breakfast-food products price, proxy measure for supermarket corn breakfast-food products, index of expected margins on competing shelf space products
13. Wholesaler and retailer average margin for cornstarch products, consumer average dried corn products price, proxy measure for supermarket cornstarch shelf space, index of expected margins on competing shelf space products
14. Wholesaler and retailer average margin for corn sugar products, consumer average dried corn products price, proxy measure for supermarket corn sugar shelf space, index of expected margins on competing shelf space products
15. Wholesaler and retailer average margin for corn oil products, consumer average dried corn products price, proxy measure for supermarket corn oil shelf space, index of expected margins on competing shelf space products
16. Consumer average dried corn products price, prices of major substitutable commodities, consumer per-capita income, proxy measure for consumer taste, and level of dried corn products advertising
17. Consumer average alcohol products price, prices of major substitutable commodities, consumer per-capita income, proxy measure for consumer taste, and level of alcohol products advertising
18. Consumer average corn breakfast-products price, prices of major substitutable commodities, consumer per-capita income, proxy measure for consumer taste, and level of corn breakfast products advertising
19. Consumer average cornstarch products price, prices of major substitutable commodities, consumer per-capita income, proxy measure for consumer taste, and level of cornstarch advertising
20. Consumer average corn sugar products price, prices of major substitutable commodities, consumer per-capita income, proxy measure for consumer taste, and level of corn sugar advertising
21. Consumer average corn oil price, prices of major substitutable commodities, consumer per-capita income, proxy measure for consumer taste, and level of corn oil advertising

E. Vertical Price Structure and Distribution Margin Generation Block

1. Generated from supply allocation and feed manufactured demand relations appearing in farm, assembler, and processor blocks along with coordinating mechanisms
2. Generated from supply allocation and wet processor demand relations appearing in farm assembler and processor blocks along with coordinating mechanisms
3. Generated from supply allocation and demand relations appearing in farm, assembler, and processor blocks along with coordinating mechanisms
4. Generated from supply allocation and country elevator demand relations appearing in farm and assembler blocks along with coordinating mechanisms
5. Generated from supply allocation and subterminal elevator demand relations appearing in farm and assembler blocks along with coordinating mechanisms
6. Generated from supply allocation and terminal elevator demand relations appearing in farm and assembler blocks along with coordinating mechanisms
7. Generated from feed manufacturer supply allocation and demand relations in assembler and processing blocks along with coordinating mechanisms
8. Generated from wet processor supply allocation and demand relations appearing in farm and assembler blocks along with coordinating mechanisms

(continued)

