

USDA

United States  
Department  
of Agriculture

FDS-09K-01  
December 2009

Outlook



A Report from the Economic Research Service

www.ers.usda.gov

# China Is Using More Corn for Industrial Products

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## Abstract

Use of corn to make starch, sweeteners, ethyl alcohol, and other industrial products has accounted for most of the growth in China's corn use over the past decade. Despite the surge in industrial use, China still has a surplus of corn. The country's exports of corn-based industrial products have grown as exports of unprocessed corn receded. Industrial processing was encouraged by government policy early in the decade. Industrial processors in China benefited from policies that kept domestic corn prices from rising in 2007/08, but many experienced losses in 2008/09 when demand slowed and the government supported corn prices.

**Keywords:** China, corn, starch, alcohol, ethanol, industry, consumption, exports, price support

## Acknowledgments

University of California-Davis student intern Yingying Gu assisted in gathering and analyzing data for this report. Helpful comments were received from John Dyck, Linwood Hoffman, and Mary Ann Normile of USDA's Economic Research Service; Richard O'Meara and Hui Jiang of USDA's Foreign Agricultural Service; Jerry Norton of USDA's World Agricultural Outlook Board; Jacinto Fabiosa of Iowa State University; and Bill Tierney of Doane Advisory Services.

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Approved by USDA's  
World Agricultural  
Outlook Board

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## Introduction

China is the world's second-leading consumer and producer of corn, accounting for 19 percent of world consumption in market year 2007/08 (fig. 1). In past years, China was a leading exporter of corn, but its exports fell from a peak of 16 million metric tons (mmt) in calendar year 2003 to under 1 mmt in 2008. To date, the country is not a significant corn importer, but many market analysts expect this may change as a result of China's rising consumption.

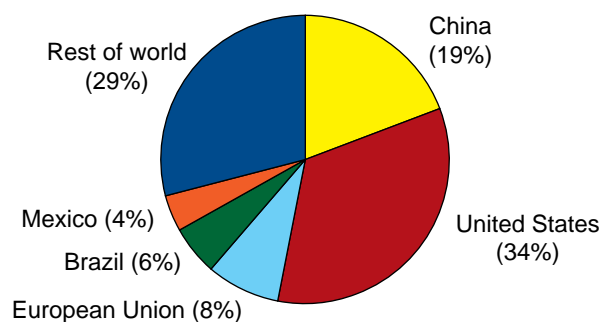
The rapid growth of industrial processing of corn makes it difficult to assess China's corn market. About one-fourth of China's corn now enters industrial processing, which yields hundreds of food, feed, alcohol, and chemical products. Estimates of corn use from analysts in China indicate that the share of corn used in industrial processing may be higher than currently estimated by USDA and is already at or above the share in developed countries. Estimates are complicated by the large number of products and co-products and the lack of statistical information on these industries.

This report describes the recent growth in industrial use of corn in China. It also reviews unpublished estimates of corn use from Chinese analysts, describes government support for industrial processing, and summarizes trends in corn product exports and prices.

At first glance, growth in both industrial use and feed use of corn would be expected to raise demand to a level that will soon turn China into a corn importer. More careful analysis, however, shows that China still had a substantial surplus of corn in the 2008/09 market year (October-September), despite the rise in industrial use. The rapid rise in processing capacity was encouraged by government policies and outpaced the robust growth in domestic demand for corn-based chemicals, food, and feed additives. Faced with excess capacity, many producers sold their products on the international market, and helped trigger a worldwide boom in imports of industrial corn products. At the same time, China's exports of unprocessed corn declined. Growth in industrial processing of corn slowed as the industry's excess capacity became apparent.

Figure 1

### China and the United States accounted for over half of world corn use in 2007/08



Note: 2007/08 market year (China: October-September; United States: September-August).

Source: USDA, Economic Research Service using USDA, Foreign Agricultural Service, Production, Supply, and Distribution estimates. Accessed in February 2009.

## Industrial Uses Dominate Growth in Corn Use

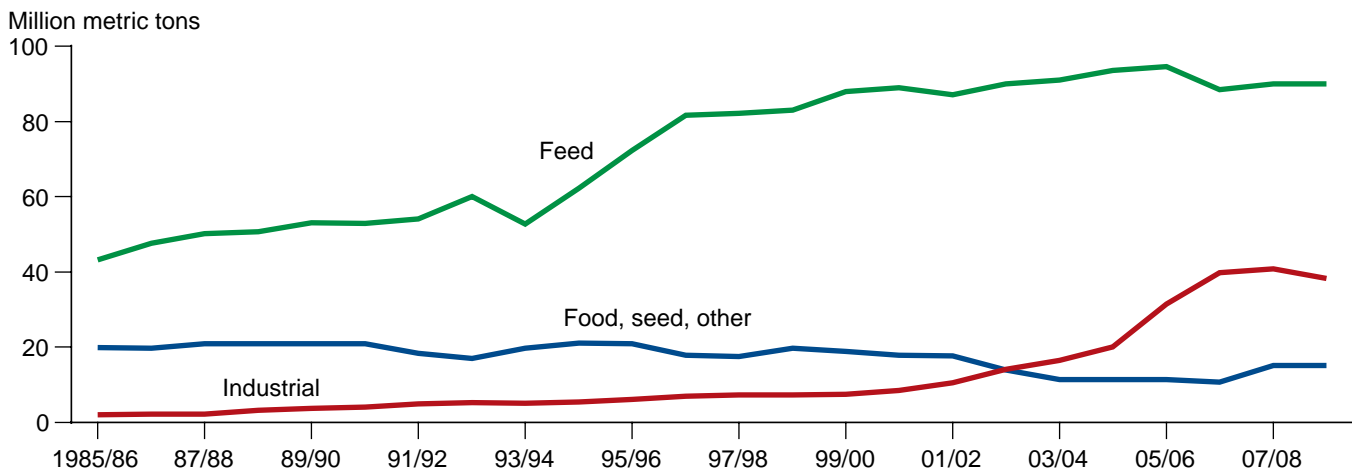
Based on estimates by Chinese market analysts, industrial uses have accounted for nearly all growth in corn use in China since 2000 (fig. 2). In 1985, less than 2 mmt of corn was used for industrial processing; however, the amount grew throughout the 1990s, reaching 10.5 mmt in 2001. With strong government support and robust demand, industrial use of corn then doubled to 20 mmt in 2004, and doubled again to 40 mmt in 2006. The growth in industrial use of corn slowed in 2007 and reversed in 2008 as the slowing economy reduced demand. Industrial processors cut back production in 2008 when the Chinese government set a minimum corn purchase price that erased profits for many types of corn processing.<sup>1</sup>

Industrial milling separates corn kernels into their components: germ, bran, and endosperm. Starch, protein, fiber, oil, and moisture are extracted and further refined into dozens of feed ingredients, sweeteners, alcohols, food additives, and other products. Starch is sold to industrial users as modified or specialty starch; processed into sugars and sweeteners like maltose, glucose, liquid and solid sugars, and high-fructose corn syrup (HFCS); or distilled into ethyl alcohol for beverages, fuel, or pharmaceutical uses. Organic acids and their salts are obtained by fermenting corn syrup or enzyme-treated starch. Acids and salts include citric acid, widely used in pharmaceuticals and foods; glutamic acids and their salts, including monosodium glutamate, that are important food-flavoring agents; and lysine, an essential amino acid used in animal feed. Corn-based starches, sugars, acids, alcohols and other products are used in making paper, pharmaceuticals, textiles, paints, cleaning solutions, and other items. Corn oil extracted from the endosperm is used as cooking oil. Residuals from processing—hulls, fiber, germ meal, gluten, distillers' dried grains and steep water—are used as feed ingredients.

