

China's Food and Agriculture: Issues for the 21st Century. Fred Gale, editor,
Market and Trade Economics Division, Economic Research Service, U.S.
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Abstract

China's impact on world agricultural markets in coming decades will depend on many factors. Growing income and transition to modern urban lifestyles will increase demand for all foods, but demand will shift toward meat and high-value products. WTO accession may increase openness of China's agricultural trade and allow more imports. An understanding of geographic variations of consumption, production, trade, and policy is critical to understanding the vast China market. Development of transportation infrastructure and market channels will make it easier for food products to reach consumers. China's approach to biotechnology and its reform of institutions for allocating land, labor, and water inputs have important implications for agricultural productive capacity.

Keywords: China, food, agriculture, production, consumption, regions, international trade, biotechnology, livestock, land, irrigation, retail, transportation, marketing, rural development, labor markets, statistics.

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Summary

As the 21st century opens, China stands ready to assert itself as a major player in global markets. Its accession to the World Trade Organization (WTO) is the latest step in China's incremental journey from an economy characterized by planning and self-sufficiency to one that is market driven and globally integrated. How will China's role in world agricultural trade evolve in coming years? Will it continue to integrate its economy with world markets? Will it import products that can be grown more efficiently in countries with more abundant land and water resources? Or will China maintain its past commitments to self-sufficiency in grains? Will the government allow markets to play a greater role in agriculture or will central planning and government-supported monopolies continue to play dominant roles?

China is one of the world's largest and most volatile customers for agricultural products. Yet, for a country of its size and limited resource endowment, its level of agricultural imports is modest. China tends to import bulk commodities and items used as intermediate inputs in labor-intensive manufacturing. China is a major exporter of high-value, labor-intensive food products, such as manufactured foods, animal products, fish, vegetables, and fruits. China's agricultural exports go largely to other Asian markets. Although per capita incomes and food expenditures in China are still low, food security is not a problem for most of the country's population. Food-consumption levels have grown and will continue to grow as the country grows richer, but this effect will further strain China's limited land and water resources.

Income growth and urbanization are likely to boost food demand considerably and change the mix of foods consumed in China. As incomes grow, demand for meat, fish, vegetable oils, and dairy products will grow particularly fast. The country's transition from rural semi-subsistence to urban lifestyles will also have profound impacts on consumption patterns, shifting demand from self-grown rice, wheat, and vegetables to fish, meat, processed foods, and restaurant meals. Consumers will also pay more attention to food quality, and they may demand foods with specific attributes.

Until the 1980s, there was relatively little value-added in China's food sector, as consumers prepared most meals at home using rice, noodles, raw vegetables, and meat produced at home, purchased from state-run foodstuff stores, or purchased directly from farmers. In the 1980s and 1990s, China's food processing and food retailing industries grew remarkably fast, as consumers demanded more quality and convenience in foods. Modern supermarkets are now the country's most widespread retail outlet for food, but they are being challenged by emerging hypermarkets, most of which are owned by foreign chains. Hypermarkets are introducing China to modern supply chain management techniques designed to improve efficiency in wholesaling and distribution. These developments may open new channels for high-value food imports. The demand for quality, uniform farm products in high volumes generated by modern processing and retailing may transform agricultural production in China.

The increase in meat consumption may be one of the most important developments in China's agricultural sector. Per capita meat and egg consumption by urban residents (not including away-from-home meat consumption) increased an average of 1.5 percent annually from 1985 to 1999. China produces nearly half of the world's pork and is the world's second-largest poultry producer and third-largest beef producer. The meat industry is expected to grow further to supply the country's

growing appetite for meat. Livestock production is shifting from small-scale household production to larger, more commercialized operations. Most of China's growing demand for livestock products will be supplied by domestic producers, predominantly specialized household and commercial livestock operations. However, these farms will increasingly rely on imported corn and soybeans or soymeal to feed their growing livestock numbers.

As exporters prepare to enter the "China market," it is important to keep in mind the regional diversity of the country. Important differences in development level, living standards, and reliance on trade are evident between northern and southern China, eastern and western China, and urban and rural China. These differences seem to be magnified as rapidly growing coastal cities pull further ahead of inland cities and rural areas. Historically, China's provinces have competed with one another to develop their local industries, a practice that dampened interregional trade and encouraged inefficient industry structure and overcapacity. Greater competition brought about by the country's WTO accession will likely encourage a more integrated national economy with fewer, more efficient firms.

The rapid development of transportation and marketing infrastructure is also playing a role in integrating the national economy. However, transportation and logistics costs account for an estimated one-fifth or more of retail prices in China, much higher than in developed countries. Marketing costs will need to be reduced to allow farmers in China's interior to compete for markets on China's coast and overseas. Inadequate port facilities and lack of warehousing and cold storage facilities impede both domestic and international trade. Increased competition after the country's WTO accession will likely push China's food marketing system to squeeze out inefficiencies and reduce farm-retail margins.

China's agricultural trade has grown slowly, especially in comparison with its booming merchandise trade. The country's goal of food self-sufficiency has led policymakers to restrain imports of land-intensive grains, the production of which has a high opportunity cost in land-scarce China. In the years leading up to WTO accession, China still maintained many barriers to agricultural trade, but it has liberalized trade considerably since the 1980s. In accordance with its membership in the WTO, China will lower tariffs, weaken state trading monopolies, increase the openness of import license and quota allocation, and require publication of trade regulations, thus weakening most of the policy instruments the government has used to restrain agricultural imports. China's WTO commitments call for annual tariff reductions that will cut the average agricultural tariff to a relatively low 17 percent by 2004. In the first few years after WTO accession, China will allow limited quantities of important agricultural commodities (grains, cotton, vegetable oils, wool, and sugar) to enter the country at low tariffs of 1-9 percent. At the same time, WTO entry may open more markets for China's labor-intensive exports, potentially moving China's trade patterns in a direction that will make more efficient use of the country's resource endowment.

From the 1950s through the early 1990s, China taxed its agricultural sector by procuring commodities at below-market prices to subsidize urban consumption and industrial development. During the 1990s, central government taxation of farmers receded (although local taxes and fees have become more of a burden for farmers). In the late 1990s, the government procured grain at above-market support prices and market prices of some commodities rose above world prices. As its control over trade weakens after the country's WTO accession, China's government may look at other means of protecting and subsidizing farmers to maintain a degree of

food self-sufficiency and social stability. Government subsidies for China's farmers are minimal now and both "amber-box" (potentially price-distorting subsidies) and "green-box" (infrastructure, education, and other subsidies not tied to prices) spending could rise considerably while staying within China's WTO commitments.

Since the 1980s, China's government has heavily supported research in biotechnology, including the development of high-yielding, insect- and drought-resistant plant varieties that potentially could allow farmers to produce more food from China's limited land area. However, China now seems to be taking a cautious approach to biotechnology. Genetically modified (GM) varieties of most of China's major crops have been developed, but only a few have been approved for commercial use. In 2001, the government published regulations on labeling of GM foods, which disrupted imports of soybeans, most of which are grown from GM seeds in the United States and South America. The regulations left out details that would determine the stringency of the regulations, leaving much uncertainty about China's approach to biotechnology.

Land and water are key agricultural inputs that are limiting factors in China's agricultural production capacity. Indeed, the current level of use of these inputs may be unsustainable. Surface water supplies have dwindled in much of northern China, and ground water is being depleted through heavy agricultural, industrial, and household use. Environmentally fragile cultivated land is being returned to forests and grass cover, while some highly productive agricultural land is being lost to urbanization. Much of China's economy is now governed by market forces, but land and water are not. Farmland is owned collectively by villages, and village leaders allocate land-use rights to households in their village. Land cannot be bought or sold by individual farmers, and land rentals are relatively uncommon and mostly informal. The land-tenure system is equitable, but the lack of land markets impedes the readjustment of land to its most efficient use. Water is exploited as a common property resource, and low marginal prices lead to overuse. The development of improved institutions to manage and allocate scarce land and water resources will be crucial to expanding China's agricultural production capacity.

Labor is China's most abundant resource, and roughly half of the country's workers are employed in agriculture, where incomes are low. The creation of nonfarm jobs for China's large rural population is critical to the country's economic development. Job creation will be a difficult challenge, as many rural and urban employers will face competitive pressures to cut costs after China's WTO entry, thus making employers less inclined to hire more workers. China will need to develop credit markets in rural areas and reverse its historical urban bias in education, technology, and infrastructure investment to spur development in the country's rural hinterland and create new jobs. The easing of restrictions on rural-urban migration will also be necessary. Service industries, which tend to concentrate in urban areas, will account for much of China's job growth.

Reliable statistical information is needed to accurately assess China's development and for markets to work efficiently. Many market analysts distrust China's official statistics, many of which rely on a bureaucratic bottom-up reporting system set up for a centrally planned economy. Improvements in China's statistical system, including implementation of modern survey methods and reconciliation of duplicative statistics produced by multiple agencies, will improve the functioning of markets. It will be equally important for China to increase transparency by publishing important numbers, such as grain and cotton stocks, which are now considered state secrets.

Author Affiliations

Colin Carter	University of California-Davis
Wen Chern	Ohio State University
Xinshen Diao	International Food Policy Research Institute
Cheng Fang	Iowa State University
Frank Fuller	University of Arkansas
Fred Gale	Economic Research Service, USDA
Brad Gilmour	Agriculture and Agri-food Canada
Hsin-Hui Hsu	Economic Research Service, USDA
William Lin	Economic Research Service, USDA
Bryan Lohmar	Economic Research Service, USDA
Albert Park	University of Michigan
Scott Rozelle	University of California-Davis
Agapi Somwaru	Economic Research Service, USDA
Francis Tuan	Economic Research Service, USDA
Eric Wailes	University of Arkansas
Jinxia Wang	Center For Chinese Agricultural Policy, Chinese Academy of Sciences
Funing Zhong	Nanjing Agricultural University

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Introduction

As the 21st century opens, China stands ready to assert itself as a major player in global markets. Its accession to the World Trade Organization (WTO) is the latest step in China's incremental journey from an economy characterized by planning and self-sufficiency to one that is market driven and globally integrated. China may undergo unprecedented changes in the coming century as it transforms itself from a largely rural, centrally planned, low-tech economy into an urbanized, market- and consumer-driven economy, where new technologies are used and developed.

A Key Player in Agricultural Trade

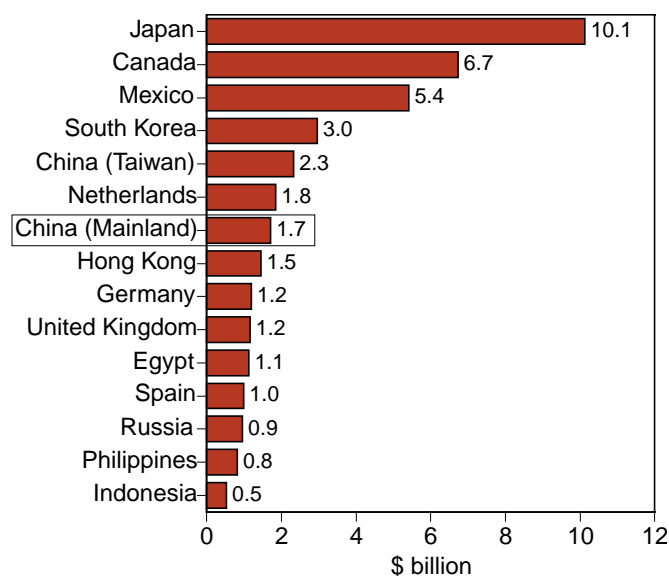
The food and agricultural sector in China may see some of the most dramatic changes. With one-fifth of the world's consumers, one of the world's fastest-growing economies, and a limited endowment of arable land, China is seen by many as a potential source of increased demand in world food markets. Currently, China's food import levels are surprisingly small for a country with such a large population and a limited land base. For example, mainland China's purchases of food and agricultural imports from the United States are similar in value to purchases by Taiwan, Hong Kong, and the Netherlands, places with much smaller populations. Despite its size, China is only the seventh-leading destination for U.S. agricultural exports, with sales averaging \$1.7 billion per year during 1995-2000 (fig. A-1). At the end of the 20th century, China accounted for just 3 percent of world agricultural trade, was largely self-sufficient in food production, and was a major exporter of many agricultural items. While China is already a major market, it has significant potential for increased food imports.

China's role in world agricultural markets is magnified by the volatility of its patterns of trade. Since the late 1970s, U.S. agricultural exports to China have followed a roller coaster pattern as China periodically buffeted grain and oilseed markets with unexpected purchases or sales (fig. A-2). Wide year-to-year swings in China's agricultural imports add considerable uncer-

tainty to commodity markets. With its new membership in the WTO, however, China may become a larger and steadier trading partner in markets for food and agricultural products.

This report is an introduction to issues related to China's food and agricultural outlook for the 21st century for policymakers, business analysts, researchers, and others interested in how the world's most populous—and perhaps fastest changing—country will affect agricultural trade and commodity markets in the coming decades. A series of brief articles on 13 key issues provides brief background information on each issue, assesses the current state of knowledge, and asks questions about what might happen and what we need to know. The articles are speculative in nature, and may raise as many questions as they answer. The list of issues covered here is by no

Figure A-1
Average annual U.S. agricultural exports to leading countries and regions, 1995-2000

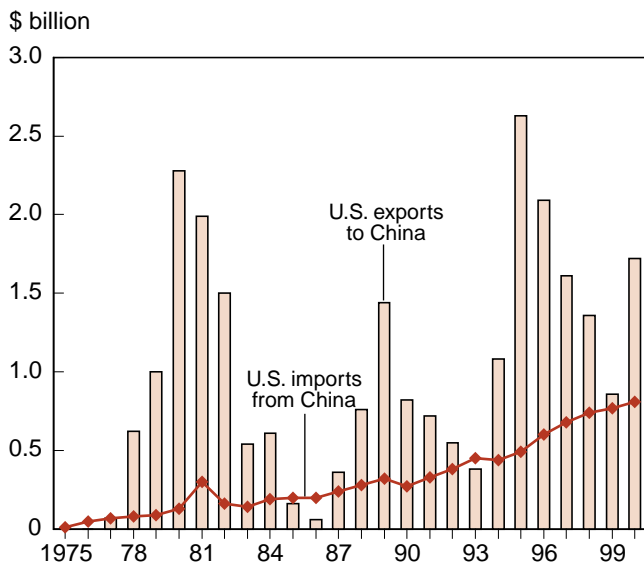


Note: Chart shows average value of U.S. total agricultural exports for years 1995-2000.