Table 6G-6 continued

9. Generated from dry, alcohol, and breakfast-food processor supply allocation and demand relations in assembler and processing blocks along with coordinating mechanisms
10. Generated from export supply allocation and demand relations appearing in assembler block along with coordinating mechanisms
11. Generated from industrial cornstarch allocation equations and demand relations appearing in processor and distribution block along with coordinating mechanisms
12. Generated from consumer cornstarch allocation equations and demand relations appearing in processor and distribution block along with coordinating mechanisms
13. Generated from industrial corn sugar allocation equations and demand relations appearing in processor and distribution block along with coordinating mechanisms
14. Generated from consumer corn sugar allocation equations and demand relations appearing in processor and distribution block along with coordinating mechanisms
15. Generated from industrial corn oil allocation equations and demand relations appearing in processor and distribution block along with coordinating mechanisms
16. Generated from consumer corn oil allocation equations and demand relations appearing in processor and distribution block along with coordinating mechanisms
17. Generated from wet livestock feed product supply allocation and demand relations appearing in processor and distribution blocks along with coordinating mechanisms
18. Generated from dairy cattle feed supply allocation and demand relations appearing in the processor and distribution blocks along with coordinating mechanisms
19. Generated from beef cattle feed supply allocation and demand relations appearing in the processor and distribution blocks along with coordinating mechanisms
20. Generated from hog feed supply allocation and demand relations appearing in the processor and distribution blocks along with coordinating mechanisms
21. Generated from broiler feed supply allocation and demand relations appearing in the processor and distribution blocks along with coordinating mechanisms
22. Generated from poultry feed supply allocation and demand relations appearing in the processor and distribution blocks along with coordinating mechanisms
23. Generated from dry corn feed supply allocation and demand relations appearing in the processor and distribution blocks along with coordinating mechanisms
24. Generated from alcohol feed supply allocation and demand relations appearing in the processor and distribution blocks along with coordinating mechanisms
25. Generated from breakfast-food feed supply allocation and demand relations appearing in the processor and distribution blocks along with coordinating mechanisms
26. Volume of dry corn products handled by wholesalers and retailers, wholesaler and retailer labor costs, expected rate of return on retailer-invested capital, average processor-level dried corn price, processor-level dry corn price risk
27. Volume of corn alcohol products handled by wholesalers and retailers, wholesaler and retailer labor costs, expected rate of return on retailer-invested capital, average processor-level corn alcohol price, processor-level corn alcohol price risk
28. Volume of corn breakfast-food products handled by wholesalers and retailers, wholesaler and retailer labor costs, expected rate of return on retailer-invested capital, average processor-level corn breakfast-food price, processor-level corn-breakfast food price risk
29. Volume of cornstarch food products handled by wholesalers and retailers, wholesaler and retailer labor costs, expected rate of return on retailer-invested capital, average processor-level cornstarch food price, processor-level cornstarch food price risk
30. Volume of corn sugar food products handled by wholesalers and retailers, wholesaler and retailer labor costs, expected rate of return on retailer-invested capital, average processor-level corn sugar food price, processor-level corn sugar food price risk
31. Volume of corn oil food products handled by wholesalers and retailers, wholesaler and retailer labor costs, expected rate of return on retailer-invested capital, average processor-level corn oil food price, processor-level corn sugar food price risk
32. Generated by adding numbers 23 and 26 of this block
33. Generated by adding numbers 24 and 27 of this block
34. Generated by adding numbers 25 and 28 of this block
35. Generated by adding numbers 12 and 29 of this block
36. Generated by adding numbers 14 and 30 of this block
37. Generated by adding numbers 16 and 31 of this block

acreage, and yield relationships across regions and farm sizes. The incorporation of these elements should provide a more accurate representation of the farm block and thus admit more realistic policy analysis.

The supply-allocation of the farm, assembler, and processor blocks are weakly treated by current modeling formulations. The USDA Feedgrain–Livestock Model and the CARD Simulation Model treat this component in terms of broad categories (feed versus food versus seed), and then only in terms of simple identities. This simplification reflects, in part, the overemphasis of these modeling efforts on the farm production component. It is in the supply-allocation relations that the coordinating mechanisms have a major influence. Hence, if we desire to evaluate various institutional arrangements or proposed changes in them, the supply-allocation relations must be empiricized. Finally, in contrast to much of the previous and current modeling work, these relations are specified on a quarterly rather than an annual basis. This specification has the advantage of allowing coordinating mechanisms and inventory-holding behavior to assume some importance in the model.

Since the assembler, processor, and distributor components have been generally neglected by previous and current modeling efforts, price-transfer or demand relations among various levels of the marketing chain for corn have also been neglected. The inclusion of these relations along with equations representing capital expansion decisions, inventory decisions, use of coordinating mechanisms, and the distribution of aggregate growth among various regions participating in these components will allow our formulation to take explicit account of human and managerial influences, which in the final analysis motivate the system.

The interdependencies between the U.S. corn system and other commodity systems should also be recognized. These interdependencies are not included in Tables 6G-5 and 6G-6. However, the blocks can easily be combined with established livestock models. Here the previous modeling work of Rausser and Freebairn (1973, 1975), the USDA (n.p.) representations for the livestock sector, and the CARD Simulation Model will prove useful. Still, these models require a bit of further work on specifying the alternatives available for feeding beef cattle. In particular, the allocation between fed and nonfed beef has not been properly specified. This failing is understandable, given the modelers' reliance on secondary data that reveal little fluctuation in feedgrain prices.

The USDA Feedgrain–Livestock Model and the CARD Simulation Model will prove of some value in obtaining useful representations of U.S. food demand for corn. However, to obtain an adequate representation of the demand for corn emanating from final consumer demand, their specifications should be disaggregated for such dry products as breakfast foods, corn meal, and grits; wet products such as sugar, starches, oil and syrup; and alcohol and distilled spirits. The modeling efforts concerning the demand for these products has been indeed meager, and much remains to be done.