<sup>1</sup>Estimates by China National Grain and Oils Information Center and other analysts in China show surprisingly little growth in feed use of corn in recent years. Livestock production (and feed demand) is growing at a slower pace than in the 1990s, and efficiency of feed conversion is improving. However, it is difficult to make conclusive statements about feed consumption because statistics on the livestock and feed sectors are sparse and analysts question the accuracy of official figures.

Figure 2

### Industrial processing was the fastest growing component of China's corn use during the past decade



Note: Chart shows estimated domestic use of corn. Market year is October-September.

Source: USDA, Economic Research Service using 1985-94 data from China Academy of Agricultural Sciences and 1995-2008 data from China National Grain and Oils Information Center reports.

Production of all these corn products has grown rapidly. A 2008 conference presentation by an official from one of China’s largest agribusiness companies reported fourfold growth in industrial use of corn in China over 1998-2007 (fig. 3) (Yu). The largest single categories of use were starch sugars (glucose, lactose, dextrin, maltose, HFCS, and oligosaccharides) and alcohol for beverage and industrial uses. Use of monosodium glutamate was estimated at over 4 mmt of corn in 2007. Production of lysine began in 2000 and accounted for about 2 mmt of corn by 2007. Use of corn for citric acid grew nearly fourfold in a decade. Ethanol production used 11.6 mmt of corn in 2007—most of it for beverage, industrial, and pharmaceutical uses. Fuel ethanol production from corn began on a commercial scale in 2004 at three designated plants, which now consume about 3 mmt of corn annually.<sup>2</sup>

Estimates of the amount of corn used in industrial production vary and are complicated by the wide variety of products and a lack of data.<sup>3</sup> In late 2008, ERS surveyed the corn market reports of five grain market analysis organizations in China and found their estimates of corn industrial use for the market year 2006/07 varied from 30 mmt to 40 mmt. Estimates of industrial use as a share of domestic consumption ranged from 22 to 27 percent, up from about 10 percent in 2003/04.

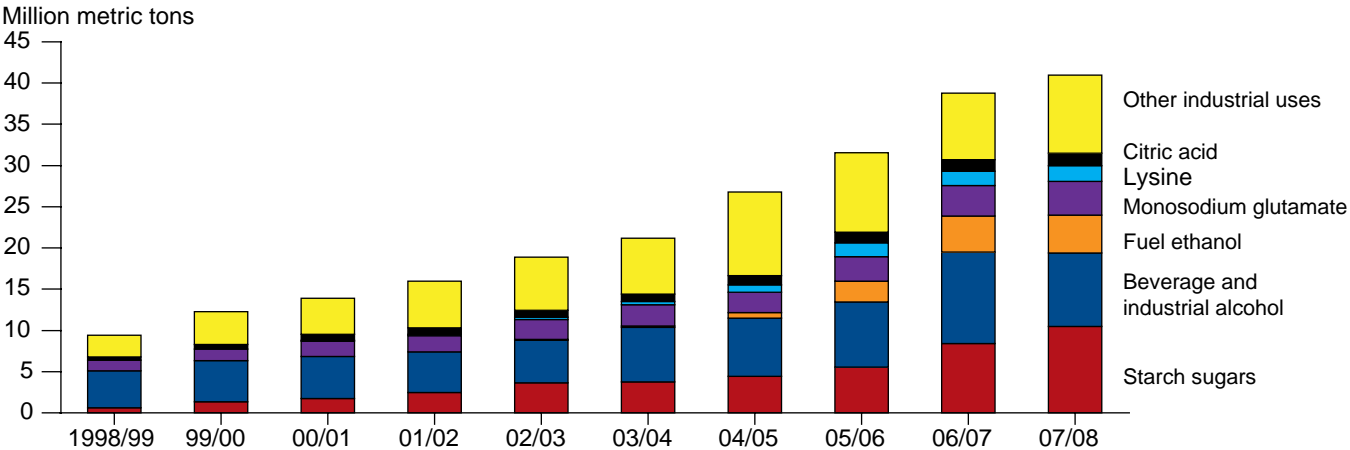
China’s share of corn used for industrial processing is already high by international standards. USDA’s production, supply, and distribution database includes estimates of two components of demand for each country: feed and residual use, and combined food, seed, and industrial (FSI) use. In China, the United States, and other industrialized countries, industrial uses account for most of the FSI category.<sup>4</sup> The USDA estimate of China’s FSI was 28 percent of its domestic corn use in 2006/07, comparable to the share in Japan and Canada and higher than the shares in South Korea, the European Union, and Brazil (fig. 4). The FSI share is much lower elsewhere in East Asia—in the range of 3-6 percent in Thailand, Taiwan, and Malaysia. Estimates of China’s FSI from Chinese analysts were even higher. The 37-percent share estimated

<sup>2</sup>A fourth ethanol plant uses wheat as its main raw material, and a fifth plant that opened in 2008 uses cassava. A number of nongrain biofuel projects are in pilot stages.

<sup>3</sup>Estimates are further complicated by the fact that many starch and alcohol products can also be made from other starchy grains. In China, starches are made from corn, cassava, Irish potatoes, sweet potatoes, and wheat. China’s National Development and Reform Commission estimated that corn-based products accounted for 92 percent of starch production.

<sup>4</sup>India and African and Latin American countries have a high food, seed, and industrial share that reflects a high share of corn used as a staple food. These countries are excluded from this comparison. China’s food use of corn is larger than that of the United States, while U.S. seed use is higher than that of China because the U.S. planted area is much bigger.

