



**AgEcon** SEARCH

RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

*No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.*

# Who Will China Feed?

**Bryan Lohmar**  
blohmar@ers.usda.gov

**Fred Gale**  
fgale@ers.usda.gov

An interview with the authors is featured  
online at: [www.ers.usda.gov/amberwaves/](http://www.ers.usda.gov/amberwaves/)



- China is a net food exporter, and its food exports, as well as its imports, are growing.
- China's capacity to continue food export growth is constrained by intense competition for limited resources by nonagricultural industry and other sectors of the economy.
- Intensive use of chemical inputs has led to deteriorating environmental quality, which may affect China's future production capacity and cause problems in export markets.

In the 1990s, many analysts saw China as a major potential market for agricultural exports from the United States and other countries. Lester Brown's highly publicized 1995 book, *Who Will Feed China? A Wake-Up Call for a Small Planet*, predicted that China would turn to international grain markets to meet the expanding food demands of its increasingly affluent population. World Trade Organization (WTO) accession was expected to be a watershed event that would finally open the Chinese market to grain and meat imports.

While China has emerged as the world's leading importer of soybeans, vegetable oil, cotton, wool, rubber, and animal hides, it has been surprisingly successful at meeting the basic food needs of its population of more than 1.3 billion people, and it has stepped up as a major food exporter. How long can China sustain this momentum?

China imports only small amounts of premium-grade rice, minor amounts of wheat in most years, and no corn. China has maintained agricultural self-sufficiency in grains as it carries out the world's largest and fastest urbanization and industrialization. Economic development is increasing competition for scarce resources in China, but growing incomes are allowing most consumers to increase consumption of fruit, vegetables, and livestock products.

China has become a significant food exporter by ramping up production in many sectors and gaining world market share. Indeed, China has been a net food exporter for most of the last three decades. China dominates world markets in a variety of products areas, including garlic, apples, apple juice, mandarin oranges, farm-raised fish and shrimp, and vegetables. At times, it

seems that China has suspended the law of scarcity by boosting production in many sectors and selling at low prices without having to sacrifice production in other sectors.

More recently, however, signs hint at a restoration of the law of scarcity, mostly in the form of rising commodity and input prices, more expensive labor, restrictions on land developments, and a reversal of China's pro-export policies. Various hidden costs of China's seemingly miraculous growth also are beginning to emerge, including dangerous chemical residues on food and related food safety problems, falling groundwater tables, polluted water, and overall environmental degradation.

### **China's Challenge: Feeding 1.3 Billion People**

For centuries, China was an agrarian economy mostly populated by small subsistence farmers. In the 1930s, John L. Buck, a Professor of Agricultural Economics at Nanjing University, estimated that plant-based foods comprised 97 percent of Chinese caloric intake, and this diet enabled farmers to maintain subsistence livelihoods on a limited land base. In the 1950s, China's agriculture underwent collectivization, and even though China's population doubled from 550 million in 1950 to over 1 billion by 1980, the country was still largely able to maintain food self-sufficiency during most of this period. Key to this achievement was the continuation of plant-based diets for much of the population, as the centrally planned and collectively run mobilization of land, water, and labor resources for agriculture was directed toward production of food grains at the expense of livestock and horticultural products.

In the late 1970s, China introduced reforms that effectively ended collective agriculture and restored traditional household production. Farm income grew and diets diversified during the 1980s and 1990s. Agricultural production gains stemmed from gains in production efficiency rather than expansion and mobilization of additional resources. The immediate effect of these reforms was a decline in area sown to grain and an increase in land devoted to nongrain crops and livestock production. Still, despite the decrease in area, grain production surged as farmers allocated their limited resources more efficiently.

Over the past two decades, the role of the market has expanded and fostered rapid economic growth in China. Everwealthier consumers began diversifying their diets to include more variety in fruit and vegetables and more livestock and fish. China Ministry of Health statistics indicate the share of calories consumed from grain and vegetable products in 2002 was 63 percent, far below the 97 percent estimated in the 1930s.

Farmers responded to changing domestic demand for food products by further diversifying production. At the same time, Chinese farmers have supplied a growing stream of food exports that include farm-raised fish, shrimp, vegetables, fruit, juices, mushrooms, tea and organic foods. But the rapid growth of livestock and horticultural production did not come at the expense of reduced grain output. After years of regional and local self-sufficiency enforced under collective agriculture, yields continually improved over the post-reform period, the result of stronger incentives, improved production practices, more regional specialization, and the introduction of new varieties.