The export submodel of the U.S. Feedgrain–Livestock Model and the Harvard-MIT Trade Model move us well in the direction of finding a reasonable

formulation of export demand for U.S. corn. Additional efforts should concentrate on adapting Breedhal and Abbott's work by specifying the influence of other major exporting countries on U.S. corn trade. Moreover, the representation of this component should include all of the influencing factors listed in Table 6G-6. These factors should not be discarded arbitrarily because of data limitations and degrees-of-freedom problems.

Empirical Implementation. As Rausser (1973) points out, the availability of secondary or published time-series data places awesome constraints on the construction of useful models. With this thought in mind, we must resort to other sources of information to empiricize the model we have advanced. These other sources of information include: (1) a priori information (expert opinion, judgments, perceptions of participants within the system, and so forth); (2) cross-section data; and (3) primary or survey data. The first source of information requires extensive consultation with system participants. The second requires judicious use of published information pertaining to a particular time. And the third source requires the collection of additional data, especially information on storage capacity within various components of the system. The methods by which these various sources of information can be combined with secondary time-series data to estimate the unknown parameters of the model outlined in Tables 6G-5 and 6G-6 are detailed in Johnson and Rausser (1975). Such methods do exist, and they can be employed to assess the desirability of new information, particularly the benefits and cost of collecting additional sample data on which to base the construction of useful model formulations.[23]

In some instances, of course, it will be impossible to obtain data on a particular variable or on its effects on other variables. Under these circumstances, there are other techniques we can turn to to assist us in the construction of the model. These techniques have been referred to in the literature as "errors in variables" and "unobservable variable" estimation methods. Although these techniques have not been used widely in an empirical setting, they are operational and should prove useful in modeling components of the U.S. corn system.

A further important issue in empirical implementation is that of structural change. Previous modelers have had little success dealing with structural changes. Prior to 1972, they were not even a crucial issue. However, given the vast changes that have occurred recently in the corn commodity system, it is clear that this issue can no longer be neglected. If the system changes, a good model ought to be able to change with it. Fortunately, a number of estimating techniques have recently been advanced to deal with such changes.[24] They emphasize the need for constantly updating the model representation and using additional information to revise previously estimated parameters. The principal benefit of the approaches is improved statistical properties of the parameter estimates and thus a more accurate and reliable basis for forecasting and policy analysis.

What resources are required to construct the model we have outlined? What

resources are needed to properly maintain and operate the model once it is constructed? Table 6G-7 outlines an answer. First, with regard to construction, a critical mass is required to achieve a working model. An intelligent effort will involve: (1) a manager rather than a modeler in charge; (2) at least two experienced econometricians who are intimately familiar with the U.S. corn system; (3) two research assistants who have the equivalent of a master's degree in economics with a specialization in mathematical statistics; (4) clerical assistants who have some familiarity with the design of surveys, interviewing techniques, and data collection and summarization; (5) a computer programmer and a large-scale computer (i.e., IBM 370); and (6) industry and other expert consultants. It is particularly important that a user be placed in the management role rather than one of the econometricians. A user-manager will offer greater assurance that the planning and decision goals in the model will be met and that the entire effort will reflect a sensitivity to the motivations and priorities of the user organization. The only other element of the model construction that may require some explanation is the need for consultants. As previously noted, judgmental information should be incorporated into the model.

The resource needs outlined in Table 6G-7 under model maintenance and operation are advanced for the purpose of continually revising the model, expanding its scope, generating its forecasts, and performing policy analysis.

Possible Uses of Model Representation. Throughout the discussion we have been principally concerned with a model which could address the policy issues we have raised. We have viewed these policy issues from the standpoint of the U.S. government's concern with international trade, foreign aid, inventory stocks, production controls, environmental quality controls, and antitrust activities. Our model is sufficiently comprehensive to evaluate the effect of

Table 6G-7. Resources Needed to Implement Proposed Modeling Effort

A. Model Construction Resources
1. User-manager (1/4 man-year)
2. Experienced econometricians (1.5 man-years)
3. Research assistants (2 man-years)
4. Clerical assistance: data survey preparation, collection, and summarization
5. Computer time and programmer
6. Industry and expert consultants