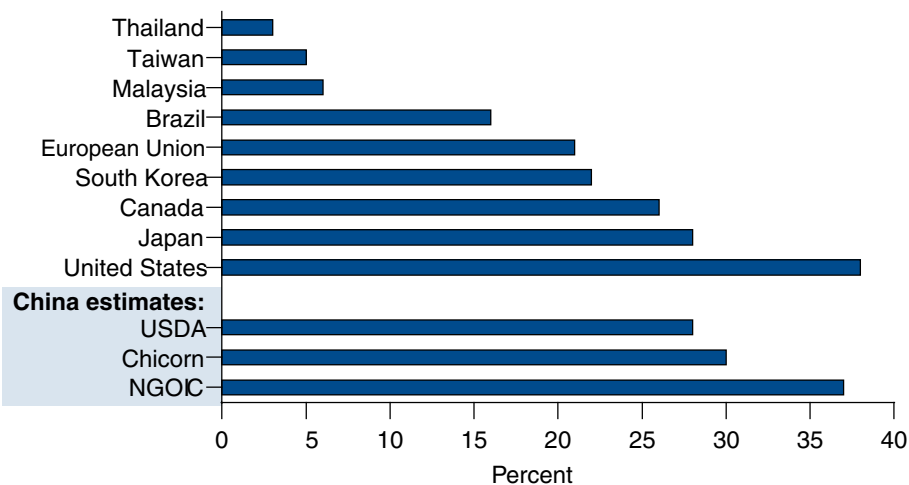
Figure 3  
**Growth in China’s industrial use of corn encompassed a variety of products**



Note: Chart shows estimated use of China’s corn for industrial products. Market year is October-September. A 2009 speech by Yue (another official from the same company) estimated that industrial use fell to 38 mmt in 2008/09, but did not provide a breakdown by product.  
 Source: USDA, Economic Research Service using Yu, Zuojiang, “Analysis on China’s Corn Deep Processing Industry,” International Corn Industry Conference, Dalian, China, September 2008.

Figure 4

**The share of China’s corn used for food, seed, and industrial uses is among the world’s highest**



Note: Chart shows FSI (food, seed, and industrial) use as a share of domestic consumption of corn. Animal feed accounts for the remaining share of use. Data are for 2006/07 market year.

Source: USDA, Economic Research Service using USDA, Foreign Agricultural Service, Production, Supply, and Distribution database, China National Grain and Oils Information Center (NGOIC), and Chicorn (yumi.com.cn).

by China National Grain and Oils Information Center (CNGOIC) is close to the world-leading U.S. FSI share of 38 percent.

The growing use of corn for industrial processing at first glance appears to reduce the amount of corn available for feed; however, a significant portion of corn used for industrial products emerges as feed additives and feed co-products. Lysine, for example, is an essential amino acid that helps animals build protein and gain weight faster. (In past years, China imported lysine, but it is now a lysine exporter.) Feed co-products of industrial corn processing include gluten feed derived from the bran and fibrous portions of the corn (a medium-protein feed) and gluten meal that remains after extracting starch (a high-protein feed). Distillers’ dried grains, another feed ingredient high in protein and fiber, is a co-product of alcohol distillation. Feed mills in China mix these products with grains, oilseed meals, and other ingredients to manufacture commercial feeds.

These products generate significant revenue for processors and constitute a significant share of the country’s feed supply. China’s 40 mmt of industrially processed corn may yield 8-13 mmt of feed co-products. Industrial processing of corn has probably increased the efficiency of corn use in China by separating corn kernels into their components so that feed mills can mix feeds more precisely. This creates a market for each component of the corn kernel and minimizes waste, in comparison with traditional methods of feeding whole or crushed corn kernels to animals.

## Policy Support Encouraged Growth

The rapid growth in corn processing in China over the past decade reflects a combination of robust demand and strong government support. In fact, processing companies' headquarters often display large photos of Communist Party leaders visiting their facilities, and company brochures usually emphasize their support from the government.

A confluence of factors led to a high level of government involvement in the 2000s. Strong policy support was offered in the late 1990s when China had a glut of corn and prices were depressed. This dovetailed with other priorities, such as promoting economic development in the northeastern provinces, encouraging the development of high-tech industries, and expanding corn-based ethanol to meet goals for renewable fuels and energy independence.

The central government identified corn processing as a key industry for government support in 2000, and the sector was singled out for support in China's 5-year plans for 2000-05 and 2006-10. The government's strategic plan for the corn industry for 2008-15 called for increased processing of corn by nurturing large-scale leading enterprises, "industrialized" supply chains, and the development of "production bases" of farmers. The plan stressed support for citric acid and other value-added products that could benefit farmers. The fuel ethanol industry was initiated in the early 2000s with government support. Fuel ethanol producers depend on government subsidies to earn profits, and a small number of plants with close government connections have been awarded quotas to sell ethanol at fixed prices to state-owned petroleum companies that monopolize gasoline blending.<sup>5</sup>

National strategies for corn processing are set by central authorities and implemented by various departments of provincial and municipal governments in conjunction with a designated processing company that may be partly owned by the local government. Companies receive support in various ways: through income tax waivers, reduced value-added tax rates, loans granted by state-owned banks, interest rate subsidies, access to real estate (often village-owned farmland that must receive government approval to be converted to industrial use) for industrial parks, and reduced tariffs on imported machinery. Local governments act as intermediaries who organize production bases of farmers to supply corn. A national program gives subsidies to farmers for the purchase of quality seeds for corn and other grains. Many subsidized corn varieties have high starch content or other characteristics that facilitate processing.

Shandong Province has been the leader in China's corn-processing industry. The industry is mainly driven by private investment, but policy support plays a role. For example, Shandong's Zouping County initiated a corn-processing export project in 2004 with support from the provincial branch of the import/export authority and the county government. At the end of the 3-year implementation, the project was intended to involve 80 percent of the county's grain producers as model farmers. Farmers are to be given extension services and market corn under contract to the Xi Wang (West King) Group, a company with capacity to process 1.8 mmt of corn annually to make starch, sweeteners, corn oil, and feed, mostly for the international market.<sup>6</sup>

<sup>5</sup>The subsidy for ethanol is set to ensure that companies can make a small profit. Companies also receive tax breaks. The subsidy was raised in 2009 to compensate producers for a decline in the fuel price that year (Beckman and Jiang; China Business Journal).

<sup>6</sup>"Zouping National-Level Corn Export Processing Base Standardized Demonstration Project Under Consideration," <http://www.zouping.gov.cn/Html/zwx/08260132.html>.

Jilin Province and other northeastern provinces—the principal corn-producing region in China—have lagged behind Shandong, but the region’s processing capacity has surged due to aggressive government support. The region has been targeted for support to address the lack of local demand for corn and to soften the impacts of the widespread failure of state-owned factories that were concentrated in the region until the late 1990s.<sup>7</sup> In 2008, the Jilin provincial government issued a food processing plan that emphasized corn-based food additives, sweeteners, acids, chemical alcohol, pharmaceuticals, and foods like frozen corn and corn porridge mix. The Jilin government has supported the Dacheng Group, said to be the largest corn processor in Asia. Two distilling plants in Jilin and Heilongjiang Provinces produce corn-based fuel ethanol.<sup>8</sup>

By 2007, the central government sought to curb the blistering pace of growth that favorable policies had helped bring about. Given mounting concerns about rising food prices, food security, pollution, and inefficient use of energy and water (Zhao), the National Development and Reform Commission (NDRC) issued a document in September 2007 that sought to freeze industrial use at 26 percent or less (according to NDRC’s estimates) of China’s corn use. The commission required the approval for new corn-processing projects by the State Council (China’s highest decisionmaking body), the closure of inefficient processing plants, and the creation of a more concentrated industry through mergers and acquisitions (NDRC; China Ministry of Environmental Protection). Authorities also halted growth in grain-based ethanol production, mandating that future growth in biofuel production come from nongrain raw materials. Authorities called for controls on production of corn-based citric acid, lysine, and other products in oversupply. A December 2007 document revising China’s foreign investment policy placed strict limits on foreign investment in corn-processing industries. During May–September 2008, the government ordered many corn processors in provinces surrounding Beijing to shut down or cut back production to reduce pollution during the Olympic Games.