Source: Calculated by ERS using data from USDA Foreign Agricultural Trade of the United States.

Figure A-2

U.S. agricultural exports to and imports from China, 1975-2000



Source: USDA Foreign Agricultural Trade of the United States.

means exhaustive, but the coverage of issues is broad enough to give the reader a good overview.

Growing Consumption, Limited Resources

China is one of the world’s largest and most volatile customers for agricultural products. Yet, for a country of its size and limited resource endowment, China’s agricultural import levels are modest. China tends to import bulk commodities and items used as intermediate inputs in labor-intensive manufacturing. China is a major exporter of high-value products, such as manufactured foods, animal products, fish, vegetables, and fruits. While per capita incomes and food expenditures in China are still low, food security is not a problem for most of the country’s population. Food-consumption levels have grown and will continue to grow as the country grows richer, but this growth will further strain China’s limited land and water resources. Further domestic production increases will require more efficient use of agricultural inputs. The transfer of millions of agricultural workers to nonfarm work is a key issue that will affect agricultural production and the welfare of China’s 800 million rural residents.

Meat Consumption May Boost Feed Imports

As China’s consumers grow wealthier and move from rural to urban areas, purchases of all foods will increase, but consumption of meats, fish, fruits, and

vegetable oils will rise the fastest. Consumption of processed foods, eating out, and concerns about food quality and safety are becoming more common in China. The rapidly maturing retail food sector reflects increasing consumer demand for convenience, quality, and value-added in foods. The increase in meat consumption may be one of the most important developments in China’s agricultural sector. The increased demand for feed grains to support a growing and modernizing livestock industry is likely to generate increased demand for imports of both meat and feed grains.

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Slow Growth in Agricultural Trade

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Constraints on Production Growth

Since the 1980s, China's government has heavily supported research in biotechnology, including development of high-yielding, insect- and drought-resistant plant varieties that potentially could allow farmers to produce more food from China's limited land area. However, China now seems to be taking a cautious approach to biotechnology. Genetically modified (GM) varieties of most of China's major crops have been developed, but only a few have been approved for commercial use. In 2001, the government published regulations on labeling of GM foods, which disrupted imports of soybeans, most of which are grown from GM seeds in the United States and South America. The regulations left out details that would determine the stringency of the regulations, leaving much uncertainty about China's approach to biotechnology.

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Reliable Market Information Needed

Reliable information is needed for analysts to accurately assess China's development and for markets to work efficiently. Many market analysts distrust China's official statistics, many of which rely on a bureaucratic bottom-up reporting system set up for a centrally planned economy. Improvements in China's statistical system, including implementation of modern survey methods and reconciliation of statistics produced by multiple agencies, will improve the functioning of markets. It will be equally important to increase trans-

parency by publishing important numbers, such as grain and cotton stocks, which are now considered state secrets.

Questions Abound

The titles of each of the 13 issue articles in this report are in the form of a question. While the report also provides a rich source of information, its main purpose is to encourage speculation and inquiry about the future path of food and agriculture in China. The emphasis on questions is especially appropriate for study of China, since the country's 20th-century path

took many unexpected twists and turns. Will China continue on the path toward increased market orientation and global integration, or will the road to reform be marked by further periodic retrenchments as in the past? Will the greater transparency and open borders mandated by China's WTO commitments reduce the uncertainty and volatility that characterized its agricultural trade during the 20th century? Will China develop its economy without leaving its large rural population behind? The answers to these questions have important implications not only for China's development but also for the smooth functioning of world markets for food and agricultural products, which affects all nations.

China at a Glance

A Statistical Overview of China's Food and Agriculture

Fred Gale

The United States and China are at very different stages of development and have quite different resource endowments that are in many ways complementary. China has the world's largest population while the United States has the world's largest economy. The U.S. economy is consumption oriented, with a large trade deficit. China is investment oriented, accumulating capital through trade surpluses and foreign direct investment. Many of China's imports are capital equipment and intermediate inputs, while the United States imports many consumption-oriented goods. The investment orientation of China is reflected by its high Gross Domestic Product (GDP) growth rate.

The agricultural outputs and the land areas of the two countries are similar, but China has a much larger labor force employed in agriculture and most of its population lives in rural areas (table B-1). Productivity and income of agricultural laborers in China are accordingly much lower than in the United States. China's food share of exports is 6 percent, surprisingly high (only 2 percentage points less than the land-abundant

United States) for a country with limited land resources. Its food imports are just 4 percent of total imports.

Surprisingly Self-Sufficient in Food

For a country with nearly 1.3 billion consumers and limited natural resources, China's level of food imports is surprisingly low. China is nearly self-sufficient in food and is a major net exporter of many food products, including manufactured food and beverages, animal products, vegetables, fish and seafood, tea, and fruits (table B-2). China's agricultural exports go primarily to neighboring Asian countries, including Japan and South Korea, which are also among the top markets for U.S. agricultural products.

Overall, China is a net importer of bulk commodities, primarily wheat. In some years, China has been a major importer of corn and cotton, and in other years, it has been a major exporter of those commodities. China is a major exporter of rice. During the 1990s,

Table B-1—China-United States statistical comparison, 1999

Item	Unit	China	United States
Population ¹	Million	1,266	282
Population growth	Percent	.9	1.2
Rural share of population	Percent	68	23
Population density	Persons per square km	134	30
Gross domestic product (GDP)	Billion dollars	989	9,152
GDP per capita	Dollars	770	30,850
GDP growth	Percent	7	3
Cultivated land area ²	Million hectares	130	174
Value of agricultural output ³	Billion dollars	255	215
Agricultural value added per worker	Dollars	325	72,000
Merchandise exports	Billion dollars	195	695
Merchandise imports	Billion dollars	166	1,059
Food share of exports	Percent	6	8
Food share of imports	Percent	4	5

¹ Data from population censuses, year 2000. ² Data from agricultural censuses, 1997. U.S. land area is harvested cropland. ³ For China: gross value of farming and animal husbandry obtained from *China Statistical Yearbook*; for United States: agricultural sector value added, U.S. Department of Agriculture. Source: World Bank World Development Indicators, except where noted.

Table B-2—China exports and imports of agriculturally related items, by category, 1995-2000

Category	Average annual trade, 1995-2000		
	Exports	Imports	Net exports
	<i>Billion dollars</i>		
Manufactured food and beverages ¹	3.5	.3	3.3
Animals and animal products ²	2.2	.5	1.7
Vegetables	1.6	.1	1.5
Fish and seafood	1.9	.8	1.2
Tobacco, coffee, tea, and spices	1.1	.2	.9
Fruits and nuts	.4	.2	.2
Grains, feeds, and milled products ³	1.4	2.6	-1.3
Oilseeds, fats, and oils	1.3	2.9	-1.6
Fiber, fabrics, hides, and skins ⁴	5.5	7.2	-1.6
Fertilizers	.2	2.8	-2.6
Other agricultural products	.4	1.2	-.9

¹ Baking products, preserved food, beverages. ² Live animals, meat, dairy, eggs, honey, and other animal products. ³ Cereals, feeds and food waste, and flour and other milled products. ⁴ Silk, animal hair, cotton yarn and fabric, and hides and skins.

Source: ERS analysis of China customs statistics reported in Hsin-Hui Hsu and Fred Gale, *China: Agriculture in Transition*, USDA/ERS Agriculture and Trade Report WRS-01-2, November 2001, appendix tables 5 and 6.

China emerged as a major market for imports of oilseeds, vegetable oils, and oil meal.

China uses most other agriculturally related imports as intermediate inputs for manufacturing. China uses imports of fabrics, hides, and skins in its export-oriented garment, footwear, and leather product industries. Net imports of fertilizers help boost China's domestic crop production, reducing the need for food imports.

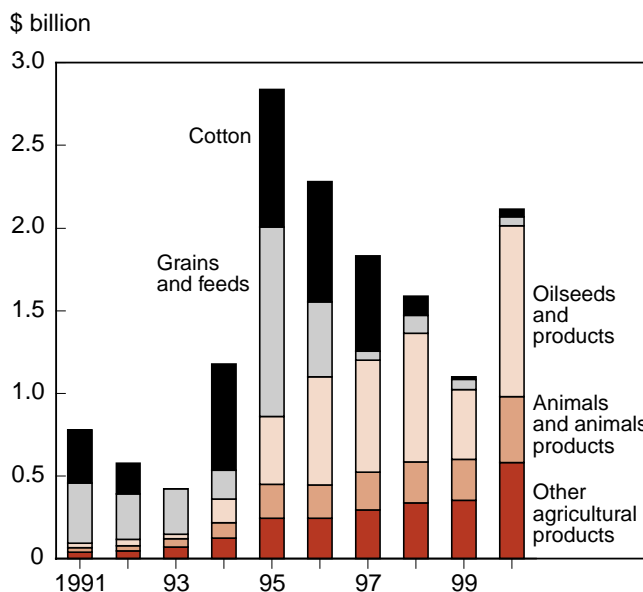
Volatility in Bulk Commodity Imports

Much of the volatility in China's agricultural trade reflects swings in imports for a few bulk commodities, especially corn, wheat, and cotton (fig. B-1). U.S. exports of cotton to China sharply increased in 1994, and grain and oilseed exports rose in 1995. In subsequent years, U.S. grain exports to China dropped off dramatically to minimal levels and cotton exports were minimal in 1999 and 2000. China's imports of oilseeds and their products have been more stable, but the overall stability in the oilseed category masks a policy-induced switch from imports of oils to imports of unprocessed oilseeds during the 1990s. China's meat and other agricultural imports from the United States have grown at a steadier rate.

Poor, But Not Hungry

China has a rising urban middle class with world-class consumption standards, but it is still largely a poor country. Its per capita GDP is similar to those of developing countries, such as the Philippines and Sri

Figure B-1
U.S. agricultural exports to China by commodity type, 1991-2000



Note: Data are for calendar years.

Source: USDA, Foreign Agricultural Trade of the United States.

Lanka.¹ In 2000, China's urban residents spent an average of \$236 per person on food, and rural expenditures were even lower, at \$56. Farm families, which still make up the bulk of China's population, grow much of the food they consume.

¹ Source: World Bank Development Indicators, per capita GDP adjusted for purchasing power parity.

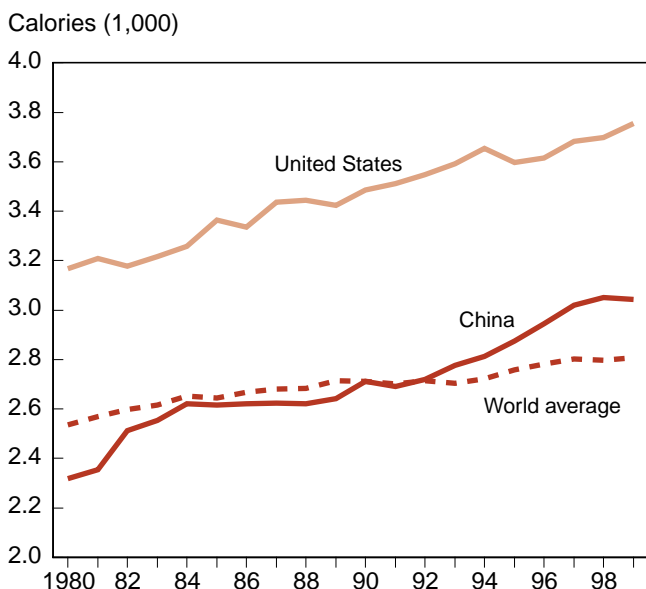
Food insecurity, however, is not a problem for most of China's population. China's per capita food supply, measured by calories per person per day, was 8 percent above the world average in 1999 (fig. B-2). Famine and food insecurity were common in China's past, but food consumption and food availability have soared since economic reforms began in the late 1970s.

High Consumption of Grains and Vegetables

Grains (mostly rice and wheat) and vegetables, by weight, make up about 70 percent of per capita food consumption in China, a much higher share than in the United States (fig. B-3). China's per capita consumption of grains, vegetables, and fish exceeds the world and U.S. averages, but China's consumption of fruits, sugar and sweeteners, and fats and oils is lower. China's per capita meat consumption exceeds the world average but is less than half that of the United States.

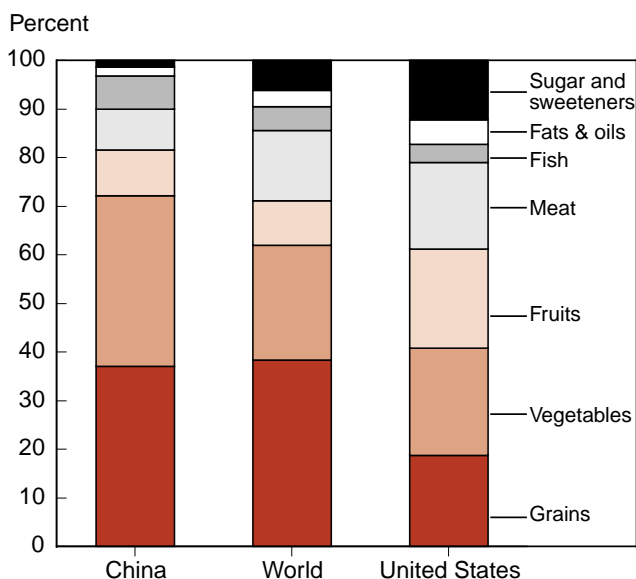
These differences in food consumption between China and the rest of the world reflect a combination of low per capita incomes in China and differing tastes and preferences. As China's consumers grow wealthier, consumption of all foods will grow, but consumption of meat, fruits, fish, fats and oils, and sugar and sweeteners will grow the fastest.

Figure B-2
Food supply—calories per person per day—China, world, and United States, 1980-99



Source: United Nations Food and Agriculture Organization, FAOSTAT database.

Figure B-3
Food consumption shares by food category, China, world, and United States, 1999



Note: Based on per capita kilograms of consumption.

Source: United Nations Food and Agriculture Organization, FAOSTAT database.

