AP-42 Section Number: 9.11.1

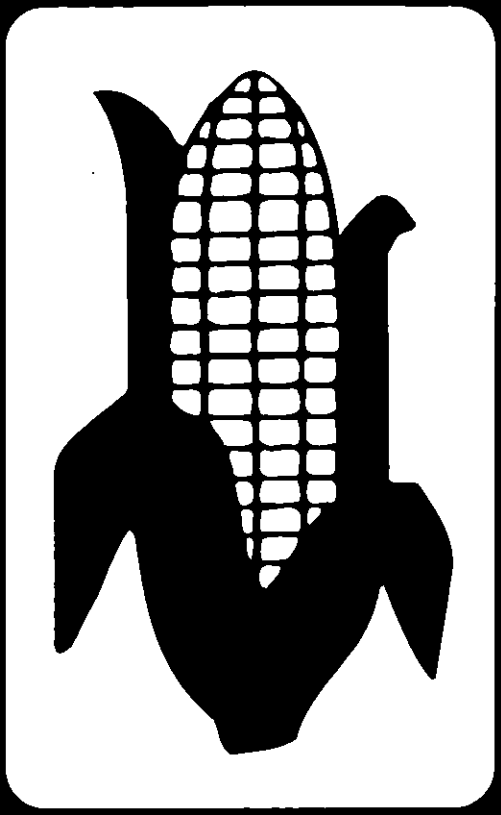
Reference Number: 4

Title: Corn Annual 1992

Corn Refiners Association Inc.

Corn Refiners Association Inc.

1992



CORN 1992 ANNUAL

Table of Contents

Cover photography by Gregory Thorp

Foreword

Eight years shy of the 3rd millennium, the world treats fantastic technological advances as *blasé*. Five centuries ago dramatic changes were neither as frequent nor as obvious. But they happened nonetheless; for precisely 500 years ago an explorer returned to the "civilized" world with maize.

Since 1492, corn has profoundly changed the world. One of Earth's three most important grains, corn sustains life in Africa, Asia and the Americas. Corn refiners, centered in the U.S. but positioned worldwide, meld corn and cutting-edge technology to produce results as spectacular and yet as utilitarian as any satellite downlink or cellular phone conversation.

Our industry continues to find new ways to make better use of corn. Corn sweeteners provide low-cost energy. Starch-based bulking agents and fat substitutes create more flavorful and nutritional food products. Corn refiners now make citric acid, pharmaceuticals, polymers, unique industrial adhesives and chemical bonding agents. And of course, they make fuels which hold the promise of America never again having to risk her security on vulnerable sources of petroleum.

500 years after corn entered world trade, the 1992 **Corn Annual** explores the industry's prospects for an even greater role in tomorrow's global market. We cannot predict the complexion of new world trade agreements, but we hope the following articles will show you the exciting horizons facing corn refiners—once the world's traders take down their barriers.

On behalf of the CRA's members, I offer a special thanks to U.S. Secretary of Agriculture Edward R. Madigan and his fellow contributors, not only for their articles but also for their active efforts to reinvigorate world trade. One of them, H. Thomas Reed, spearheads industry innovation both as president of Penford Products, Inc., and chairman of the 1992 Board of Directors of the CRA. All of us connected with the CRA appreciate Tom's commitment, leadership and skill.

Personally, I want to recognize and thank the extraordinarily capable CRA staff. Individually and as a team, their contributions, too, have enhanced the position of U.S. corn refiners as world market participants.

Terry L. Claassen
President

Member Companies and Plant Locations

ADM Corn Processing
(A division of Archer Daniels Midland Company)
P.O. Box 1470
Decatur, Illinois 62525
Plants: Cedar Rapids, Iowa 52404
Clinton, Iowa 52732
Decatur, Illinois 62525
Montezuma, New York 13117

American Maize-Products Company
250 Harbor Plaza Drive
Box 10128
Stamford, Connecticut 06904
Plants: Decatur, Alabama 35601
Dimmitt, Texas 79027
Hammond, Indiana 46320

Cargill, Incorporated
P.O. Box 9300
Minneapolis, Minnesota 55440
Plants: Cedar Rapids, Iowa 52406
Dayton, Ohio 45413
Eddyville, Iowa 52553
Memphis, Tennessee 38113

CPC International Inc.
International Plaza
P.O. Box 8000
Englewood Cliffs, New Jersey 07632
Plants: Argo, Illinois 60501
Stockton, California 95206
Winston-Salem, North Carolina 27107

Minnesota Corn Processors
400 West Main Street, Suite 201
Marshall, Minnesota 56258
Plant: Marshall, Minnesota 56258

National Starch and Chemical Company
10 Finderne Avenue
Bridgewater, New Jersey 08807
Plants: Indianapolis, Indiana 46221
North Kansas City, Missouri 64116

Penford Products Company
(a division of PENWEST)
P.O. Box 428
Cedar Rapids, Iowa 52406
Plant: Cedar Rapids, Iowa 52406