In 2008/09, the government revived support for corn processing when China found itself with a glut of corn. China had a record corn harvest that year and demand for feed and industrial corn products slowed. China’s Premier called for greater capacity utilization and improved policy support for industrial corn processing as one of eight policy measures to support farmers during the global economic slowdown. The government also needed to dispose of a large stockpile of corn reserves it accumulated when it committed to purchase more than half of the corn crop in the northeastern provinces at minimum purchase prices to shield farmers from falling commodity prices.<sup>9</sup> The government purchased 35 mmt of the record corn harvest of 165 mmt in 2008 for state reserves. Processors and feed mills were unwilling to purchase corn at the support price. At times during 2008/09, China’s corn market was at a standstill due to high domestic corn prices, slower demand for industrial corn products due to the global economic slowdown, and weak feed demand (resulting from a cyclical decline in pork production and weak dairy and egg demand in the aftermath of the 2008 melamine adulteration crisis).<sup>10</sup>

<sup>7</sup>Ma describes a shift in Jilin Province’s agricultural exports from bulk corn to processed corn products, meats, and other value-added products. Support for Jilin agricultural exports was available from a fund for international trade promotion and a fund for the renewal of “old industrial areas.”

<sup>8</sup>Other fuel ethanol plants use wheat, rice, and cassava. According to news reports, pilot projects using sweet sorghum were said to have been abandoned during 2008.

<sup>9</sup>Corn stocks had also been bolstered by tight restrictions on grain exports during 2008.

<sup>10</sup>In September 2008, it was revealed that thousands of children in China experienced kidney problems linked to the chemical melamine illegally added to watered-down milk. Melamine was also found in poultry feed.

With high raw material (i.e., corn) prices and slow demand, processors in the northeast and other regions idled much of their processing capacity. The government arranged to transfer corn from the northeast to southern provinces to ease the glut of corn in the northeast and offered a subsidy to northeastern processors for every metric ton of corn they processed. In June 2009, a rebate on value-added taxes (VAT) for export of processed corn products that had been canceled in 2008 was restored at a rate of 5 percent.<sup>11</sup>

<sup>11</sup>The value-added tax rebate for corn was kept at zero in June 2009. Rebates for some other agricultural products were set as high as 13 percent.



## Capacity Growth Outpaced Domestic Demand

China's processing capacity for corn-based products appears to have outpaced domestic demand. Central government reports call for prevention of "blind" (mang mu) investment—the creation of excess capacity when companies encouraged by local authorities simultaneously build similar large plants in multiple locations without regard to the ability of the market to absorb the new supply. Much of the new capacity is in large, modern facilities, added to an existing base of older, smaller processors that often use outmoded equipment. The highly competitive market results in price cutting and losses. With a saturated domestic market, companies have expanded overseas sales to utilize their production capacity.

A December 2008 corn-processing industry report by Chicorn ([www.yumi.com.cn](http://www.yumi.com.cn)) estimated that China was utilizing about 57 percent of its corn processing capacity in 2008. Another analyst reported that China's starch industry was operating at 62 percent of capacity and the ethanol industry was at 50 percent of capacity in 2007 (Yu).

According to the Chicorn report, China had over 500 corn processing enterprises, but most were small in scale, used outdated equipment, and had high production costs. The Chicorn report noted that the capacity to produce some products far exceeded domestic demand. Among these products were citric acid<sup>12</sup> and sorbitol (each with capacity over 1 mmt), lysine (capacity over 700,000 mt), and monosodium glutamate (capacity over 2 mmt).

ERS assessed the regional distribution of corn-processing industry capacity by analyzing data on 160 corn-processing enterprises obtained from the Chicorn report.<sup>13</sup> Nearly all processing capacity is in northern provinces where most corn is produced (fig. 5). Eastern China's Shandong Province—a major corn-producing province and a major hub of agribusiness—had the largest processing capacity (13.2 mmt) in 2008, and neighboring Hebei Province was also a leading producer (7 mmt). In earlier decades, there was little processing capacity in northeastern China (Liaoning, Jilin, Heilongjiang, and Inner Mongolia), a region that grows nearly 40 percent of China's corn but is isolated from markets in thriving coastal cities. In recent years, however, processors have concentrated on the northeast because of easy access to corn and government inducements to develop the region. The northeastern region now has about 20 mmt of corn-processing capacity, about half of it in Jilin Province.