A Major Producer

China has 10 persons to feed per hectare of arable land—more than twice the world average of 4.4 persons per hectare. Yet China has remained largely self-sufficient in food production and is a major producer of many important commodities. China's share of world production exceeds its share of world population for most major commodities (table B-3). Most notably, China produces over 40 percent of the world's pork and vegetables. China's low shares of milk, sugar, beef, soybean, and fruit production reflect its relatively low consumption levels for these commodities.

In contrast with China, the United States is richly endowed with farmland. While China's population is more than four times that of the United States, the United States has about one-third more cropland than China. The United States and other land-abundant countries can potentially relieve the stress on China's limited natural resource base by supplying China with land-intensive food and feed grains, oilseeds, and meats and poultry.

Intensive Cultivation

China maintains its high level of food production by double- and triple-cropping and applying large quantities of fertilizer and labor to its limited land base.

Table B-3—China and U.S. shares of world population, land, and production of selected agricultural commodities, 2000

Item	China	United States
<i>Percent</i>		
Arable cropland	9	13
Population	21	5
Pork	47	9
Vegetables and melons	42	6
Eggs	41	9
Tobacco	35	10
Rice ¹	34	2
Rapeseed	28	2
Corn ¹	21	40
Cotton ¹	20	19
Wheat ¹	19	11
Poultry	19	25
Fruit	15	7
Soybeans ¹	9	45
Beef and veal	9	22
Sugar cane	6	3
Milk	2	13

¹ Note: Data from U.S. Department of Agriculture, World Agricultural Supply and Demand Estimates, market year 1999/00.

Source: United Nations Food and Agriculture Organization, FAOSTAT database, except where noted.

China's high consumption and production of vegetables, which yield high quantities per unit of land, makes efficient use of scarce land resources. Importing soybeans, which have low yields per hectare, allows China to free up land for higher yielding crops. Yields of China's major crops are above world averages (table B-4). Fertilizer use per hectare is more than 2.5 times higher than the world and U.S. averages. China has over 300 laborers for every 100 hectares of farmland.

China also has a relatively high share of its land irrigated and relatively few tractors.

China's strained natural resource base and high levels of fertilizer and pesticide use mean that further expansion of agricultural output through greater input use may not be sustainable. Water supplies in northern China are dwindling, and pollution from industrial effluents and agricultural runoff is worsening. China is returning environmentally fragile land to more sustainable forest or grass cover, further reducing the availability of arable land. To accommodate growing consumer demand for food, the agricultural sector will probably need to make more efficient use of its limited land and water resources by changing the mix of crops planted, adopting higher yielding varieties, improving land management, or consolidating land holdings to achieve size economies.

China's farms are small and mostly cultivated by households. The average household cultivates about 2.5 acres, frequently in multiple noncontiguous plots. Farmland is owned collectively by villages. Village leaders allocate land-use rights among village households based on family size and labor availability. Farmers cannot sell their land, but land rentals occur in many villages.

Rising Rural-Urban Inequality

Inequality between rural and urban areas in China has risen markedly in recent years. Incomes and living standards have advanced most rapidly in coastal cities, such as Shenzhen, Guangzhou, Shanghai, and Beijing, where per capita incomes are about twice the urban average. Some rural areas, such as those in Zhejiang and Guangdong provinces, have shared in the income

Table B-4—Comparison of agricultural yields and input per hectare of cropland, China and United States, 1997

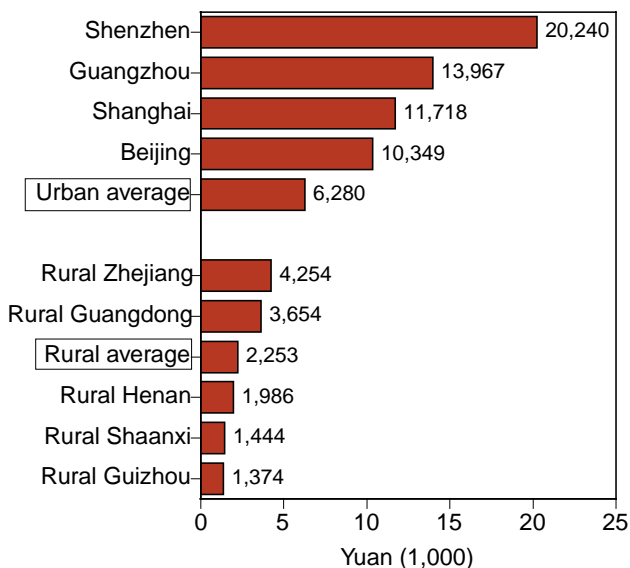
Item	Unit	China	World	United States
Production per hectare of land:				
Rice, paddy	Tons	6.2	3.9	7.0
Wheat	Tons	3.7	2.7	2.8
Corn	Tons	4.6	4.3	8.6
Soybeans	Tons	1.7	2.2	2.6
Vegetables and melons	Tons	18.4	15.7	17.1
Fertilizer consumption per hectare	Kilograms	271	94	111
Farm workers per 100 hectares ¹	Number	310	82	2
Land irrigated	Percent	40	18	13
Tractors per 1,000 hectares	Number	6	18	27

¹For China, farm employment is the sum of those engaged in crop planting, animal husbandry, and agricultural services reported in 1997 agricultural census. Other employment figures from FAOSTAT.

Source: Estimated from United Nations Food and Agriculture Organization, FAOSTAT database.

Figure B-4

Annual per capita income in China, selected cities and rural provincial averages, 2000



Note: 1 dollar = 8.28 yuan.

Source: China and Guangdong statistical yearbooks.

growth, but most of rural China has experienced much slower income growth. About 800 million of China's 1.3 billion people live in rural villages, where per capita incomes are less than 40 percent of the urban average. With about three workers for every hectare of farmland, farming in China is highly labor intensive and income per worker is low. China is expected to see

an exodus of labor from farms to factory and service jobs similar to the labor shift in the United States in the mid-20th century but on a much larger scale. The rural-urban income gap will be a consideration in farm and rural policy decisions as the country's leadership seeks to maintain social order and preserve its support among the rural populace.

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How Will Rising Income Affect the Structure of Food Demand?

Hsin-Hui Hsu, Wen S. Chern, and Fred Gale

As China has over one-fifth of the world's consumers and an economy growing at 7-8 percent annually, the country's rising consumption of food has the potential to significantly impact world food demand. In past decades, policymakers in China were concerned primarily with supplying enough grain to meet basic nutritional needs of China's huge population. Now, however, the emphasis is shifting from quantity of food demanded to the changing composition of food demand. Strong income growth and rapid urbanization are diversifying the Chinese diet and creating demands for high-value and specialty food products.

Population Growth Slowing

With the world's largest population (nearly 1.3 billion in 2000), China plays an important role in world food demand. U.S. Census Bureau projections show that China may add another 100 million consumers between 2000 and 2010. In future decades, however, population growth will diminish due to the rapid decline in birth rates stemming from population control policies implemented by the government in the 1970s. The Census Bureau projects that China's population will peak near 1.5 billion and begin to decline between 2030 and 2040. As population growth slows, China's population will age rapidly. The need to support the growing retired population may increase savings rates but slow future growth in disposable income. In Japan, research has found that seniors consume more rice, fruits and vegetables, while younger generations consume more beef and beer (Regmi; Mori). Similar generational differences may also affect China's food consumption.

Urban Diets: More Meat, Less Grain

Most of China's population still lives on farms in rural villages, where they grow much of their own food and have less access to markets, stores, processed foods, and refrigeration. Grain is the major component of the rural diet, and households grow much of it themselves. In 1999, rural Chinese households consumed an

average of 247 kg of grain per person and purchased only 42 kg. In 2000, rural per capita food spending was just 464 yuan (\$56) annually, compared with 1,958 yuan (\$236) for urban residents. The difference reflects lower incomes and more self-production of food in rural areas, as well as less eating out in restaurants and fewer purchases of processed foods. Purchases of perishable foods in rural areas are limited by access to refrigeration. Only 12 percent of rural households had a refrigerator in 2000.

China is expected to undergo mass urbanization during the 21st century, which could have dramatic effects on food consumption. According to China's population census, only 36 percent of the population lived in cities and towns in 2000. This urbanization rate was 10 percentage points below the world average and lower than the rate in many other countries at similar development levels. China's policymakers are placing a high priority on urbanization, and analysts project a 50-percent urban population share by 2020. Assuming total population growth of 15 percent from 2000 to 2020, a rise in China's urban population share from 36 to 50 percent would mean an increase in urban population of 270 million.

When people move to cities or towns, they tend to consume more meat, processed foods, and restaurant meals, and less grain. In 2000, China's household surveys showed that per capita red meat consumption in urban areas was 40 percent higher than in rural areas. Per capita fish consumption in urban areas was 3 times higher, and egg and poultry consumption was more than 2.5 times higher than in rural areas. Urban per capita grain consumption was only one-third the rural average. Urban residents are more likely to shop in modern supermarkets and frequently patronize restaurants. Rising living standards in urban areas are boosting demand for high-quality grain, meats, and processed foods. Imports of fragrant rice, quality wheat for breads and cake mixes, special cuts of meat, and palm oil for instant noodles are in high demand by the urban market segment.

A hypothetical calculation shows how a higher urban population share in China could slow the growth in food grain consumption and speed up growth in demand for meats and fish. If China's total population remained constant, but its rate of urbanization increased from 36 to 50 percent, China's total food grain (rice and wheat) consumption would be 12 percent lower (table C-1). Red meat consumption would rise 5 percent if urbanization rose to 50 percent, while poultry and egg consumption would rise 14 percent and fish consumption would rise 16 percent. Consumption of vegetables and edible oils would be relatively unaffected since urban and rural consumption levels are similar.

Rising Living Standards

Within the urban market segment in China, incomes vary greatly. An emerging middle class of relatively high-income consumers is based largely in Beijing, Shanghai, Guangzhou, Shenzhen, and other wealthy coastal cities. Other urban residents, including many residents of inland cities, the unemployed, and growing numbers of migrants from rural areas and retirees, have much lower incomes. High-income urban residents consume more of most foods on a per capita basis, especially milk, fruit, beer, poultry, meat, fish, eggs, and vegetables (table C-2). Consumption of grains and fats and oils is similar for high- and low-income urban residents.

Table C-1—Estimated China food consumption for alternative urbanization rates, selected food items, 2000

Food item	Urbanization rate		Consumption change
	36 percent	50 percent	
	— Million tons —		Percent
Food grains	239.1	209.5	-12
Vegetables	139.1	140.5	1
Edible oils	9.3	9.5	2
Pork, beef, mutton	20.5	21.5	5
Poultry	5.6	6.5	14
Eggs	9.3	10.6	14
Fish	8.5	9.9	16

Note: Total consumption estimated as the product of per capita consumption and population. Urban and rural totals computed separately then summed to obtain a national total. The "36 percent" column uses the population totals from China's 2000 census, which reported 36 percent urban population. The "50 percent" column assumes the urban population is 50 percent of the total 2000 population. Derived demand for feed grains is not included in the table.

Source: ERS calculations using data from China National Bureau of Statistics, *China Statistical Yearbook 2001*.

Table C-2—Major food items purchased by high- and low-income urban residents, 1999

Items	Residents		Ratio of purchases ¹
	Low-income	High-income	
	— Kilograms —		Percent
Rice	49.0	47.0	0.96
Wheat flour	19.9	16.3	0.82
Breads, fine grain products	13.6	19.7	1.45
Coarse grains	2.3	3.7	1.60
Oils and fats	7.9	8.2	1.05
Vegetables	99.4	133.9	1.35
Fruits	32.8	72.0	2.19
Pork	13.4	19.6	1.47
Beef	1.2	2.3	1.88
Mutton	0.7	2.0	2.77
Poultry meat	3.2	6.1	1.89
Fish and shrimp	3.9	6.3	1.63
Milk, fresh	3.1	12.4	3.98
Eggs	9.3	13.2	1.42
Sugar	1.7	1.9	1.17
Beer	3.8	7.6	2.03

Note: High- and low-income groups were defined as the average of the highest and lowest two income classes, respectively, of the existing eight income categories.

¹Ratio of high-income to low-income average.

Source: China National Bureau of Statistics, *Urban Household Survey, 2000*.

Income growth may affect both the quantity and the mix of foods demanded in China. Demand analysis indicates that both rural and urban residents in China increase their purchases of all major food items as their incomes grow while holding prices constant. For most food items, the growth in demand is slower than the growth in income, as consumers tend to save or spend their income gains on nonfood items. Thus, the share of expenditures devoted to food tends to fall as incomes rise.

Income elasticities estimated by Chern illustrate how the response to income varies across food items (table C-3). China's urban residents increase their purchases of fish, poultry, and pork at rates faster than their growth in income. Some studies have concluded that grain is an inferior good, but Chern's estimates indicate that consumers increase grain purchases, although at a slow rate, as incomes rise.¹ Rural residents also increase their purchases of all items as their incomes rise, but the increase in purchases is proportionately

¹ An inferior good is one whose demand falls when consumer income rises.

Table C-3—Estimated income and price elasticities in China

Item	Income elasticities		Price elasticities	
	Urban ¹	Rural ²	Urban ¹	Rural ²
Fish	3.41	.95	-.67	-.35
Poultry	3.12	.70	-1.28	-.50
Pork	1.68	.67	-1.59	-.66
Beef and mutton	NA	.65	NA	-.38
Eggs	.55	.41	-1.81	-.91
Vegetable oil	.38	.34	-.41	-.58
Vegetables	.20	.36	-.43	-.48
Fruit	.21	.62	-.88	-.94
Grain	.11	.32	-.16	-.37

Note: NA = not available.

¹ Based on pooled provincial-level data from 30 cities and provinces, 1993-96.

²Based on rural household survey data from Jiangsu province (976 households) in 1994.

Source: Chern, 2000.

less than the increase in income. For rural households, the largest increases occur for fish, poultry, pork, beef and mutton, and fruit.

Sensitive to Price Changes

As China integrates with the world economy, some food prices in China could rise while others fall. Price elasticities of demand indicate that China's consumers are sensitive to food prices, suggesting that realignments of prices could have important effects on food demand. Urban consumers are especially sensitive to prices of pork, poultry, and eggs. Effects of changing prices could offset or reinforce effects of income growth. If, for example, meat prices were to rise after China's World Trade Organization accession, the price effect might slow the growth in meat demand stimulated by rising income.