B. Continued Model Maintenance and Operation Resources
1. User-manager (1/8 man-year)
2. Experienced econometrician (1/4 man-year)
3. Research assistant (1/2 man-year)
4. Clerical assistance: data survey preparation, collection, and summarization
5. Computer time and programmer
6. Industry and expert consultants

Source: author's estimate.

various instruments that the government can use to effectuate changes in tl performance of the system. The specific instruments that the model specificatic allows include export subsidies, export controls, concessional sales, impo tariffs and quotas, government purchases of corn and holding of inventoi stocks, price supports, acreage diversions and allotments, constraints on the u: of certain inputs which influence environmental quality (particularly the qualit of land and water), and the U.S. Justice Department's antitrust activities th: influence the concentration within various components of the system--especiall in the trader, processor, and distributor components of the system.

To evaluate the desirability of using these policy instruments, one migh formally state an objective function as an integral component of the polic analysis. Measurements of input, manufacturers' margins, farmer profits, assen bler margins, processor margins, distributor margins, and consumer welfar should be included in this objective function. And given the importance o storage policies and the need for corn reserves to satisfy multiple purposes measurements of various LDCs' welfare should also be incorporated into thi objective function. Such a measurement is needed to evaluate the impact o various foreign aid levels as well as to evaluate sales at less than world marke prices. In using the model for simulation experiments, various weightings acros: those performance measures can be employed to allow investigation of the impli cations of alternative preferences for various groups.

Or, one might dispense with an explicit objective function and instead simply generate, for selected values of policy variables, the time paths of important performance variables. Policymakers can then compare the time paths or scenarios resulting from certain policies with their objectives.

Limitations of Model Use. Although modeling and quantitative methods have advanced considerably over the last few decades, there remain important qualifications and cautions to keep in mind in applying these tools. Qualifications associated with the model construction process are, of course, concerned with the frequently encountered problems of autocorrelation, multicollinearity, omitted variables, heteroscedasticity, aggregation biases, measurement errors, and the like. These problems can be adequately handled by an experienced econometrician employing the methods we have outlined.

There are, however, other more subtle problems that should be kept in mind in applying model representations for various purposes. Perhaps the most common mistake in constructing models is to fail to define at the outset how the model will be used, who the decisionmakers are, what variables can be manipulated, and how these variables should be explicitly incorporated in the model. We often find that analysts construct a model of a system without taking into account which variables the decisionmaker can control and how the model will be used for policy analysis.

Other important cautions include the following:

1. The development and use of models supplement rather than supplant the usual decisionmaking processes.
2. Model construction should be recognized as an individualistic and people-dependent process.
3. Once the model begins to augment old thought patterns, a series of misuses often arises. One of the more prevalent misuses is using the model as a substitute for sharp and logical thinking. Remember that results printed out by a computer are not necessarily "the truth." And even though many alternatives may have been tested with the model, do not rigidly adhere to the selected alternative simply because it has been rigorously tested. Instead, use the model to test the implications of this alternative and other modifications under altered conditions. Finally, models are not for justifying actions; they explore the implications of alternatives. Unfortunately, planning is an advocacy process in many organizations.
4. Develop and maintain the necessary expertise to manage and update the model. Too often models are allowed to become outdated and their creditability and usefulness deteriorate.
5. Develop scaled-down versions of the model for quick calculations. Don't spend time with the fully elaborated model unnecessarily.
6. To achieve the most effective use of the model, construct it within the user's organization. If it is somewhere else, communication, mutual understanding, and control of the model may be lost.
7. The roles of various participants in the model's construction and use should be defined clearly at the outset. Too often, team members direct their efforts every which-way.
8. A manager rather than a modeler should be placed in charge of model construction and use. Numerous studies have stated strongly that senior management's abdication of its responsibilities to technicians is one of the prime reasons that private companies and public agencies have not realized the true potential of model representations.
9. Make allowances within the model specifications for judgmental inputs. As noted above, such inputs are crucial for a truly useful representation. Moreover, successful modeling efforts often allow users to see the intermediate results, to modify results prior to the next stage, and to intervene in model use.

Many studies have found that user involvement in model construction is widely neglected, and that neglect is costly.[25] Users clearly can play an important role in the determination of construction objectives. Moreover, analysts are well advised to pay attention to user perceptions of the system. After all, people tend to trust and use something they have had some hand in developing. Finally, involving users during model development enhances their understanding and decreases the training they require to use the model. Other recommendations:

express inputs and outputs in familiar and easily comprehensible terms; selec a manager and econometricians who have common experiences and can com municate; allow model construction and data collection to proceed simultane ously; continually verify and debug the model to assure that the model satisfie: its purpose; and establish an on-going user validation.