Investments in research and development raised the quality of inputs and the efficiency of their use over the past two decades. Research into improved varieties

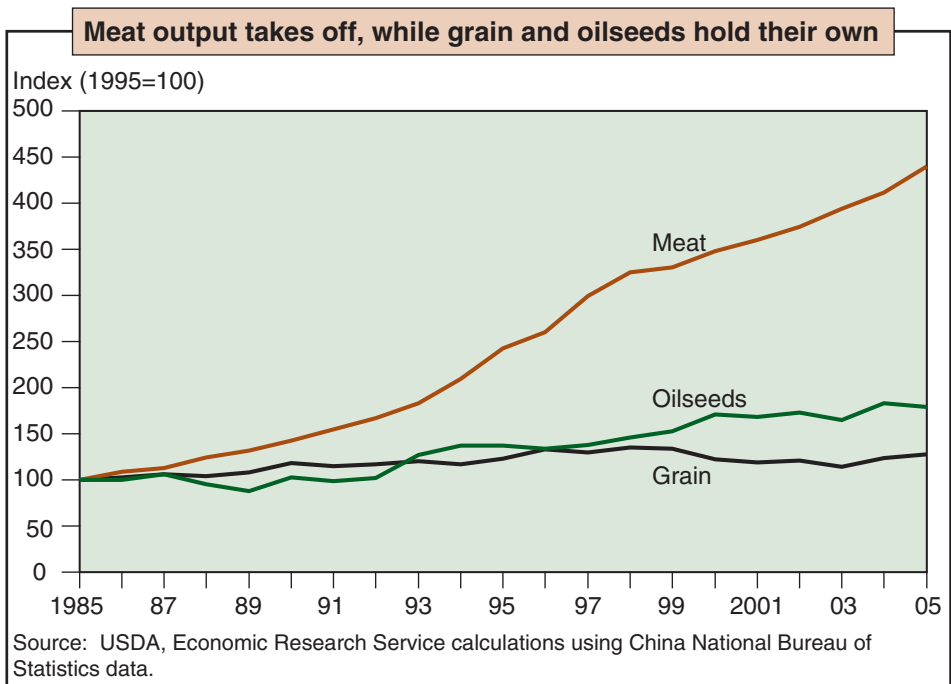
and quality of seeds surged after the late 1970s. By the turn of the century, China had more agricultural researchers than any other country, and a larger budget for public sector agricultural research than any developing country. Fertilizer quality in China also has improved over the past two decades, as farmers move away from applying pure nitrogen fertilizer to applying more nitrogen-phosphorous-potassium blends. China has been importing breeding animals—which are often crossed with domestic breeds—to improve efficiency of weight gain, improve disease resistance, and raise milk output. The government has offered subsidies to farmers for dairy herd improvement for several years.

China today is the world's largest agricultural producer and consumer. With an estimated 10 percent of world land resources and 6 percent of world water resources, China produces 30 percent of the world's rice, 20 percent of the world's corn, a fourth of the world's cotton, an estimated 37 percent of the world's fruit and vegetables, and half of the world's pork. For most products, China's world

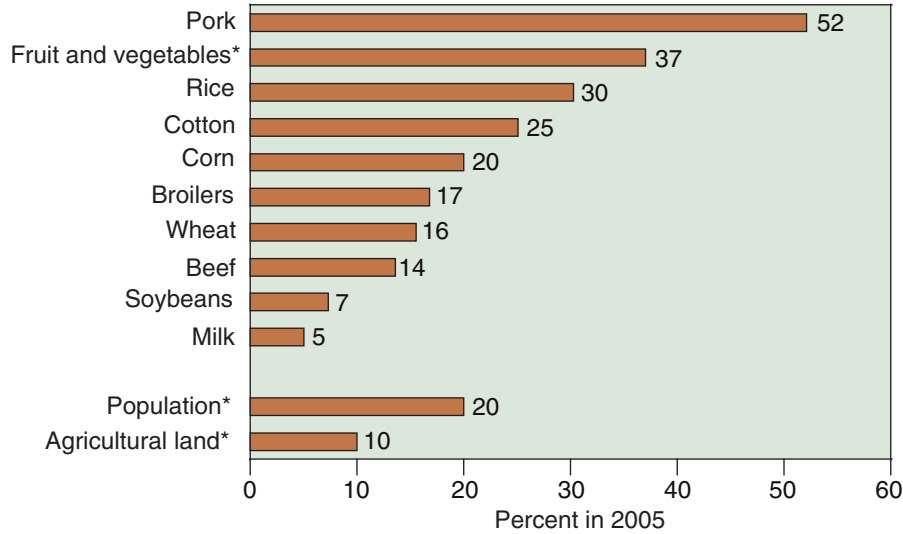
share of production is close to or exceeds its 20-percent share of world population. China, however, has exploited the means of coaxing food and fiber out of a limited natural resource base to the extent that additional gains will be more difficult than in the past.