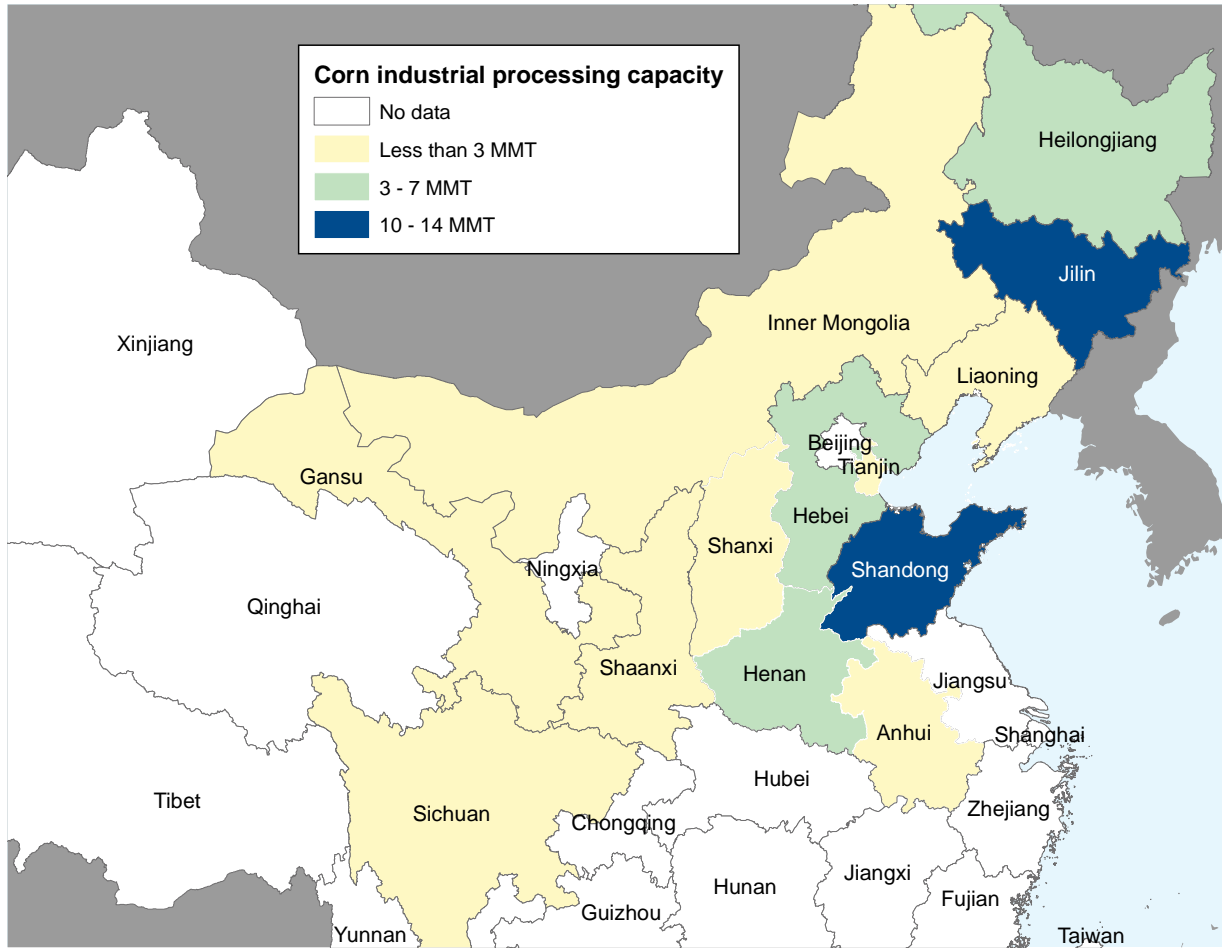
The corn-processing industry includes a small number of large companies and dozens of small mills and distilleries (see box, "Profiles of Corn-Processing Companies"). The Chicorn report listed 160 plants, their capacities, and estimated actual production in 2008 (individual plants of several large companies are listed separately). Eleven plants had capacity of over 1 mmt per year, and they accounted for about a third of the capacity of plants on the list (fig. 6). About 70 medium-sized plants (capacity 200,000-900,000 mt) accounted for about half of total capacity. Small plants accounted for the remainder.

<sup>12</sup>Eighty percent of China's citric acid is made from corn.

<sup>13</sup>The listing excluded small-scale corn processors.

Figure 5

### China's corn processing capacity is concentrated in northern provinces

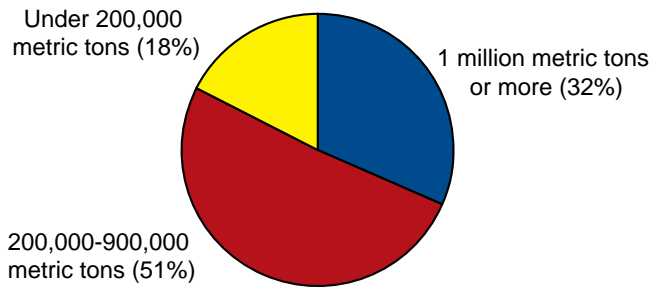


Note: Chart shows estimated corn processing output capacity in 2008.

Source: USDA, Economic Research Service analysis of data from Chicorn ([www.yumi.com.cn](http://www.yumi.com.cn)).

Figure 6

### The largest plants account for nearly a third of China's corn-processing capacity

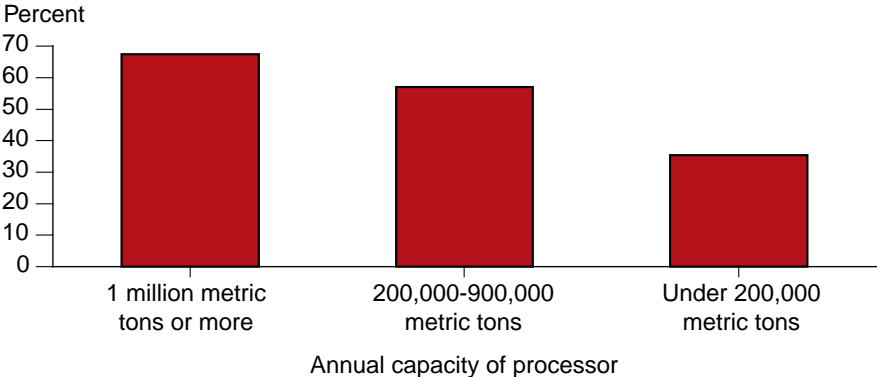


Note: Chart shows estimated annual corn processing capacity in 2008.

Source: USDA, Economic Research Service analysis of data reported by Chicorn, December 2008.

The list revealed that capacity utilization is lower among small plants. On average, the largest plants produced at about two-thirds of capacity in 2008, whereas the smallest plants used just a third of their capacity (fig. 7). About 30 of 80 small plants were reported to be idle. The list noted that all the small starch plants in Zhao County of Hebei Province (with capacity totaling 1.5 mmt) were “probably idle,” apparently due to an environmental cleanup campaign in that county.<sup>14</sup>

Figure 7  
**The largest corn processors have the highest rate of capacity utilization**



Note: Chart shows ratio of reported production to processing capacity by size of plant in 2008.  
 Source: USDA, Economic Research Service analysis of data reported by Chicorn, December 2008.

<sup>14</sup>A county government document listed 43 companies targeted for the rectification program aimed at reducing pollution by closing plants with weak environmental controls.

## Profiles of Corn-Processing Companies

China's corn-processing industry includes companies of varying scales, ownership, and location. Brief profiles of several representative companies engaged in industrial processing provide perspective on the diverse players in the industry, their roles in world markets, and the effects of government policies on their operations. Profiles are based on information provided by company web sites and news reports.

The Changchun Dacheng Industrial Group Co. (Jilin Province) claims to be the largest corn processor in Asia and the world's largest producer of lysine. It is listed on the Hong Kong stock exchange. Its main products include corn starch, sweeteners, lysine, chemicals, high-protein feed, and machinery. It has six large corn-processing plants and the capacity to process 3.2 mmt of corn annually, including 600,000 mt for various kinds of amino acids. It exports to North America, Australia, Brazil, other Asian countries, and Europe. The company was founded in 1996 and began producing starch in 1998. It initiated lysine production in 2000 "to replace imports."