Rural consumers still make up the majority of China's population, and more information is needed about their complex, interrelated production and consumption responses to price changes. For example, rural consumers both grow and consume grain. Thus, an increase in grain prices would not only increase a rural household's cost of consuming grain but also increase the household's income and incentive to produce grain. A higher grain price could induce more production and possibly more on-farm consumption. Households also hold substantial on-farm grain stocks, and price changes can induce households to sell off or add to their stocks.

What We Need to Know

How does the joint nature of farmers' production and consumption decisions alter conventional approaches to market analysis? How much farm grain production enters commercial channels?

How will increases in away-from-home food consumption and the aging of the population affect the mix of foods demanded? Does the aging of the population offset some of the consumption effects of income growth and urbanization?

Will consumers accept genetically modified food products? What quality attributes will consumers demand in foods?

Demand for Food Attributes Unknown

Little is known about how China's consumers will respond to newly developed food items and product ingredients, such as genetically modified foods, which could play an important role in China's future consumption and trade. Also, Chinese consumers may become more health conscious and pay more attention to food safety issues because the application of agricultural chemicals is poorly regulated in China and industrial pollutants are common in the soil, water, and air. Market analysts and policymakers need to know how much Chinese consumers are willing to pay for foods with specific attributes, such as high-quality ingredients, nutrition content, or brand names. Chinese consumers' willingness to pay for food attributes has implications for labeling policies for genetically modified foods and the viability of costly, identity-preserved food marketing and "green" and "organic" production methods.

China's consumption statistics are becoming less useful because they were designed to measure at-home consumption of basic commodities (see "China's Statistics: Are They Reliable?" in this report). Chinese consumers are eating more meals in restaurants, cafeterias, and dining halls, and these meals are not captured in consumption surveys. Statistics probably understate urban consumption of foods that are consumed away from home. Chinese consumers now differentiate rice and wheat according to quality and attributes, including stickiness, fragrance, and gluten and protein content, with widely varying prices. While the broad category of rice may have a low income elasticity, high-quality rice may have a high elasticity,

but this effect cannot be investigated with current statistics that do not differentiate among types of rice.

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A Maturing Retail Sector: Wider Channels for Food Imports?

Brad Gilmour¹ and Fred Gale

China's retail food sector has matured rapidly, as consumers have increased their demand for convenience and quality in food products. A highly competitive food retail sector has emerged, featuring modern supermarket chains, wider choice in products, and branded items. The continuing evolution of China's retail sector has important implications for how foreign and domestic food products reach the consumer. Producers—whether domestic or foreign—seeking to gain access to China's consumers must navigate the country's complex food distribution system.

From the 1950s through the 1970s, Chinese government entities procured, distributed, and sold nearly all agricultural commodities. In the early 1980s, there was little value-added in the country's food system. Processed foods were limited, as most households prepared meals from rice, noodles, raw produce, and meat. Service and hygiene in food retail outlets were poor, and food distribution systems were inefficient.

Following the implementation of economic reforms in the late 1970s, food marketing was one of the first sectors in China to be privatized and directed by markets (table D-1). Producers were permitted to sell grain, produce, and meat to consumers in urban farmers' markets. Small food stores, kiosks, and restaurants sprang up, and by the late 1980s, department stores were offering large food sections. Food processing output value in China reportedly grew at a 14-percent annual rate through the 1980s and 1990s (China Food and Agricultural Services). Away-from-home food spending was 15 percent of urban food expenditures in 2000, up from negligible amounts in the 1980s. Many different players entered the food retail sector, including small individual entrepreneurs, state-run companies and their privatized spinoffs, and prominent foreign-invested ventures.

¹ The views expressed in this article are those of the author and do not necessarily reflect the views of Agriculture and Agri-food Canada.

New Formats Transform Food Retailing

China's food retail sector was transformed dramatically during the 1990s by the rapid rise of supermarkets, including large domestic chains, such as Lianhua, Hualian, and Nong-gong-shang. Several foreign supermarket operators based in Japan, the Netherlands, and Hong Kong entered the China market, but most pulled out or reduced their presence as they found it difficult to compete with domestic firms. Margins in the fiercely competitive food retailing sector are very thin, and Chinese consumers are said to be highly price-sensitive. Numerous domestic competitors often received "soft" bank loans, reduced property rents, and the advantages of good personal relationships with distributors. At the same time, foreign entrants were at a disadvantage in coping with central, provincial, and municipal bureaucracies that sought to protect vested interests and support local retailers as a means of creating jobs for local workers. Independent domestic standalone supermarkets were also forced out of business or acquired by larger state-held chains.

More recently, supermarkets in China have been upstaged by foreign hypermarket retailers that offer low prices and an array of goods and services under one roof. These "hypermarkets" have extensive dry goods and frozen goods sections, fresh and frozen meat and seafood, prepared foods, and foodservice counters. They also include restaurants, fashion and sporting goods outlets, and other specialty shops. Many analysts predicted that hypermarkets would fail because Chinese consumers seldom shop for large quantities of goods and lack automobiles to carry home large purchases. However, hypermarkets won shoppers over by offering convenience, comfort, and low prices.

Hypermarkets keep prices low through efficient supply chain management. The food distribution system used by supermarkets and other food retailers in China still has much inefficiency. Numerous layers of distributors exist between the manufacturer/importer and the

Table D-1—Description of retail food outlets in China

Type of outlet	Typical product lines	Procurement methods	Operated by chains ¹	Average outlets per city ¹
			Percent	Number
Hypermarkets	Full line of fresh, frozen, and ready-to-eat foods, nonfood items, and services.	Establish direct links with manufacturers and importers.	90	90
Supermarkets	Full line of fresh and frozen foods, and nonfood items.	Work closely with local distributors.	75	1,200
Department stores	Packaged items and frozen foods. Usually one floor of a multistory retail space.	Use outdated purchasing systems.	50	40
Foodstuff stores	Packaged items.	Use informal, low-tech management and purchasing processes.	0	20
Convenience stores	Limited line of snacks, drinks and packaged items.	Tap into supermarket networks. Foreign-owned stores establish own distribution networks.	65	1,600
“Mom and pop” stores	Basic consumer products.	Buy from wholesale markets in small quantities.	0	30,000
Farmers’ markets	Fresh vegetables, fruit, meat, and seafood.	Buy from local farms.	0	50

¹ Estimated average for a major city, such as Beijing, Shanghai, or Guangzhou.

Source: Moustakerski, Peter, and L. Brabant. *People’s Republic of China Retail Food Sector Report*. U.S. Department of Agriculture, Foreign Agricultural Service, GAIN Report CH1810, November 2001.

retailer. Each layer receives a markup, relationships with the distributors are often as important as salesmanship, and most distribution is localized. Hypermarkets reduce distribution markups by purchasing goods directly from manufacturers and large distributors. Hypermarkets have also introduced modern store management and purchasing methods that are new to China. While most retail procurement in China tends to be localized, hypermarkets have sought to establish national distribution networks. Hypermarkets have also been able to keep prices low by supplementing their sales revenues with high listing, or slotting, fees paid by suppliers eager to place their products in these fashionable stores.

Greater Efficiency in Food Distribution

Hypermarkets have captured only a small share of the national market, primarily in wealthy coastal cities. The effect of hypermarkets on the China market, however, may be much wider, as domestic chains respond to the success of these stores. Just as the competitive threat of foreign supermarket chains in the 1990s led to improved customer service in domestic chain stores, the competition from hypermarkets may lead to even more choices for consumers in domestic stores and stimulate improvements in the efficiency

and openness of the food distribution system. China’s major chains are increasing services offered to consumers, offering more fresh produce, and improving the efficiency of supply chain management to counter the success of the foreign hypermarkets. Domestic chains also have announced plans to expand into the hypermarket format.

The trend in China toward hypermarkets is paralleled by growth in smaller convenience food stores, which seem to complement hypermarkets. Convenience stores have captured the market for sales of small purchase items, such as drinks, packaged foods, snacks, and ready-to-eat foods. Foreign-invested chains popularized the format, but many convenience stores in China are now operated or franchised by well-known domestic chains. Similar to hypermarkets, convenience stores maintain their own warehouses and truck networks or tap into supermarket distribution networks of parent companies. Competitors of convenience stores—smaller local supermarkets, department stores, small foodstuff stores, “mom-and-pop” stores, and food kiosks—rely on less-efficient distribution systems.

Deeper Penetration for Imports

The development of the food retail sector may be an important factor in opening the China market to

What We Need to Know

Will efficient supply chain management practices be widely adopted by domestic retailers?

Will a streamlined distribution system allow high-value imports to gain wider penetration of the China market?

How will the evolution of food retailing affect the structure of food production and processing in China?

What market penetration strategies will be successful as China's retail and distribution systems mature and Chinese consumers become more sophisticated?

imports of food and agricultural products, especially high-value items. Imported items are not common in domestic supermarkets and are rare in smaller food retailers. These retail outlets tend to procure products locally due to China's poor distribution system and a tendency for local governments to encourage local procurement to protect local producers or manufacturers. Imported items have a more substantial presence in hypermarkets, although even in these stores imports constitute no more than 5 percent of the stock. Nevertheless, the streamlining of distribution channels brought about by hypermarkets is likely to make it easier for imported food items to reach Chinese consumers. China's World Trade Organization accession commitments are expected to make it easier to distribute imported goods within the country and may enable imports and foreign retailers, currently concentrated in a few large coastal cities, to penetrate smaller cities and interior provinces.

Effects on Producers

The maturing of the retail sector in China is also beginning to affect the way food is produced at the farm level. Foreign-invested retailers, processors, and chain restaurants have sourced most of their produce, meat, and other raw materials in China, but they have had difficulty obtaining reliable supplies of standardized quality products from China's traditional system of small household farms geared toward producing food for home consumption. To keep pace with the demands of buyers, farms will have to adjust by specializing in a particular commodity, consolidating fragmented land holdings to achieve scale economies, and forging stronger links with processors and retailers. Closer relationships between firms at different stages of production and marketing are emerging as larger commercialized farm operations grow produce and animals under contract for processors, retailers, or exporters. This trend is likely to continue and may profoundly alter the way food is produced in China.

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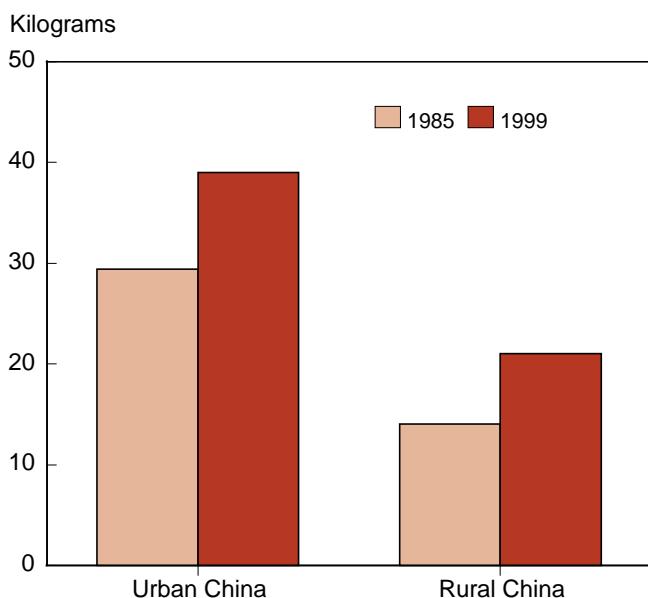
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Rising Demand for Meat: Who Will Feed China's Hogs?

Frank Fuller, Francis Tuan, and Eric Wailes

As China has continued to develop and per capita incomes of its consumers have risen, dietary patterns have shifted away from staple grains and starches toward animal proteins and fish (see "How Will Rising Income Affect the Structure of Food Demand?" in this report). Based on survey data collected by China's National Bureau of Statistics, per capita meat and egg consumption (not including away-from-home meat consumption) by urban residents increased an average of 1.5 percent annually from 1985 to 1999. Rural meat consumption grew at nearly double the rate of urban meat consumption, averaging 2.7 percent annually (fig. E-1). Despite some closing of the gap between urban and rural meat consumption, on a per capita basis, urban residents still consumed 70 percent more meat and eggs in 1999 than rural residents, revealing the great potential for consumption growth in China in the coming years. Continued income growth and urbanization will further expand meat consumption.

Figure E-1
Per capita meat and egg consumption, rural and urban China, 1985 and 1999



Source: *China Statistical Yearbooks*.

Changing Structure of Livestock Production

China's dramatic increase in animal protein consumption would not have been possible without a rapid expansion of its domestic livestock industry. Since 1985, China's pork output has increased markedly, reaching over 40 mmt (4.7 times the level in the United States) in 2000. China's beef sector has grown from an inconsequential output level in the 1980s to the third largest in the world. Likewise, China has moved into second place behind the United States in total output of poultry meat. Overall per capita meat consumption in China, however, is still lower than in the United States.

Most of China's livestock are still raised by traditional rural households that devote the bulk of their labor to crop production. Households generally keep livestock to provide food for the family, draft power, and manure for fertilizer. Since market reforms took hold in the 1980s, an increasing number of traditional households in China have taken advantage of expanded marketing opportunities to raise additional animals for sale in local markets. Many households shifted their focus from crop production to livestock and increased their swine herds from 1 or 2 head per household to 10, 50, or 100 head. Large-scale commercial operations, typically located near urban population centers, have also increased since the 1980s, encouraged by growing applications of imported technologies and management practices. Since 1985, the share of China's pork produced by traditional households has declined from 95 percent to less than 80 percent. While livestock production was traditionally a sideline activity for farm households, more farms are now specializing in livestock production. Households that specialize in livestock production and large commercial operations have risen in share of overall livestock production in China to roughly 15 and 5 percent, respectively.

This transition in livestock production will continue in the next decade and will have important impacts on

feed use in China. Traditional household operations make full use of readily available, low-cost feedstuffs, often feeding their swine large quantities of water plants, vegetables, tubers, crop residue, table scraps, and wheat and rice bran. These low-quality feeds are supplemented with some grain, protein meals, and concentrates, but traditional swine diets are often deficient in protein and energy, causing low productivity. Specialized household producers often employ more advanced management and breeding practices and feed their livestock more grain and protein meal. Specialized household swine producers use roughly 36 percent more grain, compound feeds, oilseed meals, and premix additives than traditional households. As a result, specialized households reduce the time it takes for swine to reach slaughtered weight by 30-80 days. The shift from traditional households to specialized-household and commercial operations has increased the demand for quality grain-and-oilseed-based feeds, reinforcing the growth in the number of Chinese feed mills in the 1990s.