**Signs of Stress to Land and Water**

Land and water are key inputs to agriculture and are the main constraints to China's continued production growth. Chinese farmers farm not only the most productive land in plains and valleys in the eastern third of the country but also steep hillsides, arid grasslands, drained lakes, and dry riverbeds that are generally not cultivated in more land-abundant regions like North America or Australia. While southern China has relatively abundant water that facilitates water-intensive flooding of rice paddies, the per capita water endowment in the North China Plain is roughly one-tenth the world average and is well below conventional measures of water scarcity. Yet, this region produces a large share of China's wheat,



**China produces over half the world's pork output and a third of world horticultural output**



\*Based on United Nations Food and Agriculture Organization data.  
Source: USDA, Economic Research Service calculations using USDA data except where noted.

corn, cotton, and other crops that rely heavily on irrigation.

China's current exploitation of land and water resources is either at or beyond sustainable levels. The cultivation of steep hillsides is causing massive sedimentation loss estimated at over 2 billion tons per year, decreasing productivity in areas losing topsoil, reducing water storage capacity in reservoirs, and increasing the likelihood of floods. Agricultural practices, both crop cultivation and animal husbandry, on sensitive arid grasslands are partly to blame for the desertification of these areas. In the North China Plain, the groundwater table is falling rapidly in some areas, and several surface-water sources periodically dry up before reaching the sea. The Yellow River, for example, ran dry for long periods of the year in the 1990s. Policy measures instituted in 2000, however, have ensured the river's continued flow to the ocean.

Industrial and urban growth is increasing the competition for China's limited land and water. China's nonfarm economic boom means that housing com-

plexes, industrial parks, power stations, and other projects, are being built on land converted from agriculture. Competition for land within agriculture is also intense. Increasing production of meat, dairy products, vegetables, fruit, and farm-raised fish competes with grain cultivation for area. Given the gradual shrinkage of the agricultural land base, expansion of one agricultural activity generally means that land must be diverted from another. Efforts to develop saline or other marginal lands for limited agricultural activities have yet to result in significant expansion of agricultural production onto such land.

As with land, water resources face increasing demand from nonfarm users. In 1980, industrial and domestic consumers used only 13 percent of the water consumed in China, with agriculture accounting for the remainder. By 2000, agriculture use was roughly two-thirds of water consumed in China, and industry and domestic users have raised their share to one-third. On the productive North China Plain, water diversions for human use are well over 60 percent of renewable

water resources, and nearly 90 percent in the Hai River Basin in Hebei Province.

While China intensively uses its land and water resources in agriculture, there is potential to manage both resources more efficiently. Land in China is allocated to farm households but remains collectively owned and subject to redistribution to other households or sale to nonagricultural interests by local leaders. This system reduces incentives for households to invest in land improvement and raises the cost of land transfers. It also results in small, fragmented household land holdings that confound farmers' capacity to specialize or take advantage of economies of scale and size. Additionally, farmers rarely allow land to be fallow and recover from intensive production, a practice that could have negative long-term implications for land productivity. Until the 1990s, water management in China was geared to exploiting water as a cheap resource to boost agricultural and industrial production without considering the opportunity costs. Efforts to encourage water saving are just beginning to take hold.

Reforming land and water management policies and practices in China may help improve the efficiency of resource allocation and could bring about more sustainable practices and contribute to future production growth. However, such reforms are likely to confront ideological and other resistance. Moreover, the gains may not have a large net effect on agricultural production since more efficient allocation may lead to a reduction in the levels of land and water allocated to agriculture. This is particularly true for grains, since the value of these resources in grain production is lower than in horticultural production and nonagricultural uses.