Roquette America, Inc.
1417 Exchange Street
Keokuk, Iowa 52632
Plant: Keokuk, Iowa 52632

A. E. Staley Manufacturing Company
(a subsidiary of Tate & Lyle, PLC)
P.O. Box 151
Decatur, Illinois 62525
Plants: Decatur, Illinois 62525
Lafayette, Indiana 47905 (2)
Loudon, Tennessee 37774

CRA Staff

Terry L. Claassen	*President*
Kyd D. Brenner	*Director of Public Affairs*
Edith M. Munro	*Director of Communications*
Karen S. Petrosino	*Assistant Treasurer*
Lea Ann Elliott	*Office Manager*
Marion Frayman	*Secretary*
Tracy Nylund	*Clerk*

Board of Directors

H. Thomas Reed, Chairman
Penford Products Company

Douglas A. Lapins, Vice Chairman
A. E. Staley Manufacturing Company

Martin L. Andreas
ADM Corn Processing

John G. Reed, Jr.
ADM Corn Processing

Patric J. McLaughlin
American Maize-Products Company

Fred M. Ash
American Maize-Products Company

E. S. Micek
Cargill, Incorporated

Michael A. Urbanic
Cargill, Incorporated

Samuel C. Scott
CPC International Inc.

Bernard H. Kastory
CPC International Inc.

Richard M. Jurgenson
Minnesota Corn Processors

Robert Nerhus
Minnesota Corn Processors

William H. Powell
National Starch and Chemical Company

James A. Kennedy
National Starch and Chemical Company

Philip B. Wade
Penford Products Company

Robert J. Ireland
Roquette America, Inc.

Bruce W. Brown
Hubinger (Roquette America, Inc.)

J. P. Mohan
A. E. Staley Manufacturing Company

Honorary Directors

C. G. Caldwell
National Starch and Chemical Company

Paul E. Grunder
CPC International Inc.

Harold Hellman
CPC International Inc.

G. M. Mitchell
Cargill, Incorporated

Donald E. Nordlund
A. E. Staley Manufacturing Company

Robert M. Powers
A. E. Staley Manufacturing Company

Paul E. Ramstad
American Maize-Products Company

A. M. Robinson
Hubinger

Corn Refining: An Upbeat Outlook, a Positive Example

by H. Thomas Reed
Chairman, Corn Refiners Association, Inc.

Set against the backdrop of 1991's sagging economy, the corn refining industry's performance in 1991 demonstrates a record of achievement which is the envy of many industries. Refiners increased shipments and corn usage, expanded into new products and launched new plant construction.

New Products from Corn

Every corn wet miller showed growth by introducing new products or entering new product lines.

Starch-based fat replacers made the news, with entries by American Maize-Products Company, National Starch and Chemical Company and A.E. Staley Manufacturing Company.

ADM Corn Processing's fermentation plant came on-stream, making feed additives from refined corn feedstocks, and Cargill Incorporated took its first step into ethanol production.

Penford Products Company broadened its line of starch-latex copolymers for paper coatings and has expanded that technology into textiles, paper size presses, and other paper applications. Minnesota Corn Processors entered the carbon dioxide market.

This list only suggests the potential still to be explored. New projects which will help realize even more of the potential in corn are on the drawing board. For example, Cargill, Incorporated is exploring the production of lactic acid polymers as a new product in the degradable polymer market. American Maize-Products Company is coming to market with new lines of hybridized specialty corn starches.

Refiners expanded product lines and added plant capacity in 1991.

New Plant Capacity

While corn refiners expanded their product lines, they have also added to plant capacity during 1991. A number of significant additions for products like crystalline fructose, high fructose corn syrup, dextrose and starches were undertaken during the year, such as Penford's 30 percent expansion of its starch facility. Other expansions are still in the works, including, at Penford, a further 33 percent increase in specialty industrial starch capacity by 1993.

However, the big news in plant expansion this year has been ethanol.

Corn refiners are responding to the increased need for ethanol as part of the Clean Air Act strategy to improve air quality. In 1991, Cargill came into the ethanol economy, CPC International initiated a major expansion at its Pekin Energy joint venture project. Minnesota Corn Processors, a farmer-owned cooperative, began construction of Nebraska's first corn wet milling facility, primarily for ethanol production, and other ethanol refineries are on the drawing boards throughout the corn refining industry. While just a few years ago only a few corn wet millers were in the ethanol business, today most CRA member companies are in the alcohol fuel market, including our newest member, Roquette America.

Rising Corn Demand and Product Shipments

These advances produced another year of growing corn demand and growing shipments by CRA members. Corn usage in 1991 was up over three percent, and

member company shipments increased 3.3 percent, despite the recession's effects on important consumer industries.

Wet milling industry exports grew by over 15 percent in 1991. Corn refining, which began in the United States and has reached its most extensive level of development here, is more and more an international industry.

Member company shipments increased 3.3%.