Meat Versus Feed Grain Imports

Land scarcity limits China's ability to continue increasing its livestock production to meet the growing domestic demand without increasing its imports of livestock feedstuffs. An expected relative shift in production from pork to more-efficient poultry will improve overall feed conversion, but other challenges will remain.

The development of specialized household and commercial livestock operations was facilitated by government policies that encouraged local and regional investment in improving livestock genetics, management practices, disease control, and slaughtering and processing facilities. In the last few years, however, the central government has increasingly placed the financial burden of these programs on local and provincial governments, which have had only limited success in replacing lost funding. Traditional and specialized household producers that depend on subsidized artificial insemination and vaccinations for livestock may be the hardest hit by the reduction in central government support, while commercial operations with ties to local government or international companies may feel less impact from the changes.

Large commercial operations face other challenges. These facilities are often located near major urban areas and, accordingly, must deal with issues related to

What We Need to Know

How will China's entry into the WTO affect the structure of livestock production and marketing in China?

How rapidly will China's livestock industry continue to shift from traditional household production?

What impacts will the rapid rise of supermarkets have on urban meat consumption and meat marketing?

How will China's biotechnology product policy affect future U.S. feed grain (particularly soybeans) exports?

Will China be a competitive exporter of meat products to Asia in the future?

waste and odor management. Commercial meat companies sell a growing share of their output to chain stores, supermarkets, and foodservice outlets to capture a quality premium. China lacks a well-developed, independent meat distribution industry; thus, commercial firms must develop and maintain their own transportation, storage, and distribution networks. Several commercial meat companies export relatively small quantities of meat products to Japan, Singapore, Russia, and other Asian and Middle Eastern countries, but exporters must overcome difficulties associated with meeting international inspection and quarantine standards to further expand their overseas markets. With greater exposure to international competition in the foodservice industry, supermarkets, and export markets, large commercial operations will feel most acutely the impacts of increased competition in the livestock sector brought about by China's entry to the World Trade Organization (WTO).

As domestic demand for livestock products grows in the coming years, China will continue to increase both its own meat production and its imports of meat products. Low per capita incomes and consumer preferences for freshly slaughtered meat currently limit the potential market for meat imports to low-value cuts and variety meats. However, rapidly increasing incomes in large cities and the growing popularity of supermarkets are likely to generate future opportunities for imports of high-value cuts.

Finally, most of China's growing demand for livestock products will be supplied by domestic producers, predominantly specialized households, and commercial livestock operations. These farms, however, will have to increasingly rely on imported corn and soybeans or soy meal to feed their growing livestock numbers because arable land is scarce in China and the country's capacity to expand land-intensive feed grain crops is limited. China's uncertain direction in biotechnology policy could limit feed grain imports, since the United States and other suppliers make wide use of genetically modified varieties of feed grains and oilseeds. If China imposes stringent labeling or traceability requirements that apply to feed grains and feed products, it will raise feed costs to China's livestock producers and slow the sector's growth.

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Regions in China: One Market or Many?

Fred Gale

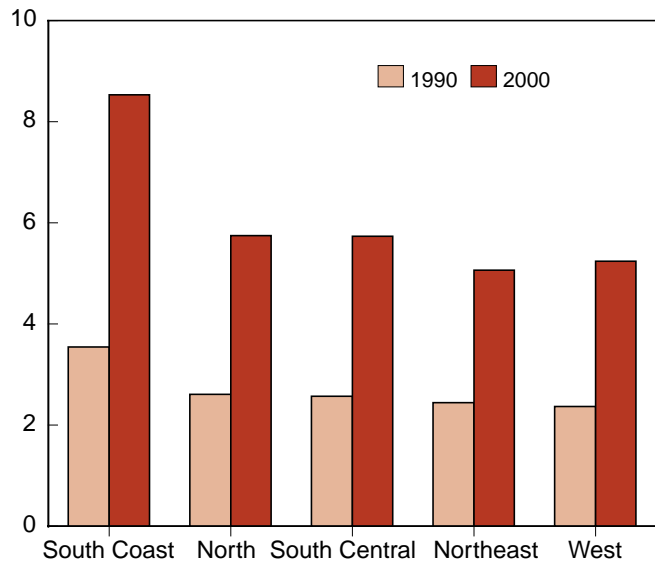
The statement "Everything is true somewhere in China" reflects the diversity among China's provinces and regions, each of which has its own character, consumer tastes, and agricultural growing conditions (see box). Differences in the level and pace of development and region-specific policies magnify the importance of understanding regional differences in China.

Post-reform development in China led to widening regional disparities in incomes—east versus west and rural versus urban. Early post-1978 development policies favored coastal areas, a reversal of earlier policies aimed at moving industry inland. Coastal growth accelerated due to favorable treatment combined with the natural advantages of coastal locations and ethnic connections with overseas Chinese investors. Incomes in other regions also experienced rapid growth, but incomes in coastal regions remained far ahead. By 2000, urban per capita incomes in southern coastal provinces averaged 8,541 yuan, while average incomes in other regions ranged from 5,064 yuan to 5,753 yuan (fig. F-1). The gap between rural and urban incomes also grew, especially during the 1990s (see "Can Rural Income Growth Accelerate?" in this report). China's economic growth—and growth in consumer demand—has been concentrated in cities along the coast. Provinces along China's southern coast account for 34 percent of China's gross domestic product and 21 percent of the country's population (fig. F-2 and table F-1). With just 10 percent of the country's cultivated land, China's south coast region must rely on other regions to help supply its food needs. Cities along China's northern coast, such as Beijing, Tianjin, Dalian, and Qingdao, are also geographic centers of consumer demand.

Coastal cities also account for much of China's consumption of imported high-value food products. In some sectors, producers in China's interior provinces compete with producers overseas for markets along China's coast. Until recent years, an overloaded transportation infrastructure, especially on north-south routes, and inefficient marketing systems made interregional trade difficult (see "Transportation and

Figure F-1
**Urban per capita disposable income,
by region, 1990-2000**

Yuan (1,000)



Note: Year 2000 constant yuan. 1990 data were adjusted for inflation using consumer price index. Weighted averages computed using provincial population as weights. Regional delineation by ERS (see fig. f-2).

Source: Calculated by ERS using data from National Bureau of Statistics.

Distribution: Will Bottlenecks Be Eliminated?" in this report). Southern feed mills and soybean crushers have relied on imported raw materials because access to corn and soybeans from northeastern China is difficult. If China can reduce transportation and distribution bottlenecks, it will become easier for domestic producers in interior provinces to supply coastal markets.

Legacy of Regional Self-Sufficiency

At times, uneven development across provinces and competing economic interests pitted provinces against one another and dampened interregional trade. China has, through much of its history, resembled a confederation of separate principalities, a tendency reinforced by 1950s-era policies that encouraged provinces to be

Important Regional Differences

It is important to understand the vast differences in resource endowments, climate, and wealth among China's regions.

Northeast

- ◆ Highest endowment of cropland per capita
- ◆ Important region for soybean and corn production
- ◆ Important center of state-owned heavy industry

South central

- ◆ Site of the Yangtze (Changjiang) River
- ◆ Poor and heavily populated
- ◆ Important region for production of rice and pork

Northern plain

- ◆ Site of the Yellow River

- ◆ Most affected by water scarcity
- ◆ Heavily populated
- ◆ Important region for temperate crops: wheat, fruit, corn, cotton

West

- ◆ Largely arid climate
- ◆ Large minority populations
- ◆ Important cotton production area (Xinjiang)

South coast

- ◆ Rapid economic growth and high incomes
- ◆ Scarcity of land
- ◆ Relatively high demand for food imports

self-sufficient in food and industry. Following economic reforms, lack of economic integration among provinces came into focus in the 1980s and 1990s when interior provinces tried to block shipments of manufactured goods from coastal provinces and tried to prevent raw materials like coal, cotton, jute, silkworm cocoons, and tobacco from leaving the province. Interior provinces sought to generate profits and tax revenue by setting up local industries to process local raw materials procured at artificially low prices. In the early 1990s, some observers predicted that China might break apart under the pressure of interprovincial trade wars. Until recent years, interprovincial flows of labor and capital were also limited by restrictions on migration and poorly developed financial institutions.

China's legacy of local self-sufficiency is slowly being undone as industries restructure in today's more competitive environment. By the late 1990s, domestic trade wars were over and interregional trade was booming. China's growing trucking industry and improved highway system have enabled distributors to bypass bottlenecks in the country's inadequate rail and water transport infrastructure. Vastly improved communications systems permit the rapid dissemination of market information and communication between customers and suppliers.

Greater competition and freer entry may accelerate the restructuring of China's industry and the emergence of

national, rather than regional, markets. Few national food brands have emerged, as regional brands and companies still dominate most markets, but certain foreign brands are recognized throughout the country. Greater competition from foreign brands, increased presence of foreign retailers, and development of national retail chains may encourage development of national brands in China. Industries made up of duplicative small companies associated with particular provinces, cities, or regions are being restructured to achieve economies of scale and reduce overcapacity. Restructuring is expected to intensify as competition from foreign firms increases. China's WTO accession commitments, in addition to allowing entry of more foreign firms, may also allow domestic firms to enter markets in provinces outside their home regions. This policy change may accelerate integration of the national economy in China.

In agriculture, markets are becoming more integrated and regional crop specialization is increasing. For example, until the 1980s, each city in China was expected to be self-sufficient in vegetables, but production is now concentrating in certain rural areas that specialize in vegetables and ship them to distant cities or overseas. Studies show that prices of similar commodities in different geographic markets move together, a further indication of market integration. Greater regional specialization may increase China's total food and fiber production capacity by making the most efficient use of the country's scarce farmland.

Figure F-2

Regions of China



Source: Economic Research Service, USDA.

Table F-1—Regional shares of population and production of major commodities, by region

Item	China total	Northeast	North	South coast	South central	West
	<i>Percent</i>					
Population ¹	100	8	27	21	37	7
Gross domestic product	100	10	27	34	24	4
Cultivated land ²	100	17	26	10	33	15
Production: ³						
Wheat	100	3	57	11	18	10
Corn	100	30	37	3	18	11
Rice	100	9	4	29	58	1
Soybeans	100	39	23	9	22	8
Meat	100	10	27	16	41	6
Fruit	100	5	43	25	22	5
Cotton	100	0	34	8	21	37

Note: Regional shares do not add to 100, due to rounding.

¹ Year 2000.² 1997.³ 1999.Source: Calculated by ERS using data from China National Bureau of Statistics, "Communique on Major Figures of the 2000 Population Census (No. 2)," *Abstract of the First Agricultural Census in China*, and *Rural Statistical Yearbook 2000*.

What We Need to Know

Will China continue to evolve toward a unified market with national companies and brands?

How will free trade after WTO accession affect disparities between provinces and support for national trade policy?

Will the central government be able to implement policies at the local level?

Grain production is gradually being liberalized and regionally integrated but has been subject to retrenchments, such as the mid-1990s Governor's Grain Bag policy, which charged each provincial governor with ensuring that local grain supplies were adequate to feed the local population.

Central-Local Policy Conflicts

China's long history as a unified nation obscures the fact that provincial and local governments have traditionally wielded considerable power that can block the implementation of central government policies. The traditional Chinese saying "The country is wide and the emperor is far away" reflects the considerable discretion and responsibility of local officials in implementing central government edicts handed down through the country's vast bureaucracy. Plant and animal quarantine offices, for example, are operated at the local level and are self-funded. Some observers speculate that local inspectors and officials may be subject to local pressures to apply national sanitary or phytosanitary standards to block shipments, thus benefiting local traders or producers. Similarly, foreign firms given a green light by national authorities to enter the China market may face local regulations, taxes, or approvals that block access. In preparation for its World Trade Organization (WTO) accession in 2001, China conducted a comprehensive review of local regulations to bring them into compliance with its WTO commitments.

Regional differences can pit provinces against one another in national policy. For example, relatively wealthy southern coastal provinces tend to support free

trade, since they have vibrant manufacturing export sectors and rely on food imports, including high-quality rice and wheat, corn, oilseeds, and poultry. Provinces in northern and central China, which are heavily populated by poor farmers growing crops vulnerable to foreign competition, are more skeptical of free trade. Development policies during the 1970s and 1980s limited foreign investment to certain coastal cities, accounting in part for the regional disparities in income today. A new western development initiative seeks to steer investment and development to China's relatively poor and politically sensitive western provinces. If WTO accession leads to greater regional disparities, the central government may introduce more region-specific development policies—perhaps directed at agricultural areas or regions with industrial unemployment—to preserve social stability.

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Transportation and Distribution: Will Bottlenecks Be Eliminated?

Brad Gilmour¹ and Fred Gale

While reduced tariffs, nontrade barriers, and other border measures may increase access to China's market, the market will still be effectively closed to foreign suppliers if goods cannot get from the port to the consumer. The efficiency of the transportation and distribution network will also determine whether the millions of farmers in China's interior heartland will be able to compete for the food dollars spent by consumers in wealthy coastal cities and other Asian markets. As transport and other marketing costs fall, the economy will become more efficient in sending price signals that will realign regional production patterns, eliminate spot shortages, equalize prices, and raise farm incomes in China's interior provinces.

Freight Traffic Booming

The Chinese Academy of Social Sciences estimates that transportation and logistics account for 20 percent of the retail prices of goods in China (and even higher for perishable products), about five times the transportation share of food costs in the United States. China's leadership seeks to reduce that share and has taken significant measures to improve the country's notoriously poor transportation infrastructure. A surge in highway and airport construction and a proliferation of highly competitive trucking firms, bus lines, and airlines now provide alternatives to China's aging railways for transporting people and freight. From 1990 to 2000, highway mileage in China increased by 36 percent and existing highways were greatly improved. China's railways, already the longest in Asia, also increased track length by 19 percent. Double tracking, electrification, and higher speed trains were introduced throughout the country. Even the length of China's inland waterways increased by 9 percent. Newly constructed rail and highway connections to networks in Southeast and Central Asia and Russia are opening additional avenues for trade.

¹ The views expressed in this article are those of the author and do not necessarily reflect the views of Agriculture and Agri-food Canada.