**Signs of Labor Scarcity**

China has been able to maintain low-cost production in international agricultural markets largely because of low

labor costs. Historically, Chinese farms have raised large amounts of output from small plots by using labor-intensive production strategies, such as growing multiple crops per year, intercropping, and growing vegetables in courtyards. But hundreds of millions of rural workers have found nonfarm employment over the last two decades. The flow of labor from rural areas enabled China's industry and cities to boom, while wage growth was relatively stagnant for much of the last two decades.

China's rapid economic expansion appears to have finally exhausted the pool of under-employed workers. Since 2003, wages have been rising at a double-digit pace. The dwindling pool of available rural workers is resulting in increased mechanization of harvesting and planting. Anecdotal evidence also suggests that intensive agricultural practices, like double-cropping, transplanting seedlings by hand, and small-scale hog production, have decreased due to labor shortages and high wages.

### Food Prices Are Rising

The recent trends in resource use, labor availability, and changing agricultural production, along with rising international food prices, are causing increases in China's domestic food prices. Food prices in China began rising in 2006, and China's government made controlling the inflationary impact of food prices a top policy concern in 2007. Pork prices in China soared to record levels in 2007 as the hog sector contracted, in part due to disease outbreaks and inclement weather in southern China. In previous cycles (as recently as 2004-05), sharp increases in prices drew more producers into hog production. But in 2007, response to the record-high prices was slowed by disease losses and the high cost of feed and feeder pigs. Ultimately, officials resorted to introducing subsidies and insurance as incentives to encourage hog production and hasten the easing of prices. Recent policies aimed at boosting grain planting have diverted land from soybean and rapeseed production, and oilseed and vegetable oil prices rose sharply in the last 2 years.

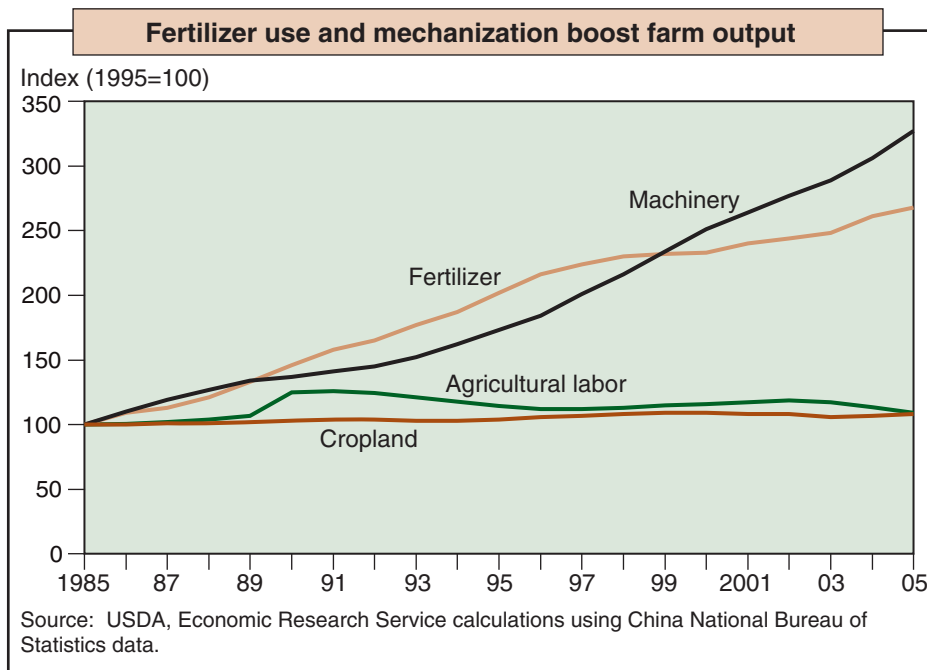


Fred Gale, USDA/ERS

Prices are rising partly due to increasing world commodity prices, but also because of China's inability to boost domestic production. In response, China has made several significant policy changes in the last year. The Chinese government withdrew rebates of value-added taxes that encouraged exports, and it introduced temporary export taxes on grain and flour to cut off grain exports and cool domestic grain prices. Also in the past year, China scaled back ambitious policies to retire environmentally sensitive land from cultivation, and it revised plans to develop grain-based bio-fuel production.