U.S. companies have expanded into world markets, winning increased acceptance for corn products. In other nations, corn refining technology is increasingly being put to work, often with joint ventures or other links to U.S. companies. Most of CRA's member firms are major factors in world agricultural markets, and all of the U.S. industry has a deep interest in developing new international roles for corn products.

Trade Challenges

Corn refiners faced other challenges besides the recession in 1991.

As corn refining has been internationalized, trade issues have become more critical to the industry's success. For example, the long struggle over agricultural trade policy in the Uruguay round of GATT negotiations presents Jekyll-and-Hyde possibilities.

A pact that compromises too much and allows too many nations to continue trade abuses could seriously damage the U.S. corn industry.

The European Community's "rebalancing" proposal represents the kind of worst-case scenario that we oppose. Rebalancing would allow the E.C. to rearrange its trade restrictions to limit imports of products like corn gluten feed in exchange for liberalization in other areas. Corn refiners reject such a zero-sum proposal, especially one which would have such a dramatic effect on U.S. corn processing and production. Rebalancing would arbitrarily raise production costs for products like ethanol and HFCS while adding nothing to the export possibilities of other segments of U.S. agriculture.

Conversely, a successful negotiation that strips market-distorting policies out of the world economy could open the door for corn refiners to expand into major markets.

Among the benefits that could flow from such a pact would be the increased use of GATT and the U.N. Codex Alimentarius Commission as vehicles for harmonizing international food standards and resolving technical barriers to trade. Such negotiations could produce widely accepted specifications that would cut commercial red tape and transaction expenses and assure safer, more consistent products to consumers around the world.

Last year's corn gluten feed dispute represents a classic example of the kind of problem that could be prevented. European customs officials, applying a novel technology to the testing of feed ingredients, suddenly ruled that U.S. corn gluten feed did not meet E.C. specifications and began placing prohibitive customs duties on the product.

After months of meetings and a major effort to improve E.C. officials' understanding of the nature of corn refining and refined feed products, U.S. and E.C. officials recognized that U.S.-produced corn gluten feed was acceptable under their import classifications. However, the cost of the misunderstanding in time and money was significant not only for corn refiners, but also for the industry's European customers.

Corn refining would also benefit from higher profile GATT reforms—such as opening restricted markets like the European Community to corn sweeteners or Asian markets to modified starches. While any GATT agreement will require many adjustments, some positive and some negative, the U.S. corn refining industry is

positioned to be one of the winners in a truly fair global trading environment.

The same is true of the pros and cons of a North American Free Trade Agreement. If political leaders can achieve the necessary reforms, corn refiners, with their efficiency as sweetener producers and expertise in starch technology, can look forward to even more growth potential in the decades ahead.

Domestic Concerns

Domestic policies can also encourage or thwart the growth of industries like corn refining.

While harmonizing international food standards would benefit corn refiners, the current U.S. tendency to balkanize regulations represents a threat to industry. In areas such as food labeling, food safety and right-to-know regulations, state legislation may force the food industry to cater to 50 separate sets of rules. As on the international level, both U.S. consumers and industries are better off with a single, well-enforced regulatory system that provides the same protection for all Americans.

Looking Forward

While corn refiners are proud of their achievements in 1991, what's most important is that we look forward to even better growth, as we realize some of the gains initiated last year.

Since 1980, the corn wet milling industry has achieved an average compound growth rate of about 6.5 percent annually. Maintaining that rate would mean that our industry will use nearly two billion bushels of corn each year by 2001. That is our goal.

Achieving that goal will require a series of events—some within the control of our industry, and some not. We can be sure that corn wet millers will continue the research, development and productive investment which will support this goal. We can be sure that American's corn producers will be ready with adequate, quality, raw materials. We can be less sure of the course of political events which may promote or retard this growth. However, our industry is committed to do all it can to take wet milling to the two-billion-bushel mark and beyond in the next decade.

Shipments of Products of the Corn Refining Industry—1991

Starch Products	
(Includes corn starch, modified starch and dextrins)	5,149,754,000
Refinery Products	
(Includes glucose syrup, high fructose corn syrup, dextrose, corn syrup solids, maltodextrins)	23,752,992,000
High fructose corn syrup—42%	7,086,236,000
High fructose corn syrup—55% +	9,124,011,000
Total HFCS	16,210,247,000
Total—Domestic Basic Products	28,902,745,000
Total—Export Basic Products	698,864,000
Corn oil (crude and refined)	1,097,760,000
Corn gluten feed and corn oil meal	9,329,472,000
Corn gluten meal	1,872,666,000
Steepwater	386,152,000
TOTAL SHIPMENTS	42,287,659,000

Compiled for the Corn Refiners Association, Inc., by Ernst & Young. Statistics represent shipments by members of the association. Shipments are in pounds, commercial weights.