Despite this growth in capacity, China's transportation network remains strained because freight traffic is growing at an even faster rate. Total freight traffic increased by 39.6 percent from 1990 to 2000, with most of the increase hauled on highways (table G-1). The highway share rose from 75 to 77 percent between 1990 and 2000 as the railway share fell. More food is being transported by truck, but rail remains the chief transport mode for grain and other bulk commodities. Civil air routes tripled in length during the 1990s and air freight has grown dramatically, but air transportation still accounts for only a small share of total freight traffic.

While the global shipping industry has generally been contending with overcapacity, China's seaports struggled to keep up with 160-percent growth in seaborne freight volume from 1990 to 2000 (fig. G-1). The country's ports handled 56 million tons of grain in 2000, up 87 percent from 1990. Containerization and intermodal facilities account for a growing share of shipping freight. Container-handling facilities are in short supply in China.

Cold Chain Facilities Critical

Warehousing and other storage facilities are critical to an efficient marketing system. With China's growing consumption of high-value frozen and perishable foods, cold warehousing and transport facilities are becoming an important link in the country's marketing chain. Cold storage capacity is believed to be only 20-30 percent of growing cargo demand, and spoilage losses of up to 33 percent of perishable freight are

Table G-1—Increase in China freight traffic, 1990-2000

Mode	1990	2000	Change
	— Million tons —		
Highways	7,240	10,388	43.5
Rail	1,506	1,744	15.8
Waterways	801	1,224	52.8
Pipelines and other	159	189	18.9
Total	9,706	13,545	39.6

Source: China National Bureau of Statistics, *China Statistical Abstract 2001*.

Figure G-1

Major China ports, by volume of freight traffic, 2000 (million tons)



Note: 23 million tons of freight were shipped through other ports not shown.
 Source: China National Bureau of Statistics, *China Statistical Abstract 2001*.

common. Most of China’s food is still transported by rail, but lack of temperature-controlled equipment and logistical problems make it costly to transport foods, particularly frozen and perishable foods.

China’s lack of electricity and its inadequate infrastructure also have indirect impacts on food demand. Refrigerator ownership enables Chinese consumers to purchase more frozen and perishable foods and spend more of their food dollars at supermarkets. Refrigerator ownership, in turn, depends not only on consumer incomes but also on reliability of electricity supplies. Similarly, improvements to local roads and increases in automobile ownership will change the food distribution system by making it cheaper for consumers to travel to centralized retail centers and improving access to modern food markets to rural consumers.

Industry Restructuring Needed

China will continue to expand its transportation infrastructure through a combination of public and private

investment. In the next 5 years, China is expected to add an additional 200,000 km of highways to the existing 1.4 million km. Annual public highway spending has been roughly \$25 billion in recent years, but international financing agencies and private investors have assisted in funding highway projects. Nearly all high-grade highways generate significant toll revenues that can make highway investments attractive. Joint ventures with overseas interests have played an important role in upgrading port facilities.

An improved infrastructure by itself will not bring efficiency to China’s food marketing system. Restructuring and competition in the marketing sector are needed to ensure that food is transported, stored, and marketed efficiently. A government monopoly still manages the rail system. The State Price Bureau sets rail rates based on socialist accounting principles rather than market forces, financial viability, or customer impact. A large proportion of cold storage facilities are controlled by local bureaus formerly under the now-defunct Ministry of Internal Trade. In rail transport, grain bureaus, and other

What We Need to Know

Will lack of refrigerated and container handling facilities affect trade patterns?

Will transportation and marketing infrastructure allow agricultural production to concentrate in least-cost regions?

Will transportation bottlenecks limit the growth of China's fruit and vegetable exports?

Will improved transportation reduce regional inequality by allowing coastal growth to spill over to interior regions?

parts of the marketing chain, the volume of product handled per employee is very low, suggesting considerable inefficiencies.

China's government is trying to reform domestic distribution industries by separating policy and administrative functions from commercial operations and breaking up monopolies into multiple commercial companies that will compete with one another. Competition will intensify as a result of the country's WTO accession, when foreign companies will be allowed to enter the railway cargo service sector and operate their own internal distribution networks. China's domestic food marketing sector appears vulnerable; however, foreign entrants in China's food retailing sector have faced stiff competition and a number have exited the China market altogether.

Shifting Regional Production and Trade

The geographic distribution of food supply and demand makes distribution costs an important factor in determining the structure of both foreign and domestic inter-regional trade. Imported rice, wheat, edible oils, and other high-value products are consumed largely in wealthy coastal cities, mostly in southern China. Since these areas are near ports and have good transport infrastructure, transportation bottlenecks will be less of a concern for importers of these products. New soybean crushing plants have been constructed near ports to facilitate access to imported beans. Transport problems will have more effect on feed grain imports and the livestock sector. Currently, much of China's livestock production occurs in inland provinces, while demand for livestock products is growing in wealthy coastal cities. As livestock numbers and the adoption of modern feeding practices increase, more feed grain imports will be needed to

meet demand. If the cost of transporting feed grain to inland locations remains high, livestock production may shift eastward toward coastal cities to give producers better access to both final markets and imported feed grains. Unless managed carefully, this trend could increase land and labor costs and the likelihood of environmental damage by expanding the livestock industry in highly populated, wealthy areas.

Failure to reduce transport costs may also increase regional income differentials. If domestic transportation margins remain high, it will be difficult for farmers in inland provinces to compete with suppliers in other regions. Continued bottlenecks in the country's domestic transportation infrastructure and inefficient marketing industries will make it difficult for inland Chinese producers to compete with overseas producers for the growing coastal China market and markets in neighboring Asian countries. High transport and marketing costs would therefore limit the potential size of the market for inland farm products and keep farm incomes low in China's interior.

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Will China's Agricultural Trade Reflect Its Comparative Advantage?

Colin A. Carter and Scott Rozelle

China is potentially an important global trader of agricultural commodities, a role that will become more pronounced following the country's World Trade Organization (WTO) accession. At various times during the 1990s, China imported as much as 17 percent of the world's traded wheat, 25 percent of its fertilizer, and 28 percent of its soybean oil, while exporting as much as 10 percent of the world's traded corn. China's role in global agricultural trade has been modest, and the country has run small annual agricultural trade surpluses in recent years (fig. H-1).¹

Since 1980, agricultural trade has grown slowly in comparison with China's surging merchandise trade (fig. H-2). The nominal value of China's total merchandise exports and imports grew at annual rates of about 13 percent from 1980 to 1999 (World Bank). Agricultural exports and imports grew considerably slower, at average annual rates of 6.6 percent (exports) and 5.0 percent (imports). Growth in the *real* value of agricultural trade (exports plus imports) averaged only 2 percent annually from 1980 to 1999—less than half the growth rate of real agricultural Gross Domestic Product. The agricultural share of China's trade fell from about 33 percent in 1980 to about 7 percent in 1999—reflecting export-led industrial growth, improved resource allocation among sectors, and the shifting of comparative advantage from agriculture to light manufacturing.

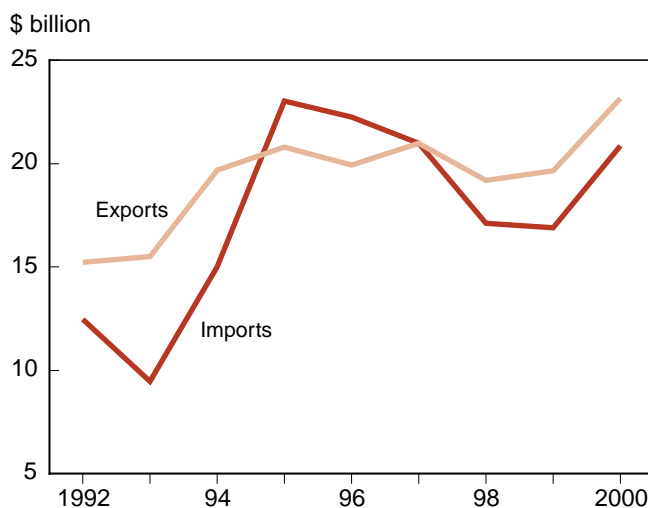
While growth in China's agricultural trade has been slow in comparison with the rapid growth of its industrial exports, China's share of world agricultural trade actually increased somewhat to just under 3 percent in 2000 (World Trade Organization). China still maintains many barriers to agricultural trade, but it has liberalized trade considerably in a sector in which protection is high in many other countries.

¹ China's status as a net exporter or importer of agricultural products depends on which commodities are classified as "agricultural." China is a net importer of grains, oilseeds, and industrial inputs, such as cotton, textiles, hides, and skins. It exports manufactured foods, beverages, fish, tea, fruits, and vegetables.

Shift Toward Comparative Advantage

Broadly speaking, the rationale for freer international trade lies in the efficiency gains that a country enjoys through using resources most efficiently by specializing in production in certain goods and trading these goods in world markets. Specialization according to comparative advantage means that a country produces commodities that are best suited to the country's resource endowment, and this raises national income. A shift toward freer trade may provide added side-benefits from scale economies and increased domestic competition. With an abundant rural labor force relative to its land base, China has a comparative advantage in labor-intensive agricultural products, such as fruits and vegetables, and manufactured agricultural products. However, agricultural policy in China and trade barriers in other parts of the world have tilted China's agricultural production away from its comparative advantage.

Figure H-1
China agricultural exports and imports, 1992-2000



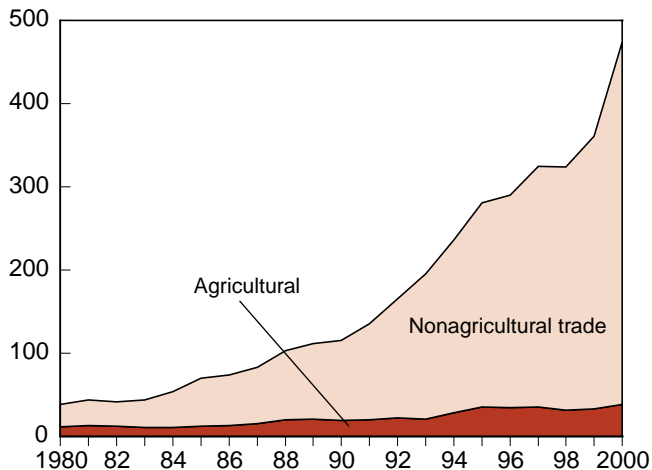
Note: Data not adjusted for inflation.

Source: ERS analysis of China customs statistics reported in Hsin-Hui Hsu and Fred Gale, *China: Agriculture in Transition*, USDA/ERS Agriculture and Trade Report WRS-01-2, November 2001, appendix tables 5 and 6.

Figure H-2

China agricultural and nonagricultural trade, 1980-2000

\$ billion



Note: "Agricultural" includes primary goods less mineral fuels. "Nonagricultural" includes mineral fuels, lubricants, manufactured products, and other goods. Data not adjusted for inflation.

Source: China customs statistics data as reported in *China Statistical Yearbooks*.

China's declining comparative advantage in grains and other land-intensive crops should lead to increased net grain imports in the future. A gradual shift in the composition of imports from food to feed grains seems inevitable as well. In addition, China will most likely expand its exports of more labor-intensive crops, such as fruits and vegetables, and manufactured agricultural products such as textiles.

China's mix of agricultural trade has expanded modestly along comparative advantage lines since 1980. However, imports of land-intensive commodities have not risen significantly, and China is still only a small net importer of grains and oilseeds. Exports of fruits and vegetables have shown little trending.

A cereal grain export blockade, in effect during portions of 1994 to 1996, had a strong impact on China's grain trade. Net grain imports rose during the embargo and fell in 1997, the first full year following the lifting of the embargo. The importance of grain exports to China's agricultural trade has since fallen. Thus, the embargo appears to have accelerated the declining trend in cereal exports, as China's exports shift toward commodities in which it has a comparative advantage.

Grain Self-Sufficiency Remains a Priority

China's policy emphasis on grain self-sufficiency may have impeded the shift toward comparative advantage in trade. Throughout the 1980s, the external grain trade was used to balance supply and demand for individual food and feed grains. In the 1990s, as China's lack of comparative advantage in grain production became more apparent, the target for domestic grain self-sufficiency was lowered to 95 percent of total grain consumption needs. Grain self-sufficiency remains a high priority, albeit with a less stringent criterion.

China is trying to improve the efficiency and responsiveness of its trading system in meeting national requirements, an objective that sometimes conflicts with self-sufficiency. During the 1990s, China initiated a number of policy and institutional reforms to improve market efficiency, including consolidating exchange rates, eliminating most government-determined prices, encouraging competition by decentralizing and deregulating the trade of many commodities, transforming trading companies into handling agents, reducing the number of commodities requiring import and export licenses, and reducing tariffs.

For most commodities, foreign trade has been decentralized and competition has increased. The number of firms eligible to engage in foreign trade increased from about 1,200 in 1986 to about 200,000 in 1996. However, agricultural trade in "strategic commodities," such as food grains, textile fibers, and chemical fertilizers, continues to be restricted to specialized and monopoly national trading corporations. The government's Cereal, Oil & Foodstuffs Importing and Exporting Corporation (COFCO) controls most of China's international grain trade for national and provincial grain-trading companies. Prior to China's WTO accession, COFCO handled almost all imports and exports of China's grains, oilseeds, and vegetable oils, making it an exceptionally large trading company. China's WTO accession terms included commitments to set aside specified shares of wheat, corn, rice, vegetable oils, sugar, and cotton that could be imported by any end user. Some national trading corporations have been transformed into for-profit enterprises, including COFCO for grain, edible oil, and sugar; China National Chemicals Import and Export Corporation for chemical fertilizer; and the Cotton Import and Export Company of China.

The monopoly structure of China's state trading may account for the erratic nature of China's agricultural trade. However, one of the most important effects of China's WTO accession agreement may be the weakening of state trading monopolies. COFCO's wide year-to-year swings in trade volume have contributed to price fluctuations within China. While price stabilization is an important goal of China's trade policy, China's domestic prices of rice, wheat, and corn have all been more volatile than international prices. COFCO may have even exacerbated domestic price volatility by importing during periods of relative grain abundance and exporting during periods of relative grain scarcity. The lack of transparency in China's trade transactions also causes uncertainty by withholding information from COFCO's customers and suppliers. China's accession to WTO will diminish COFCO's monopoly power by setting aside shares of grain imports for nonstate traders. This commitment will increase the amount of competition and transparency in China's grain trade and forge a stronger link between domestic and international prices.