The Zhucheng Xingmao Corn Developing Co., Ltd. (Shandong Province) was established in 1993. It has over 10,000 employees and seven starch mills. The company produces starches, sweeteners, corn gluten meal, monosodium glutamate, poultry feed, and corn oil. Its processing capacity is 3 mmt of corn. Its annual output is 2 mmt of corn starch, 300,000 mt of modified starch, 150,000 mt of corn protein meal, and 150,000 mt of corn oil. It exports products to 40 countries. Zhucheng is involved in a number of central and provincial government food technology projects and is part of a Ministry of Agriculture plan to promote a regional adjustment of farm production.

The Chengfu Food Group (Heilongjiang Province) is a private company with 1,300 employees that produces monosodium glutamate, sweeteners, lysine, feed, packing materials, and organic fertilizer. Its annual capacity is 400,000 mt of corn. Its output in 2006 of various products totaled 91,720 mt. Chengfu has six "green" corn production areas (certified as free of pollution and without toxic pesticides) that comprise about 165,000 acres. It is designated as a national agricultural leading enterprise, which entitles the company to government financial support and other benefits in exchange for purchasing crops from small farmers. Chengfu exports to Russia and east Asian countries.

Limin Starch Company is a collective enterprise with multiple starch production facilities in Zhao County of Hebei Province. The No. 1 plant was constructed in 1982 and has annual capacity of 50,000 mt of corn starch output and 100-200 employees. It has ISO 9001 quality management system certification and is designated as an agricultural leading enterprise of Shijiazhuang City. A document issued by the county government in 2007 announcing a pollution-control program aimed at starch processors identified Limin as lacking environmental controls. The document listed 28 plants that would be closed and 19 that would have to meet requirements by a deadline. Limin plants were included on both lists. The December 2008 Chicorn report stated that all small processors in Zhao County (total capacity of 1.5 mmt) were probably idle.

## Growth in Exports of Industrial Products

The conventional view among analysts is that rising industrial use represents increasing demand for corn in China that will turn the country into a corn importer. But a closer look shows that China's corn supply has outpaced domestic demand. China's exports of unprocessed corn decreased in recent years, but its exports of industrial corn products rose. Thus, China still has a surplus of corn—its exports have shifted from unprocessed corn to processed value-added products. CNGOIC estimates that China's corn supply exceeded its use by 5.8 mmt in 2007/08 and 22 mmt in 2008/09.<sup>15</sup>

ERS investigated recent trends in industrial product exports by analyzing China customs statistics for a set of 19 corn-based starch, oil, sugar, feed, and chemical products (appendix table). These products are largely made from corn in China, although some may be made from other raw materials as well.<sup>16</sup> The list of products is not exhaustive—other products that use corn as raw material are not included. For example, corn-based ethanol is not included since ethanol can be made from different raw materials and the statistics do not distinguish corn-based ethanol. The quantity exported is the weight of final products. The volume of corn used as raw material exceeds the volume of the final products in most categories.

China's exports of corn-based products boomed as producers saturated the domestic market. With keen competition and downward pressure on prices in the domestic market, many producers expanded overseas sales. Exports of industrial corn products rose from 1.4 mmt in 2004/05 to a peak of 3.4 mmt in 2007/08 (fig. 8). The rising exports of corn-based industrial products coincided with a decrease in exports of unprocessed corn from 7.6 mmt in 2004/05 to 550,000 mt in 2007/08.<sup>17</sup> Exports of unprocessed corn sank further to 172,000 mt in 2008/09. The decline reflects policies taken by Chinese officials during calendar year 2008 to prevent food prices from rising, including withdrawal of grain export quotas, cancellation of VAT rebates for exports of grains and their products, and a temporary export tax on grain exports. Exports for the 2008/09 market year totaled 2.9 mmt, below the previous year's peak but higher than export totals for 2006/07 and earlier years.

Exports of industrial corn products grew exponentially through the second quarter of 2007 (fig. 9). Exports increased for a range of products, including citric acid, lysine, corn starch, dextrans, sugars, syrups, distillers' grains, residues of starch and corn milling, and monosodium glutamate. China imported nearly all of its lysine until the 2000s, but it is now a net exporter. Jilin's Dacheng Group now claims to be the world's largest lysine producer. China dominates world markets for some products. In 2007, China accounted for over 80 percent of global citric acid exports and over 60 percent of global fructose exports.

China's exports of industrial corn products dipped during the second half of 2007 and then rebounded to a high level during the first two quarters of 2008. During 2007-08, international grain prices surged, but China's restriction on corn exports helped keep China's corn price below international prices. This gave Chinese producers of industrial products lower raw material costs than

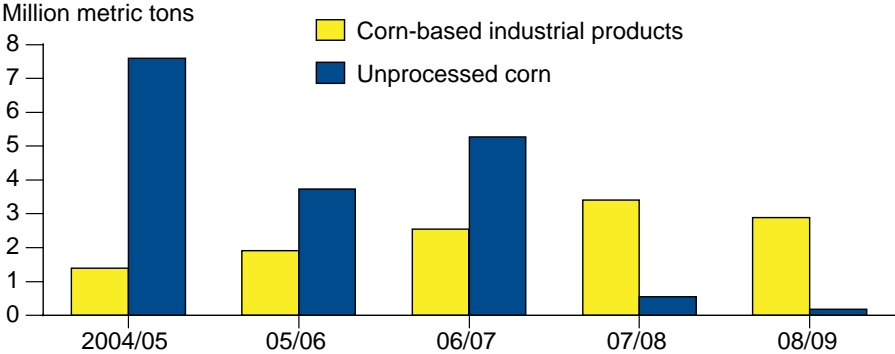
<sup>15</sup>Based on the corn balance sheet in China National Grain and Oils Information Center's feed grain market supply and demand situation report for November 2009.

<sup>16</sup>ERS confirmed that product categories were primarily corn-based by checking the geographic origin of exports. For example, exports of sugar products (harmonized system code 170290) originated mostly from northern corn-producing provinces, not southern provinces where cane sugar is produced.

<sup>17</sup>ERS did not include ethanol in its estimate of corn industrial product exports since customs statistics do not distinguish corn-based alcohol. Yu reported a higher total of 3.8 mmt of corn exported in the form of processed products in 2007. China had a surge of ethanol exports during 2006 but cancellation of the VAT rebate reduced ethanol exports from Jilin and other provinces in 2007 (Ma; Yu).

competitors in other countries. However, China’s advantage reversed later in 2008 when international prices dropped, and Chinese officials supported corn prices above the international level. China’s industrial corn product exports dipped sharply in the fourth quarter of 2008 before recovering in 2009. In June 2009, officials restored the VAT rebate for exported corn starch at a rate of 5 percent. By the second quarter of 2009, exports of industrial corn products recovered to near the peak levels reached in the first two quarters of 2008. Exports for the 2008/09 market year totaled 2.9 mmt, below the previous year’s peak but higher than export totals for 2006/07 and earlier years.