Member Company Products

	ADM Corn Processing	American Maize-Products Company	Cargill, Incorporated	CPC International Inc.	Minnesota Corn Processors	National Starch and Chemical Company	Penford Products Company	Roquette America, Inc.	A.E. Staley Manufacturing Company
Starch Products									
Unmodified, food	●	●	●	●	●	●		●	●
Unmodified, industrial	●	●	●	●	●	●	●	●	●
Modified, food		●	●			●	●	●	●
Modified, industrial	●	●	●	●		●	●	●	●
Dextrins	●	●				●		●	●
Cyclodextrins		●						●	
Refinery Products									
Glucose syrups	●	●	●	●	●		●	●	●
Maltodextrins		●					●	●	●
Dextrose monohydrate	●			●				●	●
Dextrose anhydrous				●				●	
HFCS-42	●	●	●	●				●	●
HFCS-55	●	●	●	●				●	●
Crystalline fructose	●								●
Co-Products									
Crude oil	●		●						●
Refined oil	●		●	●					●
Corn gluten feed	●	●	●	●	●	●	●	●	●
Corn gluten meal	●	●	●	●	●	●	●	●	●
Corn germ or corn germ meal	●	●	●	●	●	●	●	●	●
Steepwater (CFCE)		●	●	●	●	●	●	●	●
Carbon dioxide	●				●				●
Other									
Ethanol, fuel/industrial	●		●	●	●			●	●
Ethanol, beverage	●								
Fermentation and other chemicals	●		●					●	

Product lists are accurate as of publication date but may change with time.

What Agriculture Needs In the Next Ten Years

by Edward R. Madigan
Secretary of Agriculture

What farmers need in the next ten years can be summed up fairly easily. They need stronger domestic markets and a better shot at export markets.

Getting that done is not so easy. But we can do it.

The first priority for farmers is to operate in a sound, expanding U.S. economy with a low rate of inflation. That's better than any government program.

A bustling economy that creates paychecks builds demand for farm products. Paychecks that steadily gain buying power over time are the underpinning of the kind of strong economy with low inflation that farmers need.

Some people say that farmers like inflation. Land prices go up. And farmers can pay off their debts with cheaper dollars. But I didn't find farmers in my former congressional district in Illinois talking that way about inflation in the late 1970s and early 1980s.

Inflation forced farmers' costs sky high. Farmers couldn't keep up. Their debts mounted rapidly in 1975-80, and their interest charges soared out of sight! And farm net income sagged.

Farmers sell three-fourths of their farm products into the domestic market. Much of that demand is built in. People are going to continue eating. Each baby adds a growing, healthy appetite to the demand for farm products. However, our population isn't growing as fast as it once did.

Population experts think that in the next 30 years we might add about 44 million people to the U.S. population, more than a third fewer than in the last 30 years.

It surprises most people to learn that farmers have fed the 71 million larger population in the last 30 years by harvesting less land. In 1960 farmers harvested 255 million acres for the U.S. domestic market. In 1990 it took only 216 million acres—15 percent fewer.

How do farmers do it? By increasing productivity and better efficiency, mainly. Yields are higher and farm output per hour increased more than three times faster than in U.S. businesses.

The first priority for farmers is a sound. . .U.S. economy with a low rate of inflation.

To maintain a strong domestic farm market in the U.S. in the next decade and beyond, we need to develop higher-value industrial uses for farm and forest products. We need that to help offset the decline in the rate of population growth and to absorb increased agricultural productivity.

We are using more corn per capita domestically. But we need to do better for corn and other farm products. Corn growers have benefitted from a steady increase in the use of corn for cereals and starches—and the big increase in the use of high fructose corn syrup and corn for producing ethanol.

We have put new funds in next year's USDA budget to increase research in industrial uses for farm products. We will be pushing ethanol research, particularly methods of reducing ethanol production costs to make it an economically competitive fuel. Already the ethanol industry is using close to 400 million bushels of corn per year in ethanol production. The potential is much greater.

The implementation of the Clean Air Act will make ethanol and ethanol-based fuels an increasingly important renewable resource fuel. We have an opportunity to increase the domestic outlet for corn, help the country meet its environmental goals, reduce our petroleum imports, improve our national security, strengthen our balance of trade, and create important new markets for corn and other farm products.

New uses for traditional farm crops...can stimulate the vitality of our rural communities.

New uses aren't limited to ethanol. One company has plans underway to convert biodegradable plastics from agricultural crops. A plant in McAllen, Texas, plans to make newsprint from kenaf, an agricultural crop. Mobil Oil is making a refrigerant and lubricant from rapeseed oil and is marketing it commercially. Austria, trying to combat pollution, has plans to manufacture diesel fuel made from soybean oil.

New uses for traditional farm crops not only mean added income for agriculture, but can stimulate the vitality of our rural communities. New uses will put idle land to work and will strengthen farm prices. This will increase demand for farm production items supplied through rural businesses. New uses will also create more jobs in rural marketing and processing industries. That increases the tax base in rural areas and strengthens rural institutions.

Concern for the environment will become more important as farmers contribute to good living conditions while staying economically competitive. We are increasing our USDA budget in important areas to help with that. We are boosting research on biotechnology that will build greater disease and pest resistance into our plants and animals. It will lead to plants that will be more resistant to drought, summer heat, and frosts, and plants that will be more receptive to saline soils. It will give us the ability to fight insects with hormones and fight livestock diseases with bioengineered vaccines, instead of harsh chemicals.