Grain trading in China still remains subject to import and export licenses and quotas. However, for other commodities, such as soybeans, trade has been more open and competitive for several years. Restrictions against importing soybeans were almost completely removed during 2000 and 2001, and soybeans entered China at near world prices, until problems with import inspections and uncertainty over new biotechnology regulations slowed imports in mid-2001.

Reforms Reduce Distortions

Until the mid-1990s, China consistently taxed farmers by maintaining farm-gate prices below border price equivalents, but taxation of farmers has diminished in recent years. By 1997, most farmer procurement and farmer market prices approached international price equivalents—and for brief periods in 1996/97 may have exceeded international prices. Nominal protection rates estimated at official exchange rates for the major grains, oilseeds, and cotton clearly show declining negative protection (i.e., taxation) over the 1980s and 1990s and now hover within a 10 percent band around zero.

Exchange rate policies, however, still impose an implicit tax on many commodities because China's currency is overvalued. According to the International Monetary Fund (IMF), China's renminbi is fixed above the free market rate. Even though there was a

What We Need to Know

Will China increase imports of grain and other bulk commodities in accordance with its comparative advantage?

Will increased competition in trade improve domestic efficiency and transparency and reduce farm-processor price spreads?

How will increased participation of nonstate trading entities affect domestic price stability and domestic and international price linkages?

Will state traders remain competitive without government-sanctioned monopoly status?

Will nontariff barriers remain important after WTO accession?

significant depreciation of the renminbi between 1990 and 1994 (when the currency lost more than 40 percent of its value), the IMF estimates that the renminbi has been overvalued from 8 to 13 percent since 1995. This situation was exacerbated by China's resolve not to devalue its currency during the 1998 Asian financial crisis. Agricultural protection rates remained negative in recent years when calculated at real effective exchange rates. If the impact of the overvaluation of the domestic currency and the trade protection system is considered, agricultural incentives are further distorted, depressing food prices and redistributing income from farmers to urban consumers and the agroprocessing sector.

China has used subsidies for encouraging exports in some years (such as corn in 2000), but the support has been relatively small and only available in some provinces. Not surprisingly, exportable commodities—such as rice, corn, and cotton—are more heavily taxed than importable commodities, such as wheat. Export subsidies were ended as part of China's WTO accession commitments.

Trade Barriers: How High?

In 2001, China's agricultural import tariffs of 40 to 60 percent were higher than the average for industrial goods (17 percent). However, China's WTO commitments call for annual tariff reductions that will cut the average agricultural tariff to 17 percent by 2004. China's average agricultural tariffs will be considerably lower than those of most developing countries. In

the first few years after China's WTO accession, limited imports of important agricultural commodities (grains, cotton, vegetable oils, wool, and sugar) under a maximum tariff-rate quota (TRQ) will be allowed to enter at tariffs as low as 1 percent. Imports above the TRQ quantity will be assessed a tariff that is much higher, but still below those assessed by many other countries. WTO commitments will likely preclude China from following the protection-based agricultural trade policies used by its more developed East Asian neighbors.

While China's tariff reductions suggest more open trade, China also maintains a variety of nontariff barriers that restrict imports, including import licenses, and state trading. Phytosanitary and food safety measures, such as China's regulations on genetically modified agricultural products, should be science based, according to WTO rules, but many observers are concerned that China will use such measures to block imports (see "Is Biotechnology in China's Future?" in this report).

Little evidence points to increased reliance on comparative advantage in China's agriculture. The modest and

limited expansion of agricultural trade along comparative advantage lines is striking, despite an overall increase in China's foreign trade. The country's WTO membership is likely to have a significant impact on the future pattern of China's agricultural trade, assuming the WTO will reduce China's tariff and nontariff agricultural trade barriers and those of its trading partners.

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How Might China Protect Its Agricultural Sector?

Cheng Fang, Francis Tuan, and Funing Zhong

China has insulated its domestic food markets from foreign competition and world price fluctuations by maintaining tight control on agricultural trade. As China opens its agriculture to foreign competition after World Trade Organization (WTO) accession, will it protect its farmers?

Urban Subsidies Give Way to Farm Aid

From the 1950s through the 1970s, Chinese farmers were effectively taxed rather than subsidized. Under the centralized government procurement system, farmers were paid low prices for mandatory sales of commodities to the government. After rural reforms began in 1978, the government raised procurement prices to stimulate grain production while continuing to sell grain to urban consumers at subsidized retail prices. China's official statistical reports indicate that spending on price subsidies (mostly grain crops and some livestock products) was 71.2 billion yuan (\$8.7 billion) in 1998, up from 7.9 billion yuan in 1979. Until the 1990s, most of these subsidies accrued to urban consumers and processors that paid subsidized prices, sometimes below the price paid to farmers. Low commodity prices benefited urban consumers and yielded government revenues from export sales and taxes paid by agroprocessors' profits. As urban residents' income and agricultural production increased over the past two decades, widespread urban food subsidies became unnecessary and taxation of agriculture began to disappear.

In the late 1990s, the government tried to boost farm incomes by procuring grain at above-market support ("protective") prices. In some years, China maintained prices of important commodities, such as wheat, soybeans, and corn, substantially above international levels by keeping a tight reign on imports through unannounced quotas and license requirements, maintaining government monopolies on import and export of commodities, subsidizing exports, and taking other measures (fig. I-1). Input subsidies and government

support for infrastructure and research also aided the agricultural sector.

Still, not all commodities in China are subsidized. Some commodities have prices below international levels (negative protection). Rice, a staple food and a source of modest export revenues, is the most notable example. Some argue that overvaluation of the Chinese currency in the years after the 1998 Asian financial crisis (when the central government resisted pressure to devalue) hurt farmers by reducing the effective cost of products from competing countries. Finally, there have been concerns that central government subsidies have been absorbed by the bureaucratic grain marketing system or offset by rising local taxes and fees assessed on farmers. Data on local taxes and fees are scarce, but estimates indicate that local agricultural taxes and fees amount to 25 percent of farmers' net income. Thus, on the whole Chinese farmers are still taxed, although the level of taxation is lower than in the past.

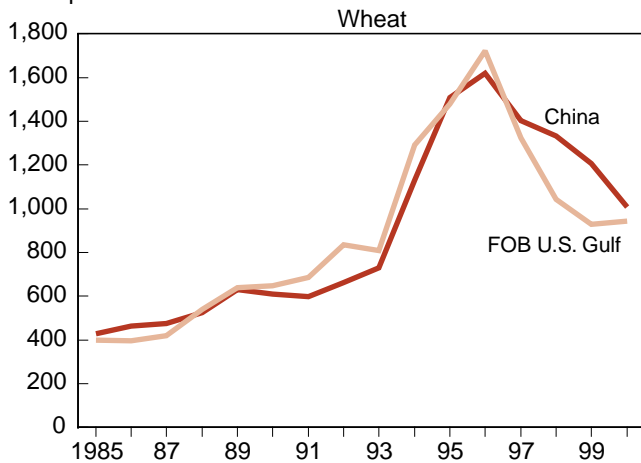
Open Markets Will Challenge Farmers

China's protection of agriculture has relied on strict control of agricultural trade, but China's WTO accession will substantially reduce tariffs on most agricultural products, eliminate export subsidies, and loosen state control over imports and exports. The government will also be required to publish information about import quotas and regulations. Trade in commodities previously dominated by state trading entities will be opened to nonstate trading companies. Tariffs on nongrain products will range from 3 to 20 percent. Imports of grains, cotton, vegetable oils, wool, and sugar will be allowed to enter at minimal tariff rates up to set limits—tariff-rate quotas (TRQ)—from 2002 to 2004. Soybeans and soymeal will have bound tariffs of 3 percent (soybeans) and 5 percent (soymeal). By comparison, the world average tariff for food and agricultural products is 62 percent (U.S. Department of Agriculture). The terms of China's

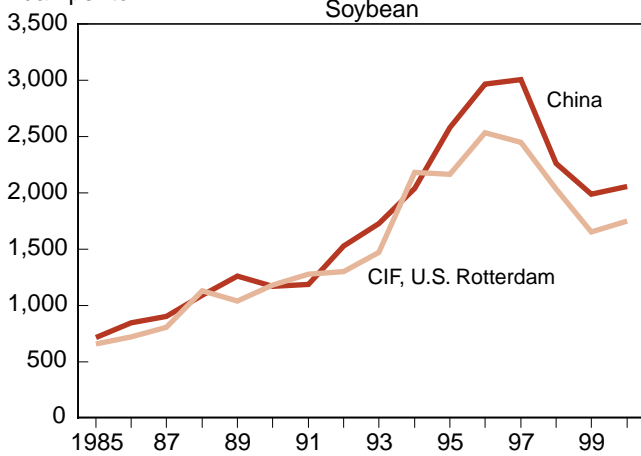
Figure I-1

China farm gate and world reference prices, 1985-2000

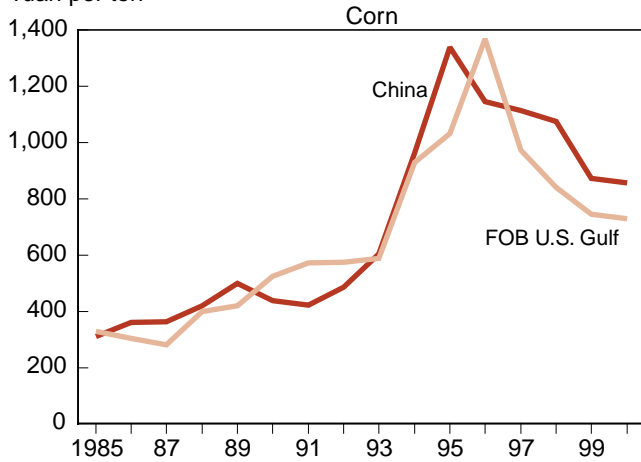
Yuan per ton



Yuan per ton



Yuan per ton



Source: China Price Bureau and International Monetary Fund, International Financial Statistics.

What We Need to Know

What is the long-term self-sufficiency level for China's agriculture?

Could regional liberalization of grain self-sufficiency affect China's overall agricultural protection?

Which "boxes" and what measures will be used after the WTO accession?

Who will provide funds for subsidies to farmers: central or local governments?

WTO accession could make it one of the most open countries in the world in terms of agricultural trade.

In a more liberalized agricultural trade environment, China's government will likely search for ways to protect agriculture to maintain grain self-sufficiency; stabilize domestic markets in the face of droughts, floods, and world price fluctuations; support farm incomes; and preserve social stability. China's farmers are internationally competitive in many commodities, but the country's corn and cotton prices were substantially above world levels at the time of China's WTO accession. Impacts on Chinese farmers of open markets will likely be modest and gradual, but China may implement policies to mitigate adverse effects of WTO accession since roughly half of its population relies on agriculture.

Self-Sufficiency Main Concern

Self-sufficiency in grain has been the government's main concern in formulating China's agricultural production and trade policy. WTO accession will not threaten self-sufficiency—now defined in China as meeting 95 percent of domestic food grain needs—in the near term. China has produced all of its own rice (and has been a net exporter) for the past two decades, and that trend is likely to continue in the near future. Even if TRQs for wheat and rice were to be entirely filled in the years following China's WTO accession (which many expect to be unlikely), grain imports would still be well below 5 percent of consumption.

In the longer term, market forces may bring about structural adjustments within the agricultural sector, such as movement of resources out of grain production and into more labor-intensive crops that use less land. The small scale of farms prevailing in China makes

producing grain less profitable than producing high-value products, such as horticultural crops or livestock. In the long term, it is possible that market forces could push imports of food grain past the 5-percent threshold. China will likely continue to produce most of its own grain even without subsidies, but government leaders may institute policies, at least for the next several years, to keep grain self-sufficiency below the 5-percent threshold.

Subsidies: Room for Growth

Concerns about low rural incomes or excessive reliance on imports could motivate China's government to increase subsidies for agriculture through price supports, income transfers, and indirect subsidies. The Uruguay Round Agreement on Agriculture (URAA) classified price supports as an "amber-box" trade-distorting policy, the use of which should be limited. As part of its WTO commitments, China agreed that the value of its trade-distorting amber-box support for agriculture would not exceed 8.5 percent of its total value of agricultural output (China's *de minimis* exemption). China's current amber-box support is minimal, so there is considerable potential for China to provide price support to farmers while remaining within its WTO commitment. Internal budgetary constraints are likely to keep subsidies far below the committed level. The 8.5-percent annual threshold based on China's current crop output value would amount to \$14 billion.

The URAA placed no limits on "green-box" subsidies, which do not directly distort trade. These subsidies include government-supported research, disease control, infrastructure, and policy subsidies for certain grain marketing and promotion services. The green-box category also includes income-support payments made directly to farmers that do not stimulate production, assistance to help farmers restructure agriculture, and environmental and regional assistance programs. Green-box payments must come directly from

taxpayers and cannot involve transfers from consumers. China will likely use green-box subsidies to further improve infrastructure and research, develop and import new grain varieties and technologies, address water shortages, and adjust agricultural production structure. Spending on these programs will also be constrained by availability of funds.

China's agricultural policy is devolving to some extent to the provincial level. In wealthy areas in coastal provinces, provincial governments are looking at possible approaches for subsidizing farmers within their provinces. Grain-deficit coastal provinces have now eliminated government-set procurement prices and are relying on markets to determine grain prices. Government procurement prices are still set for key commodities in grain-surplus provinces in China's central and northeastern regions. China will face a great challenge in protecting incomes of the huge number of farmers in the poorer central and western provinces that are still heavily dependent on agriculture.

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Is Biotechnology in China's Future?

Fred Gale, William Lin, Bryan Lohmar, and Francis Tuan

China is at the forefront of plant biotechnology research and is the world's fourth-ranked country (behind the United States, Canada, and Argentina) in area sown to biotech crops. Genetically modified (GM) varieties of all of China's major crops, as well as some fish and livestock, are in development or testing, but by 2001 only a few GM plant varieties had received commercial approval, including two types of cotton (which account for nearly all of China's biotech crop plantings) and varieties of tomatoes, sweet peppers, and petunias (table J-1). GM tobacco was China's first transgenic crop widely grown in the early 1990s, but it was withdrawn due to trade concerns.