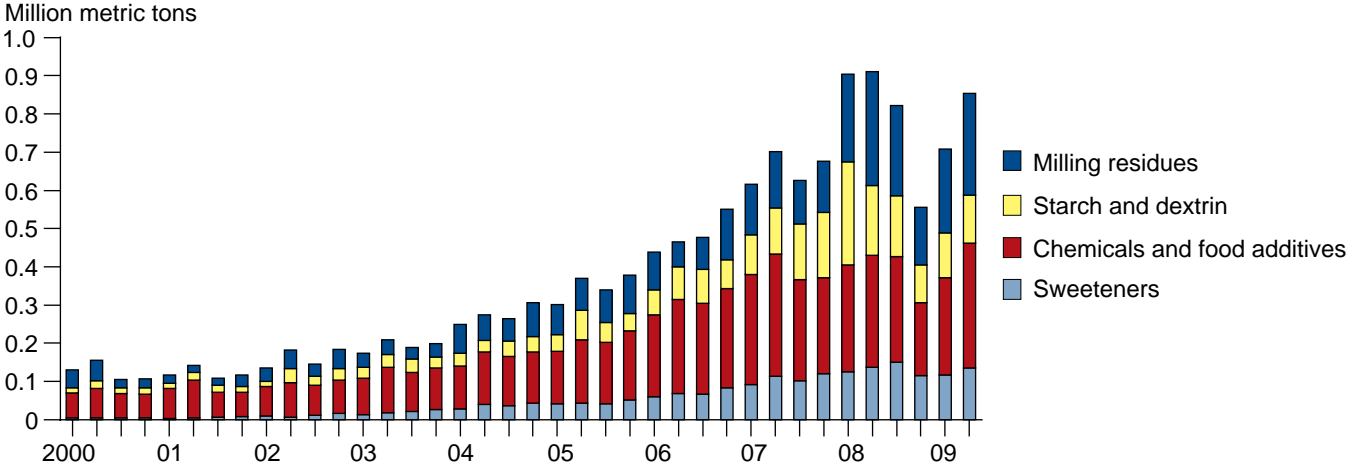
Figure 8  
**China’s exports of industrial products grew as unprocessed corn exports diminished**



Note: Market year is October-September. Industrial products include corn starch, corn oil, milling and distilling residues, glucose, fructose, other sweeteners, lysine, glutamic acid, citric acid, dextrans, and sorbitol.

Source: USDA, Economic Research Service analysis of China customs statistics.

Figure 9  
**China’s exports of corn industrial products have risen**



Note: Chart shows quarterly exports. Starch and dextrans: corn starch and dextrans. Chemicals and food additives: citric acid, lysine, glutamic acid, and sorbitol. Milling residues: residues of corn milling, starch manufacture, distilling, and brewing. Sweeteners: glucose and fructose.

Source: USDA, Economic Research Service analysis of China customs statistics.

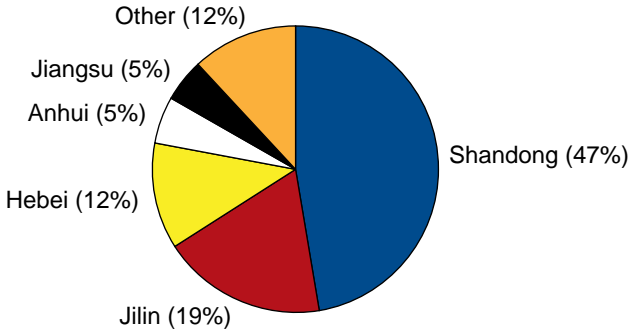
China’s industrial corn product exports come mainly from a few geographic areas where large processors are concentrated. ERS analysis of corn industrial product exports using China customs statistics by city and province shows that 47 percent of the country’s exports for January-September 2009 came from Shandong and 19 percent came from Jilin (fig. 10). These two provinces accounted for a combined 68 percent of industrial corn product exports, much higher than their 24-percent share of corn production. Sixty percent of Jilin Province’s exports came from Changchun City, where the Changchun Dacheng Group (see box, “Profiles of Corn-Processing Companies,” on page 12) is headquartered.<sup>18</sup> Forty percent of Shandong’s exports came from Weifang and 16 percent from Zhucheng City.

Other large sources of industrial corn product exports in China include Rizhao, Huimin, Linyi, and Qingdao Cities in Shandong Province, and Siping, Baicheng, and Jilin Cities in Jilin Province. Hebei accounted for 12 percent, but most of those exports came from a single city: Qinhuangdao. Anhui accounted for 5 percent (mostly from Bangbu City) and Jiangsu 5 percent. Apart from Jilin, other major corn-growing provinces in the north-east (Liaoning, Heilongjiang, Inner Mongolia) accounted for a combined total of just 4 percent of industrial corn product exports (they accounted for more than one-fourth of corn production in 2008).

<sup>18</sup>In China’s administrative system, a city or prefecture encompasses a multi-county region that includes rural areas surrounding the city. Many counties have been reclassified as cities since the 1990s.

Figure 10

**Shandong and Jilin Provinces account for most of China’s exports of corn industrial products**



Note: Chart shows share of quantity exported for January-September 2009, based on place of origin recorded on customs documents.

Source: USDA, Economic Research Service calculations based on China customs statistics accessed through Global Trade Information Services, Inc.



## High Corn Prices Squeeze Manufacturers

Corn prices are a determinant of the competitiveness of corn-based industrial products.<sup>19</sup> China's exports of industrial corn products have risen despite a relatively high and rising domestic corn price (fig. 11). On average, China's domestic corn price is 20-40 percent higher than the price at U.S. gulf ports. Since 2005, China's corn prices have been on an upward trend, reflecting gradually tightening corn supplies. The cumulative 4-year increase in corn price at Dalian in northeastern China from April 2005 to April 2009 was about 65 percent. The average unit value of exported corn starch rose in tandem with the corn price.

In 2008/09, China's corn processors were buffeted by volatile fluctuation in world corn prices and a reversal of Chinese corn price policy. When international prices of corn and other commodities spiked in 2008 (Trostle), Chinese policymakers enacted temporary policies (as described earlier) to prevent domestic grain prices from soaring. The U.S. gulf price of corn rose above the China corn price, and the unusual shift in prices gave Chinese industrial processors a cost advantage in raw materials. This was a principal factor behind the soaring exports of industrial corn products during the first half of 2008 (see fig. 9).