Overall, these advancements will cut farm costs per unit of production.

Advancements in biotechnology will also help food processing as we create new foods, more nutritious foods, foods with longer shelf life, higher quality foods, and higher value foods.

Other countries around the world will be doing the same. We must lead the way or lose markets. We can't defend our markets or prosper by standing still and hanging onto higher cost, less efficient methods of farm production and processing. Others will pass us by.

American farmers sell one-fourth of their products into competitive export markets. This has been a growing market, but we have lost ground. In 1960 we exported the production from 64 million U.S. acres. By 1980 that had reached 137 million acres—a remarkable 114 percent increase. Unfortunately, that had declined to 81 million acres by 1985.

We know what it means to lose export markets. We learned a very costly lesson in 1981-85. Our farm export tonnage and dollar value shrank more than one-fourth.

Our domestic demand held up—in fact, actually set records throughout 1980-85. But our loss of farm export markets plunged American agriculture into a steep recession. It was very painful. Could there be any clearer evidence that the severe 1980-85 farm recession was a farm-export recession.

During that time, the European Community decreased its wheat and feed grain imports by nearly 18 million tons and boosted its exports. U.S. exports of wheat and feed grains suffered losses of comparable size.

How did the E.C. do it? By boosting production, keeping out grain imports with restrictive border barriers, and spending large amounts of money to subsidize its farm exports in markets where we and other exporters were competing.

That's what the present GATT Uruguay Round negotiations are all about. It's why the U.S. is adamant that we get world-wide changes in trade rules that will prevent harm to U.S. farmers and U.S. agriculture—and to other countries as well.

GATT has been a hard fight for more than five years. We have "hung tough" because so much is at stake for American farmers. But not just that. So much is at stake for our entire economy, for other countries, and for economic growth in the world. The negotiations go beyond agriculture.

The GATT agreement will affect the vigor and growth of American businesses and the creation of jobs for the American workforce. That affects U.S. farmers in their primary market where they sell three-fourths of their farm products.

That is the agenda: Aggressive action to broaden and increase the demand for U.S. farm products here at home and abroad; better research to hone the competitive ability of U.S. agriculture and the quality of its products; increased profitability for American farmers; and cooperation among federal, state and local governments and local businesses and private groups and leaders to bring new life to rural communities.

Corn: Supply and Disappearance

	Supply				Disappearance						Ending Stocks		
					Domestic Use								
Year beginning September 1	Beginning stocks	Production	Imports	Total	Food, alcohol and industrial	Seed	Feed and residual	Total	Exports	Total disappearance	Govt. owned	Privately owned	Total
					Million bushels								
1981/82	1,392.1	8,118.7	0.6	9,511.3	714.0	19.4	4,244.5	4,977.9	1,996.8	6,974.7	280.1	2,256.5	2,536.6
1982/83	2,536.6	8,235.1	0.5	10,772.2	840.0	14.5	4,573.2	5,427.7	1,821.3	7,249.1	1,142.7	2,380.4	3,523.1
1983/84	3,523.1	4,174.3	1.7	7,699.1	911.0	19.1	3,876.3	4,806.4	1,886.4	6,692.8	201.5	804.8	1,006.3
1984/85	1,006.3	7,672.1	1.7	8,680.2	1,046.0	21.2	4,114.5	5,181.7	1,850.3	7,032.0	224.9	1,423.3	1,648.2
1985/86	1,648.2	8,875.5	9.9	10,533.6	1,133.0	19.5	4,114.2	5,266.7	1,227.3	6,494.1	545.7	3,493.8	4,039.5
1986/87	4,039.5	8,225.8	1.8	12,267.0	1,206.8	16.7	4,669.4	5,892.9	1,492.5	7,385.3	1,443.2	3,438.5	4,881.7
1987/88	4,881.7	7,131.3	3.4	12,016.4	1,226.0	17.2	4,797.7	6,040.9	1,716.4	7,757.3	835.0	3,424.1	4,259.1
1988/89	4,259.1	4,928.7	2.8	9,190.6	1,275.0	18.4	3,940.9	5,234.3	2,025.8	7,260.1	362.5	1,567.9	1,930.4
1989/90	1,930.4	7,525.5	1.9	9,457.8	1,337.0	18.9	4,389.2	5,745.1	2,368.2	8,113.4	233.0	1,111.5	1,344.5
1990/91[1]	1,344.5	7,934.0	3.4	9,281.9	1,348.0	19.3	4,668.7	6,036.0	1,724.6	7,760.7	371.1	1,150.1	1,521.2
1991/1992[2]	1,521.2	7,474.5	20.0	9,015.7	—— 1,400.0 ——			5,000.0	6,400.0	1,525.0	7,925.0	25.0	1,065.7	1,090.7

[1]Preliminary
[2]Projected
Source: USDA

While it has the potential to be a relatively low-cost producer, the nation's land resources are limited, and the rapid rate of population growth will make it very difficult for production to catch up with demand.