Concluding Remarks, and Implications for a Complete World Corn Model

The considerations faced in constructing a model for the U.S. corn system are much the same as those for models for other nations and regions. The qualitative dimensions of the input, producer, assembler, processor, distributor, and consumer components of corn systems within various countries are much the same as those within the United States. The quantitative dimensions, however, are quite different. National food policies, standards of living, transportation and inventory facilities, assembly and distributional networks, weather conditions, market mechanisms that provide price information, the availability of various inputs, management capability, and foreign exchange capacities differ substantially among various countries. Hence, a good model of the world corn system requires a substantial expansion of the export submodel discussed here. Export components for each country will have to be added to a working model of the U.S. system.

The concentration of corn production within a few countries facilitates the development of a world model. Most efforts should be devoted to modeling these countries' systems along with the processor-distributor-consumer components of major importing countries. Proper identification of the input, producer, assembler, and distributor components will be crucial–especially for LDCs, whose system components will differ rather substantially from those of the U.S. system.

To illustrate the above differences in the context of the model specified early in this appendix, briefly consider the producer component along with the supply allocation equations. For LDCs it is imperative that the producer component be disaggregated into a least two subcomponents: one associated with subsistence or traditional production and the other associated with modern or market-oriented production. In addition, one needs quantitative representations of the transition from traditional to modern production. This transition is influenced by such factors as the coordinating mechanisms and government research and extension activities that have a direct bearing on productivity, technical progress, education, and managerial performance. By separating these aspects of the producer component, one may investigate the distributional effects of various government policies, especially input and output price subsidies and taxes.

The supply allocation component obviously differs from that of the U.S. model that would be advanced for LDCs. Because LDC producers hold corn on farms for human consumption, a model has to represent the consumption needs

of participants within the subsistence subcomponent. This is no simple task; it requires a great deal of primary data and expert opinion. In modeling other components of LDC corn systems, potential bottlenecks must be recognized in the quantitative formulation for the assembler, processor, and distributor components. Here the influence of coordinating mechanisms becomes crucial, particularly the means by which they can be deployed to eliminate or reduce such bottlenecks. Finally, in the consumer component, much more emphasis will have to be given to nutritional requirements and distributional effects than is necessary for the U.S. model. The model designer might do this by dividing the consumer component by income and nutritional levels.

The empirical implementation of the model specified, with the qualifications noted above, requires far more ingenuity for LDCs than for the United States. If research investigators rely solely on secondary data sources, the implementation of such a model is clearly impossible. To construct useful decision models for LDCs, heavy doses of a priori information cross-section data, and additional primary data will be required. Our framework for empirically implementing a model also leads to questions regarding the proper data base, particularly the organization and resources devoted to data-collection agencies. Policies of LDC governments in this area have been notoriously deficient. Empirical implementation of the model advanced here would define these deficiencies and provide a formal basis for evaluating the costs and benefits of alleviating them.

In addition to the uses of the model noted above, there are a number of other potential policy applications of a world corn model. For purposes of exposition, these potential applications can be divided into three categories: national, regional, and global. The national applications are much the same as those discussed for the U.S. system. Of course, the emphases of LDCs will differ from those of the United States. The relation between nutritional levels and economic welfare aspects of different trade, production, pricing, and distributional policies are far more important in LDCs than in the United States. Moreover, the affects on risk, returns, and margins resulting from changing the price structure of farm block production inputs is perhaps also of more importance in LDCs. Educational, extension, and research policies are also of much greater relative importance in LDCs due to the dichotomy between subsistence and modern subcomponents of the farm production component. Finally, the effects of food aid on both consumer nutritional levels and responses of farmers in both subsistence and modern subcomponents requires more precise modelling efforts, especially in properly delineating the incentive effects of food aid and governmental reserve policies

On a regional basis it is difficult to isolate a decision-making unit which will have any direct influence on the performance of the corn system within any particular country. Nevertheless, a number of institutes and networks exist which could utilize models constructed for individual countries within their region to monitor the impact of structural shifts, weather conditions, along with produc-

tion levels of major exporting countries outside their region. For example, the institute and network framework suggested by this study would be a reasonable place to locate individual country models comprising Southeast Asia. The institute could be charged with the responsibility of revising and updating individual country models on a periodic basis; evaluating the impact of current conditions in other countries' corn systems of the world on Southeast Asia; monitoring weather conditions and their possible impacts via simulating the corn system model for Southeast Asia; formulating long-run forecasts given particular policy scenarios; and publishing the results of utilizing the model in a popular form which would be readily available to public decision-makers and all other participants within the corn systems of Southeast Asian countries.