In the fourth quarter of 2008, international commodity prices plunged and the worldwide economic crisis slowed demand for corn. Chinese authorities scrambled to support grain prices, announcing four rounds of corn purchases for government reserves at minimum prices. Authorities purchased 35 mmt of the 2008/09 corn crop in northeastern provinces—more than half of the crop in that region—to support prices.<sup>20</sup>

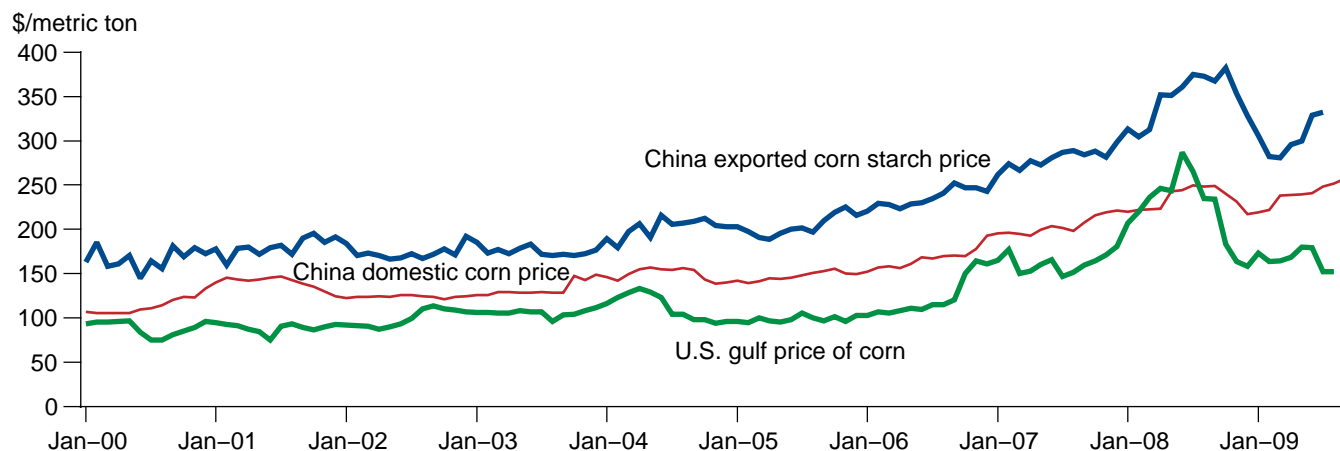
The competitive position of industrial users of corn in China reversed sharply as prices of starches, alcohol, and related products fell while raw material

<sup>19</sup>According to Yue, corn represents 90 percent of the variable cost of starch production, 80 percent of alcohol variable costs, and 50 percent of citric acid variable costs in China.

<sup>20</sup>The government announced plans to purchase 40 mmt, but news reports indicate that 35 mmt was actually purchased.

Figure 11

### Price of China's exported corn starch rose with domestic corn price



Note: Exported corn starch price is the ratio of export value to quantity for corn starch (HS code 110812). China domestic price is wholesale price at Dalian converted to dollars at the official exchange rate.

Source: USDA, Economic Research Service using China National Grain and Oils Information Center, USDA, and China customs statistics.



costs (corn prices) were supported at high levels. In 2009, CNGOIC forecast a decrease in industrial use from 40.8 mmt in 2007/08 to 38.3 mmt in 2008/09, followed by a recovery to 41 mmt in 2009/10. Many corn processors in China idled their plants in late 2008 and 2009. Yue reported that alcohol manufacturers' capacity utilization fell to 36 percent in August 2009, down from a peak of 62 percent. Capacity utilization was also down sharply for starch, citric acid, and lysine production.

As the 2009 harvest approached, the tradeoffs from supporting corn prices became clear. It was widely anticipated that the government would again support corn prices at a high level to protect farmers' income and encourage them to continue planting corn. However, the high corn price translated to negative profit margins for corn processors. According to news reports, many processing facilities were idle for much of 2009 and many were bankrupt or trying to sell their factories (Wang). Small privately owned companies—with less access to bank loans and ineligible for processing subsidies (only processors with at least 100,000 mt annual capacity were eligible)—were in an especially precarious position. High corn prices also crimped the profits of feed mills (who were not given subsidies) and livestock producers.

A regional imbalance in corn supply and demand also emerged. In much of the country, corn supplies tightened and prices rose, as private and onfarm inventories became mostly depleted as the crop year came to an end. According to industry news reports, at least 22 mmt of government corn reserves remained unsold in northeastern warehouses (Qi). In August and September 2009, China's government auctioned about 12 mmt of corn from reserves, but much of the corn offered went unsold since many buyers were unwilling to purchase corn at the minimum prices set for the auctions. With large reserves still in government warehouses, many observers wondered whether there would be enough space to store the new corn crop after harvest in fall 2009 (Qi).

## Slower Growth and Consolidation May Be Ahead

The rapid growth in processing capacity since 2000 is not likely to continue. Central government policymakers are now encouraging industry consolidation and elimination of excess capacity. Enthusiasm for support for grain processing has waned due to growing concern about domestic food security. Increased focus on pollution, water supplies, and energy use may lead to closure of some plants, cancellation of new projects, and higher operating costs in other plants. Closing plants with weak effluent controls or inefficient water and energy use may simultaneously address the excess capacity issue since these companies tend to be small, old facilities with low efficiency.

The industry is likely to consolidate into fewer, larger companies through mergers, acquisitions, and closures of small outmoded plants. The concentration of the industry reflects economic forces as well as government priorities of creating strong “industry champions” with branded products and eliminating weaker small companies with lax environmental controls and inefficient use of energy and water. Some industry members thought the consolidation would be hastened by the bankruptcy of small processors during 2009, as described earlier (see Wang). At the same time, a handful of large companies are emerging as influential players in the domestic industry and in international markets.

China’s future as a processor of corn products depends largely on the scarcity or abundance of corn in the country. The Chinese government encouraged the development of the corn-processing industry largely to reduce excess corn supplies and raise farm prices. A trend of rising corn prices in China since 2005 suggests that these goals have been met. If Chinese corn prices continue rising in future years, the growth of the industry will slow and exports of industrial corn products may decline.

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## Appendix

**Appendix table—China exports of corn industrial products, 2008/09**

Product description	HS code	Quantity	Value
		<i>Thousand metric tons</i>	<i>Million dollars</i>
Corn (unprocessed)	1005	172.2	48
All industrial products of corn		2,888.0	1,734
Corn starch	110812	279.6	89
Crude corn oil, not chemically modified	151521	5.5	7
Refined corn oil and fractions, not modified	151529	12.4	18
Glucose (dextrose), under 20 percent fructose in dry form	170230	358.5	142
Glucose and syrup containing 20-49 percent fructose	170240	25.5	26
Chemically pure fructose in solid form	170250	0.2	1
Fructose	170260	35.6	20
Other sugar, including inverted sugar and syrup	170290	130.4	105
Bran sharps and other residues derived from milling corn	230210	340.3	52
Residues of starch manufacturing	230310	421.9	88
Brewing or distilling dregs and waste	230330	70.9	13
D-glucitol (sorbitol)	290544	49.7	29
Citric acid	291814	597.5	523
Salts and esters of citric acid	291815	92.7	91
Lysine and its esters	292241	84.5	102
Glutamic acid and its salts	292242	232.3	293
Dextrins	3505	150.8	133

Note: HS = harmonized system. Data are for October 2008-September 2009 market year.

Source: USDA, Economic Research Service analysis of China customs statistics.