### Hidden Costs Now and in the Future

In addition to having an impact on the production costs borne by farm households, applications of agricultural chemicals and exploitation of natural resources can have external costs borne by others or by future generations. These costs are becoming more evident in China. As education and access to news improves, Chinese consumers are growing more concerned about the quality of the environment and the food they eat, and are seeking changes. In a 2007 survey of household food consumption choices in Beijing, far more households reported choosing food products according to quality and safety attributes than according to price.





Tom Wahl

Chinese farmers have applied heavy doses of chemical fertilizer and pesticides to overcome natural resource constraints and significant pest pressures. Farmers use a variety of veterinary drugs to control diseases that spread quickly among livestock and fish raised in crowded facilities, and they use feed additives to enhance animal growth. Residues of toxic pesticides, drugs, and industrial pollutants detected in food are a potential health hazard. A sizeable share of China's industrial production also takes place in rural areas and in close proximity to agriculture. The external costs of industrial production, such as water pollution, often are borne by agricultural producers.

China's food industries have been stung by quality and safety problems both overseas and in domestic markets. There is a strong campaign to reduce and regulate farm chemical use. Chinese officials now ban food production in heavily polluted areas and limit use of toxic chemicals. Exporters must go through stringent certifications and product testing, raising the costs of production and limiting the development of potential export markets for food products. Chemical fertilizer and animal waste also contribute significantly to water pollution and may be constrained by environmental regulations.

## The Future of Agricultural Production and Trade in China

China's sheer size and relatively open trade policies ensure that it will continue to be a major importer and exporter of agricultural products. However, rising prices and increasing attention to environmental and food safety problems in 2006-07 seemed to signal the end of "easy" growth. In coming decades, China's agricultural export juggernaut might be slowed as it faces resource and labor scarcities and confronts environmental and food safety costs that were not always taken into account during the decades of robust growth. Slower export growth, coupled with growth in domestic consumption, may shift the food industry's attention toward supplying the domestic market.

While future gains in China's agricultural production will not come as easily as in the past, there is still scope to achieve further growth. Indeed, the United States and many other countries have faced similar resource and environmental constraints and still maintained robust growth in agricultural production while transitioning into more environmentally friendly production practices. China, however, is developing at a much more rapid pace than other countries, has a very large and diverse agricultural sector, and has yet to fully establish supporting institutions to facilitate this transition while increasing the efficiency of production.

China is establishing policies to maintain production growth and reduce the environmental impact of agricultural practices. Research institutes are developing new crop varieties and production systems that could increase yields and use water more efficiently. The livestock industry is importing breeding stock and developing larger scale commercialized operations to improve the efficiency of livestock production. Agricultural officials

in China are promoting demonstration projects in more sustainable modes of agricultural production. China is strengthening farmers' rights to land—although stopping short of allowing full ownership of land—so farmers can rent land, consolidate their holdings, and achieve efficiencies in size and scale. Moreover, agricultural officials seek to band small farms together into "production bases" to supply uniform products to selected agribusinesses which, in turn, supply farmers with standardized inputs, technical information, and production credit.

Changing consumption patterns will play an important role in China's future agricultural trade. As Chinese consumers diversify their diets, aggregate consumption of traditional food grains, such as rice and wheat, is flat or declining. Some land historically used to grow food grains is being shifted to feed grains to support the growing livestock sector. Finally, China's fruit and vegetable production will continue to grow and, over time, food safety issues will likely be resolved. However, a large share of the increases in the production of these products will be consumed by China's own large and increasingly wealthy population.  $\mathbb{W}$

### This article is drawn from . . .

*Demand for Food Quantity and Quality in China*, by Fred Gale and Kuo Huang, ERR-32, USDA, Economic Research Service, January 2007, available at: [www.ers.usda.gov/publications/err32/](http://www.ers.usda.gov/publications/err32/)

"The Ongoing Reform of Land Tenure Policies in China," by Bryan Lohmar, Keith Wiebe, and Agapi Somwaru, in *Agricultural Outlook*, September 2002, available at: [www.ers.usda.gov/publications/agoutlook/sep2002/ao294f](http://www.ers.usda.gov/publications/agoutlook/sep2002/ao294f)