Because HFCS and other corn sweeteners can be produced at low cost compared to sugar, Mexico should be encouraging development of a domestic corn refining industry, even if it will be necessary to import the corn. The diverse products that corn refiners manufacture will all be needed as Mexico's industries evolve. And the technology is one that any developing economy would benefit from.

It is, of course, possible that agriculture and food will somehow be excluded from NAFTA coverage. But the outcome is clearly one in which U.S. corn refiners have a stake, whether through creation of an export market, or through participation in development of Mexico's own corn refining industry.

U.S. Per Capita Sweetener Consumption

Year	Refined sugar	HFCS	Corn sweeteners			Honey and edible syrups	Total caloric sweeteners
			Glucose	Dextrose	Total		
			Pounds, dry basis				
1985	62.7	44.9	18.1	4.2	67.2	1.4	131.3
1986	60.0	45.6	18.3	4.2	68.1	1.4	129.5
1987	62.4	47.2	18.5	4.3	70.0	1.4	133.8
1988	62.1	48.6	18.7	4.3	71.6	1.4	135.1
1989	62.8	48.7	19.2	4.3	72.2	1.4	136.4
1990	64.5	49.1	19.6	4.5	73.2	1.4	139.1
1991*	64.5	49.6	19.8	4.5	73.9	1.4	139.8
1992**	64.5	50.0	20.0	4.6	74.6	1.4	140.5

*Preliminary
**Forecast
Source: USDA—Economic Research Service

HFCS: The Outlook In A Changing World Scene

by Landell Mills Commodities Studies

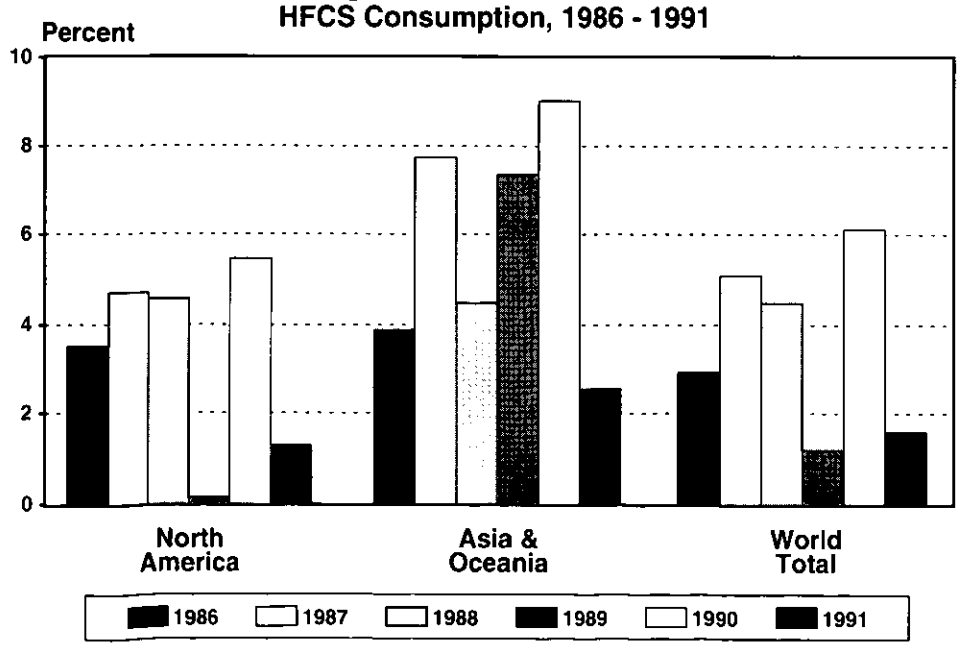
1990 was a good year for the HFCS industry. [We will concentrate in this review on prospects for HFCS, the biggest and most diverse of the corn sweetener sectors.] Sales of HFCS moved ahead in all of its major markets, and its share of the nutritive sweetener market increased in every major country, apart from Argentina.

Globally, 1990 saw HFCS consumption rise by 6.1 percent to total 7.7 million metric tons[1], dry weight. With sugar demand stagnant in the rest of the world, HFCS found it relatively easy to boost its share of the global market for sugar and HFCS combined above 7 percent for the first time. The industry's rise in sales of more than 6 percent in 1990 was in stark contrast to the second half of the 1980s, when HFCS consumption grew at an average annual rate of 3.4 percent (see Diagram 1).

It is unlikely that the strong showing made in 1990 signals an acceleration in HFCS sales in the 1990s. Indeed, preliminary estimates for 1991 suggest that HFCS sales rose to 7.8 million tons, dry basis, only 1.1 percent above consumption in 1990. The particularly robust advances in corn sweetener sales in 1990 were the result of an unusual set of circumstances, including relatively high world sugar prices, particularly strong growth in Japan as a result of an unusually warm summer, and rapid increases in some developing markets.