It is also difficult to isolate a world decisionmaking agency that has some direct influence on the world corn system. However, it is clear that organizations such as FAO and the World Bank can use a complete world model in much the same fashion as the institute in Southeast Asia. They can employ the model to examine the effects of individual country trade, foreign aid, and the credit policies of developed countries vis-à-vis developing countries. They can simulate the possible long-run consequences of various trade distortions on LDCs' food availability—including not only tariffs and quotas but also trade preference schemes and concessional sale policies by the United States. A comprehensive model will also allow a more precise evaluation of World Bank credit policies. Furthermore, the quantitative measurement of the effectiveness of food aid, trade, and credit policies will allow examination of the price responsiveness of farmers and the reallocation of domestic resources resulting from demand shifts within LDCs.

One final point of importance. Even if a complete world corn model is never used for policy purposes, it might still be of substantial value. Attempts to construct such a model improve perceptions of the dynamic evolution of component interactions, country interactions, the interactions of corn systems with other commodity systems, and the feedback effects of policy decisions. The mathematical aspects of construction force the people involved to be consistent in their perceptions and to evaluate whether their perceptions are based on fantasy or fact.

NOTES

1. Recent research has shown that very large savings can be obtained in grain use by substituting silage for corn.

2. The model advanced to determine the optimal storage rules was a straightforward application of Bellman's (1961) dynamic programing procedures.

3. Available data prior to the Gustafson study (except for years in which acreage allotments were in effect) show clearly that the major variation in year-to-year output is due to variations in yields.

4. This investigation followed rather closely the framework advanced by

Houck and Subotnik (1969) to analyze the influence of governmental programs on soybean acreage response.

5. These relative effects should be interpreted with caution, since the effective price-support values are considerably greater than the effective diversion rate values. In fact, the total influence on corn acreage of *PF* exceeds that of *DP*.

6. This measurement pertains to the 1969 calendar year.

7. The work by Foote, Klein, and Clough (1952) and Meinken (1953) is closely related to the two 1953 publications by Foote.

8. It is not clear from Ray and Heady's presentation what the actual data base is for the constructed model. They simply state that "time series data for many of the commodity resource demand variables are not published. The commodity input series were developed from cost and return input-output studies, published and unpublished data from the U.S. Department of Agriculture, discussions with officials with the USDA's farm economics division and the national trends of the aggregate input series." Of course, published data for the remaining variables included in the model are readily available from secondary sources. It is likely that the data cover the postwar period up until about 1969.

9. These authors use the same categorization of variables employed by Tyner and Tweeten (1965). That is, for each commodity submodel they have a *preinput component* providing estimates of feedgrain acreage, commodity stocks, machinery stocks, and stocks of physical assets needed in the *input* component, which estimates current-year input levels. These latter levels are then fed into the final component to determine the supply of various commodities.

10. A number of commercial interests are also constructing large-scale econometric models of the U.S. agricultural sector that include corn as one of their commodity systems. The first of these models to be completed has been developed by Chase Econometric Associates, Inc. It includes ten major commodity systems and is based largely upon the earlier model constructed by Evans (1967). This model is described in Harvard Business School case No. 4-576-197, copyright 1976. The second commercial model, covering twenty-seven commodities, was constructed by Data Resources, Inc. This model is currently on-line and generating forecasts. It, too, is described by a Harvard Business School case, numbered 4-576-117, copyright 1976. A final commercial model is in the early stages of its development by Wharton Econometrics Group.

11. Food and Agricultural Organization, "Agricultural Commodities–Projection for 1975 and 1985," 1967.

12. USDA, "The World Food Situation and Prospects to 1985," 1974.

13. A further criticism of the USDA approach is that the department does not report the model on which its projections are based. It is impossible for other research investigators to evaluate the model or to examine the accuracy of their results by duplicating the projections and forecasts reported by the USDA.