Few of the elements which helped the HFCS sector in 1990 are likely to be present over the next few years. With world sugar prices at a much lower level and recessions, or at least much slower economic growth, in HFCS's most important markets, North America and Japan, the prospects for rapid advances over the next few years are slim.

Diagram 1: Annual Growth in HFCS Consumption, 1986 - 1991



In the following paragraphs, the market conditions for HFCS in several regions are reviewed, with an eye towards identifying where there might be potential for substantial progress, given favorable relative price conditions. Because 1990 is the latest year for which there are final statistics, we have concentrated our discussions on that year; however, we have commented on preliminary estimates for 1991 where available.

Trends in North America

North America continues to dominate the world picture, accounting for almost 75 percent of global HFCS consumption (as against only one third of world glucose and dextrose output). On the production side, the official US statistics for 1990 reveal an increase of well over 5 percent in domestic HFCS output over

its level in 1989, belying the pessimism engendered by the growth in the share of diet soft drinks in the US market.

However, some of this increase constituted a replenishment of users' stocks after they were drawn down in 1989, while another important factor was a sharp reduction in net imports from Canada. In contrast to 1990, preliminary estimates for 1991 suggest that output increased over 1990's level by less than 2 percent, to 5.7 million tons, dry basis.

The cross-border trade that occurs between the US and Canada is one of the major features of the broader North American picture. Until recently, the general trend has been for flows to run from Canada to the US, with Canadian shipments to the US peaking at roughly 200,000 tons, dry weight.

Canadian sugar prices are linked to world market values; therefore, the revival of world prices after 1985 helped to boost Canadian HFCS sales. By 1990, US shipments to Canada exceeded 80,000 tons and the export surplus of Canada had fallen below 50,000 tons, a quarter of the level just four years earlier.

The two other growing regions for HFCS sales are Latin America and Africa.

Trends in Asia

The Asian region made an important contribution to the global 1990 and 1991 HFCS performances. Sales in the Japanese HFCS industry, although growing more slowly than its North American counterpart, strengthened in 1990, largely as a result of a very warm summer, which boosted sales of soft drinks.

Compared with growth of 3 percent in 1989, the increase in HFCS sales was well over 5 percent in 1990. With the resumption of more typical summer temperatures in Japan in 1991 came a more normal rate of increase in consumption, with HFCS sales rising by 1 percent over the level in 1990.

Elsewhere in Asia, Taiwan is likely to be the next 100,000 ton-plus HFCS producer. High domestic sugar prices, an expanding soft drink sector and government support for maize imports were the spurs to the rapid development of HFCS sectors. In 1990, HFCS production in Taiwan exceeded 67,000 tons, dry basis, a gain of over 30 percent on 1989. Preliminary figures suggest that output rose substantially in 1991, as well.

Trends in Latin America and Africa

The two other growing regions for HFCS sales are Latin America and Africa. HFCS sales in the two regions combined increased by more than 17 percent between 1989 and 1990. The largest corn sweetener industry in the two regions is found in Argentina, where HFCS production quotas were in place until 1991, but where the sector is now entirely unregulated.

However, when quotas were in place, it was not the supply side that was constraining demand, but the other way around. 1987 was the last year in which the economy was performing well enough to generate demand for the entire production quota, which stood at 82,495 tons of fructose content (equivalent to roughly 170,000 tons, dry basis). The quota rose by approximately 10 percent in 1988, but total sales actually fell back. The recession which took hold in 1989 pushed sales down further, to a greater degree than the decrease that was imposed upon the 1989 quota.

The first half of 1990 saw a continuation of the recession, but the situation started to improve in the second half of the year. For 1990 as whole, output is estimated to have recovered to the levels prevailing four years earlier. This revival has continued into 1991 with sales to the soft drink sector reported to have been very good.

Trends in Europe

The only region which singularly failed to participate in the acceleration in HFCS output was Europe. EC production remains capped by quotas, which are set at 291,115 tons, dry basis, within the framework of the Sugar Regime of the Common Agricultural Policy. Elsewhere, the disintegration of East European economies has taken its toll on HFCS producers. Two projects that were supposed to have been commissioned by now, in Bulgaria and Kirghizia (in the old USSR), are still some way from start-up.

Prospects for the 1990s

The HFCS industry began the 1990s with relatively rapid growth in sales. A much more modest increase in 1991 showed how unusual was 1990's rise in demand and highlighted the sensitivity of prospects for HFCS to world sugar prices. Relative costs of sugar and HFCS play a very important role in determining the location of wet milling plants.

It comes as little surprise to discover that the current rapid slowdown in HFCS production worldwide has coincided with a period of depressed world sugar prices. Many of the potential producers of HFCS are importers of sugar; therefore they make an explicit trade-off between the costs of importing more sugar from the world market and the likely costs of production of HFCS. When world prices of sugar do eventually manage to sustain a recovery, the viability of new HFCS plants will look much more attractive, and a new wave of investment can be expected to materialize.

[1]All measures in this article are expressed in metric ton of 2,204.62 pounds.

World Corn Supply and Disappearance

	1990/91	1991/92
Exports		
Argentina	3.7	4.6
South Africa	0.8	0.8
Thailand	1.2	0.9
China	6.6	7.5
United States	44.5	39.0
Others	0.6	3.2
TOTAL	57.2	56.0
Imports		
Mexico	1.9	1.0
European Community-12	3.7	2.0
C.I.S.	10.1	9.0
Japan	16.0	16.2
Eastern Europe	1.4	0.3
China	0.0	0.0
Taiwan	5.3	5.5
Republic of Korea	5.6	5.5
Others	13.3	16.6
TOTAL	57.2	56.0
Production		
Brazil	23.5	26.0
Mexico	14.1	14.5
Argentina	7.6	8.0
South Africa	8.2	6.0
Thailand	3.8	3.7
European Community-12	21.6	26.6
C.I.S.	9.8	11.0
Eastern Europe	21.1	30.9
China	96.8	95.0
United States	201.5	189.9
Others	70.9	69.7
TOTAL	478.9	481.3
Utilization		
European Community-12	26.9	29.0
C.I.S.	17.1	20.0
Japan	16.3	16.3
China	80.4	82.0
United States	153.3	162.6
Others	173.8	176.8
TOTAL	467.8	486.6
Ending Stocks		
Foreign	43.6	49.2
United States	38.6	27.7
TOTAL	82.3	76.9

Source: USDA • Based on October/September year in millions of metric tons. • 1991/92 represents a forecast total.

U.S. Corn for Grain: Yield and Production

State	Area Harvested			Yield			Production		
	1989	1990	1991	1989	1990	1991	1989	1990	1991
	1,000 Acres			*Bushels*			*1,000 Bushels*		
AL	180	240	210	81	58	80	14,580	13,920	16,80(
AZ	13	7	5	145	160	170	1,885	1,120	85(
AR	58	73	80	122	95	100	7,076	6,935	8,00(
CA	185	160	115	160	160	160	29,600	25,600	18,40(
CO	930	830	840	145	155	153	134,850	128,650	128,52(
DE	133	172	169	100	115	106	13,300	19,780	17,91⁴
FL	80	75	75	74	71	68	5,920	5,325	5,10(
GA	550	550	550	95	68	100	52,250	37,400	55,00(
ID	50	30	63	125	130	125	6,250	3,900	7,87⁵
IL	10,750	10,400	11,000	123	127	107	1,322,250	1,320,800	1,177,00(
IN	5,200	5,450	5,450	133	129	92	691,600	703,050	510,60(
IA	12,250	12,400	12,200	188	126	117	1,445,500	1,562,400	1,427,40(
KS	1,240	1,450	1,650	125	130	125	155,000	188,500	206,25(
KY	1,180	1,200	1,250	116	100	89	136,880	120,000	111,25(
LA	142	186	247	95	116	85	13,490	21,576	20,99⁵
MD	400	450	450	110	118	95	44,000	53,100	42,75(
MI	1,970	2,070	2,300	113	115	100	222,610	238,050	253,00(
MN	5,600	6,150	6,000	125	124	120	700,000	762,600	720,00(
MS	140	140	150	70	80	75	9,800	11,200	11,25(
MO	2,290	1,960	2,200	96	105	97	219,840	205,800	213,40(
MT	4	9	15	80	95	120	320	855	1,80(
NE	7,000	7,300	7,800	121	128	127	847,000	934,400	990,60(
NJ	71	75	77	102	118	110	7,242	8,850	8,47(
NM	60	55	60	160	145	165	9,600	7,975	9,90(
NY	570	620	660	93	98	98	53,010	60,760	64,68(
NC	950	1,070	950	93	68	90	88,350	72,760	85,50(
ND	465	460	570	75	80	90	34,875	36,800	51,30(
OH	2,900	3,450	3,400	118	121	96	342,200	417,450	326,40(
OK	78	88	85	120	114	110	9,360	10,032	9,35(
OR	22	18	15	160	150	146	3,520	2,700	2,19(
PA	960	970	860	103	113	75	98,880	109,610	64,50(
SC	340	320	255	91	45	85	30,940	14,400	21,67⁵
SD	2,650	3,000	3,250	72	78	74	190,800	234,000	240,50(
TN	530	510	510	107	86	86	56,710	43,860	43,86(
TX	1,400	1,450	1,500	106	90	110	148,400	130,500	165,00(
UT	20	19	21	132	140	140	2,640	2,660	2,94(
VA	365	365	335	110	100	84	40,150	36,500	28,14(
WA	90	80	80	175	175	180	15,750	14,000	15,84(
WV	46	50	38	95	105	75	4,370	5,250	2,85(
WI	2,800	3,000	3,200	111	118	119	310,800	354,000	380,80(
WY	41	50	49	95	120	119	3,895	6,000	5,83⁴
US	64,703	66,952	68,842	116.3	118.5	108.6	7,525,493	7,933,068	7,474,48(

Source: USDA