14. These countries accounted for almost all U.S. corn exports until the mid-sixties and in recent years they have accounted for about 70 percent of exports.

15. Dummy variables are incorporated to reflect the formation of agricultural policy for the EEC; for the Soviet Union, a policy of "tightening their belts" during production shortfalls since the early 1960s; for Argentina, a currency collapse in 1958; for India, the famine years of the 1960s; and for Indonesia, the period after the fall of Sukarno when a new government came into power.

16. In other words, supply relations will not exist for countries that behave as price setters and that charge different monopoly rents over the period used as a basis for estimation.

17. The doubling of E_c is justified on the grounds that for the EEC feedgrain trade, the domestic and international markets are reasonably closely connected. This connection is reflected by the E_p measure of 0.57, which suggests that 57 percent of all production shortfalls within the EEC are covered by trade.

18. Recall that the USDA formulation assumes that the entire market extends into the international market.

19. Abbott also goes on to perform a policy analysis in the context of the estimated trade equations. Presently this analysis is only preliminary.

20. Given world variability in cereal production and a price elasticity of -0.2, the probability of positive optimal carryover in 1975 is essentially nil. However, with the price elasticity of -0.1 and with growing variability over time, there is a 0.82 probability of no carryover and a probability of 0.95 that the optimal carryover will be ten million tons or less.

21. The authors refer to these policies as "maximum efficiency future policies." These policies include: a change in farm structure to a larger, more efficient farm size; increases in research expenditures to increase crop yields 15 percent above trend projections; and elimination of production controls to allow greater efficiency in the geographic location of crop production. They also assume a price-support program will be implemented by the government to encourage the adoption of new technology and to prevent severe declines in farm prices and incomes. Governmental purchases are presumed to be employed to prevent farm prices from falling below minimum levels of $1.20 per bushel for wheat, $0.90 per bushel for feedgrains, and $0.18 per pound for cotton.

22. Note that the major list of endogenous and explanatory variables does not include explicit reference to the endogenous variables listed for the livestock sector. The reason for not including these variables, as subsequently pointed out, is that once the model in Tables 6G-5 and 6G-6 is constructed, it can be combined with a slightly altered version of some of the existing U.S. livestock sector models. Hence, we will not make a major effort to construct relations explaining the dynamics of the U.S. livestock sector.

23. These methods are based on the adaptive or dual control techniques already discussed. They rely on the specific dimensions of model purpose, learning, and the sequential design of experiments. They formalize the purchasing of information and the learning of probabilities, and they recognize that the accumulation of information or empirical knowledge ought to be treated in an "active" rather than a "passive" fashion. In essence, this approach examines issues of information, revision, and additional data collection within a strategic research and development framework. Philosophically, the approach recognizes that the unobservable of today may well become observable tomorrow.

24. For discussion of these techniques, see Rausser, "Structural Changes, Nonstationary Parameters, and Approaches for Updating Quantitative Models," 1975. For an application, see Freebairn and Rausser (1974).

25. See, for example, McKinsey and Company, Inc., "Unlocking the Computer's Potential," New York, 1968.

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About the Authors

Professor Ray A. Goldberg is the George M. Moffett Professor of Agriculture and Business at Harvard Business School and heads up the Agribusiness Program. His most recent publications include co-authorship of THE LESSONS OF WAGE AND PRICE CONTROLS–THE FOOD SECTOR and senior author of AGRIBUSINESS MANAGEMENT FOR DEVELOPING COUNTRIES–LATIN AMERICA. He is currently a member of the Board of Governors, International Development Research Centre of the Government of Canada, as well as past Chairman of the Commonwealth of Massachusetts Governor's Commission on Food. He works closely with private, cooperative, and governmental institutions in domestic and international agribusiness.

Richard C. McGinity is a graduate of Princeton University and of Harvard Business School, where he was a Research Associate to the agribusiness program. He is completing his doctoral dissertation relating technological change to a food industry structure. Mr. McGinity is currently Manager of the Agricultural Commodity Systems Technical Area of Parsons Brinckerhoff Quade & Douglas, Inc., a planning and engineering consulting firm.