Insect-resistant Bt (*Bacillus thuringiensis*) cotton, approved for commercialization in 1997, accounted for most of China's acreage planted in GM crops in 2001. Adoption of Bt cotton revived cotton production in the north China plain, where devastating boll worm infestations had affected production in the mid-1990s. Bt cotton was quickly accepted by farmers

and accounted for nearly all cotton grown in Hebei province in 2000. China's success with Bt cotton suggests that biotech crops can have dramatic impacts on agriculture. Insect-resistant cotton varieties reduced production costs by 14-33 percent (Pray et al.), reduced farmer health risks, and improved water quality by reducing the frequency of pesticide sprayings. Preliminary calculations suggest that shortrun benefits of Bt cotton far exceed the costs of the crop's development (Huang et al.).

Though China's government has enthusiastically backed biotech research since the 1980s, its slowness in approving biotech food crops seems to represent a cautious approach to releasing GM foods to the market. In light of emerging consumer concerns about GM foods in Europe, Japan, and South Korea during the late 1990s, policymakers may have second thoughts about the safety of genetically modified foods. Alternatively, China's caution in releasing GM varieties may be a strategic move aimed at gaining a competitive edge in overseas markets by keeping China's production free of genetically modified varieties. The long delay in publishing final biotech regulations in 2001 and the lack of details in those regulations suggest that policymakers are still debating the biotech issue.

Table J-1—Number of genetically modified plants approved in China through 1999

Crop	In trials or awaiting commercialization	Commercialized
	<i>Number of varieties</i>	
Cotton	13	2
Rice	16	0
Wheat	1	0
Corn	2	0
Soybean	2	0
Potato	8	0
Rapeseed	2	0
Tobacco ¹	4	1
Peanut	1	0
Cabbage	1	0
Tomato	5	1
Sweet pepper	2	1
Petunia	2	1
Other	6	0

¹ Insect-resistant tobacco was commercialized in 1992 but stopped in the mid-1990s for trade reasons.

Source: Huang, J., Q. Wang, and Y. Zhang. "Agricultural Biotechnology Development and Research Capacity in China," Center for Chinese Agricultural Policy, Chinese Academy of Sciences, February 2001.

Strong Commitment to Biotech Research

Most biotech research in China has been government-funded. During the 1990s, China's investment in plant biotechnology rose at a significant rate. Between 1995 and 1999, biotech spending more than doubled from the equivalent of \$40 million to \$112 million and China announced plans to increase research budgets 400 percent over the next 5 years (Huang et al.). Biotech research in animal and plant agriculture combined is estimated to account for 15 percent of China's agricultural research, much higher than the 2-5 percent share typically devoted to biotech research in developing countries. China accounts for an estimated 10 percent of the world's public expenditures on agricultural research and development (Pardey and Beintema).

China's share of total biotech research expenditures is much smaller than its share of public expenditures because there has been little private research in China. Private spending has been estimated to account for half of biotechnology research expenditures worldwide. Most of the genetically engineered herbicide- and insect-tolerant corn, cotton, canola, and soybean varieties that have been widely adopted by farmers outside China were developed by the private sector. In China, a Bt cotton variety developed by Monsanto is the only private sector variety that has been widely adopted. Lack of protection for intellectual property rights and restrictions on foreign firms have kept many foreign agricultural biotech firms from entering the China market.

The most popular genetically engineered varieties developed by the private sector have appealed to farmers on the basis of the cost and labor savings they promise. The early commercial successes have been GM crops for feed and industrial use (soybeans, corn, and cotton). In contrast, China's biotech research program has devoted a larger share of resources to increasing yield and pest resistance in rice and other food crops, a reflection of the government's concerns about food security. Private firms have tended to concentrate on developing seeds for high-volume, high-margin markets for widely grown crops in order to recover the high initial development and regulatory approval costs in Western countries. China's research institutes have developed an inventory of smaller specialty varieties (vegetables, flowers, peanuts, tobacco, fish, and animals) that may give China's farmers a competitive edge in niche markets in China and other developing countries.

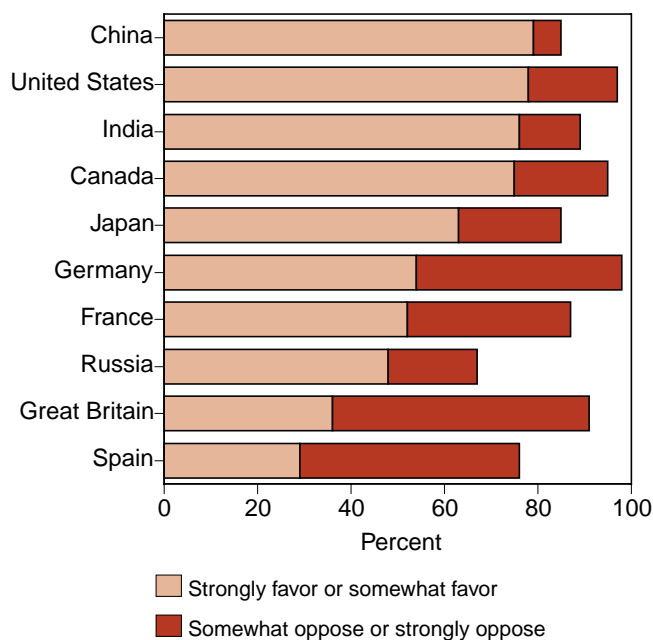
Will Consumer Acceptance Continue?

The sparse information available suggests that the public and news media in China have been supportive of agricultural biotechnology. A 1999 Environics International survey of consumers in 10 countries found that China's consumers were among the world's strongest supporters of agricultural biotechnology research (fig. J-1). Preliminary 2001 survey results reported in China's official newspaper, *China Daily*, indicated that China's consumers had a high level of awareness, but little accurate knowledge, of GM foods. The support for biotechnology probably reflects the government's traditionally strong support, since the news media is controlled by the state. A shift in official policy regarding genetically modified foods could

Figure J-1

Attitudes toward biotech crops in various countries, 1999

How do you feel about the use of biotechnology to grow pest-resistant crops requiring fewer chemicals?



Source: Environics International, reported in *Washington Post*, October 16, 1999.

lead to a change in media coverage and in consumer attitudes. Some scientists have expressed concern that consumer attitudes could easily be shifted by inaccurate or negative media coverage (Sheng).

Markets for GM-free foods have developed in Japan and other countries. Such markets could develop in China as consumers direct more attention to food safety and environmental issues. However, most Chinese consumers will probably not be willing to pay the substantial price premium associated with costly segregation and identity-preservation transportation, storage, and handling methods required to ensure that such products are free of GM content.

Regulatory Environment Uncertain

In January 2002, China published regulations that required labeling and safety certification for all GM animals and plants entering China for sale, production, processing, or research. Foreign companies selling genetically modified organisms (GMO) for seed, production, or processing and importers intending to use GMOs for research purposes are required to obtain a GMO safety certificate from China's Ministry of

Agriculture. The application for the certificate requires documentation that the GM product has been found to be safe and is permitted for use and sale in the exporter's home country, and applicants must specify safety measures to be taken in the course of exporting the GMO to China. China's regulations require importers to be issued safety certificates before they can sign contracts to import GMO products to China, and the approval process for certificates can take up to 270 days. The products specifically covered include soybeans, rapeseed, oil and meal made from soybeans and rapeseeds, corn, cotton seeds, and tomatoes, and the regulations direct China's State Council to issue a full list of products that require GMO labeling.

The initial regulations published by the Chinese government left important details unspecified. Trade in soybeans was disrupted as traders waited to see whether imports of GMO soybeans would be allowed under the new regulations. The United States raised concerns that the lack of details given, the complexity of the regulations, and apparent discriminatory treatment of imported versus domestic products could disrupt trade in oilseeds and corn. Costly paperwork to obtain safety certificates, testing, and uncertainties about whether shipments will be approved for import could raise costs for Chinese processors and reduce China's imports from the United States, Canada, and Latin America, where GM varieties of oilseeds and corn are widely grown.

The effects of China's GMO regulation will be determined in large part by how inspection, testing, and approval are administered and operated. Testing for biotech content must be rapid, economical, accurate, and standardized. Failure to effectively regulate the dissemination and marketing of bioengineered plants and animals could lead to consumer dissatisfaction and wide resistance to biotechnology if defective or harmful varieties are released or consumed by the public. China will also need to carefully regulate and monitor biotech producers to ensure that safe and appropriate practices are used in the cultivation of biotech crops. For example, plantings of Bt cotton should be interspersed with non-Bt "refuges" to prevent development of resistant pests, but it is not clear that this practice is being followed in China.

Public Versus Private Sector

Will the private sector play a bigger role in China's biotech research? Until recently, China's fragmented

What We Need to Know

Will China's regulation of biotechnology boost or retard the dissemination of GM food and fiber?
Will imports be affected?

Will Chinese consumers' acceptance of genetically modified foods continue?

How will the adoption of GM crops in China affect exports to other Asian countries vis-à-vis U.S. products?

How will the structure of the Chinese seed market evolve as foreign firms gain entry and how will this affect farm input costs and access to seed technology?

seed industry was made up of small regional companies that relied on the public sector for research and development. However, in recent years the seed industry has begun to commercialize. Several large companies from other sectors of the economy have bought up local seed companies to forge them into national companies. A number of provincial seed companies and research institutes have been able to raise capital on the stock markets. A few foreign companies have been allowed to enter the Chinese seed market and are likely to grow further following China's WTO accession. To encourage further biotech development in the domestic seed market, China is strengthening protection for intellectual property rights and relaxing restrictions on private and foreign firms.

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Does China's Land-Tenure System Discourage Structural Adjustment?

Bryan Lohmar and Agapi Somwaru

China's land-tenure system combines private use rights with public ownership to provide economic incentives for farm households, while stopping short of allowing full land ownership and alienable rights. Nominally, agricultural land is collectively owned by the *xiaozu*, which are groups of 30-40 households (hereafter called groups); in some cases, the village is the collective owner (there are around 10 groups in each village). Regardless of who owns the land, the village leadership may still influence, or sometimes dictate, land-use and land-allocation decisions.¹

Farmers Are Allocated Use Rights

Under collective ownership, farmers in China do not own the land and cannot sell it. Instead, village authorities allocate farm households use rights, or rights to cultivate specific parcels of land.² Villages can divide land parcels into four tenure categories, each with different rights and responsibilities attached, but not all villages differentiate among all four categories (table K-1). The most common allocation is "responsibility land," which is allocated to households in return for the household's commitment to deliver a quota of grain. The bundle of rights extended to farmers varies among villages, sometimes among groups in the same village, and also according to the tenure category of each parcel. Households are allocated land-use rights so long as they use the land for agricultural production. Aside from use rights, the most important right allocated to farm households is the right to residual income, which allows farmers to freely sell their output (except for a grain delivery obligation for responsibility land) and retain their earnings. Some, but not all, villages give house-

holds the right to rent land, which also varies among the four major tenure types.

Collective owners (in practice, village authorities) can periodically reallocate land-use rights among households. Originally, village authorities allocated land to farm households according to the number of people in a household to maintain egalitarian access to land.³ Some villages reallocate land to equalize the distribution of land among households when the demographic composition of households changes through deaths, births, and marriages. The frequency, nature, and magnitude of reallocations vary among villages and groups (not always for egalitarian reasons), and sometimes without ample notification to households.

Why Does Land Tenure Matter?

Because farm households do not own and cannot sell their land, they do not necessarily benefit from the increase in land value that comes as China's economy grows and develops. In fact, without clear rights of ownership, it is unclear exactly who will benefit from the inevitable increase in the value of land as the country's economy grows. Classical economics argues that the rents to rising land values go to the owners, so does that mean that the groups and villages that nominally own the land will be the beneficiaries of aggregate economic development? How will those benefits be distributed to individual farm households that belong to the collective?

The land-tenure system may prove to be a costly bottleneck that impedes needed adjustments in China's rural economy as it copes with rapid economic change and globalization. Lack of land markets and frictions inherent in the land-tenure system slow the transfer of land from low-value to high-value uses and may impede needed adjustments in China's agricultural sector. The unavailability of land rentals may prevent

¹ Sometimes, however, the groups can make allocation decisions on land that is nominally owned by the village. Village leaders, in turn, are selected by means varying from open, contested elections to appointment by township authorities.

² In economics literature, property rights institutions are often analyzed as extending a bundle of specific rights. For example, in the United States, private ownership, in itself, does not extend the right to drill for oil, open a public business, put up a big sign, or even build a house without proper permits.

³ In some cases, villages also took into consideration the number of able-bodied workers when making the original land allocations.

Table K-1—Village land-tenure categories in China, 1996

Tenure category	Description of tenure category	Land under tenure category	Villages reporting the right to rent land in given category ¹
		<i>Percent of land</i>	<i>Percent of villages</i>
Responsibility land	Allocated to households in return for delivery of grain to state grain bureaus	76	79
Ration land	Allocated on a per capita basis to provide the household with food grain security	10	56
Private land (plots)	Allocated in small parcels for vegetables and other nongrain crops	4	92
Contract land	Contracted from a village pool of land, often through open bidding, by households interested in expanding their land holdings	9	48
Other land	Reclaimed wasteland allocated to households that participate in the reclamation effort	1	-

¹Includes villages that reported extending the tenure category in question to farm households. For example, only 32 percent of the villages reported having ration land.

Source: 1996 village survey, reported in Lohmar, 2000, "The Effects of Land Tenure and Grain Quota Policies on Farm Household Labor Allocation in China," unpublished Ph.D. dissertation, University of California-Davis.

households with successful cash-crop operations from expanding, especially in villages where leaders seek to promote the production of staple grains.⁴ Villages with successful rural enterprises that need land to expand a nonagricultural enterprise will work through village leaders to attain their land, making it less likely that those households most willing to give up their land will be chosen for land expropriation. The payments made to households that do give up their land may or may not be acceptable reimbursement for the loss to those households (Guo).

China's land-tenure system also discourages specialization and free flow of labor. Since land rights are tied to village residence and delivery of grain quotas, farm households are discouraged from moving to towns and cities to find work because they may lose their land rights. These residency requirements, along with the urban household registration system, help explain why most migration in China is temporary and by individuals rather than entire families. Institutions established to overcome the conflicts involved in moving land from agricultural to nonagricultural uses also often maintain residency requirements. Some wealthy villages in coastal areas have pooled their land to establish industrial facilities, allocating shares to the profits to farm households. These shares, however, are

also tied to village residency and discourage movement out of the village.

Finally, without land ownership, farmers have less incentive to invest in land improvements and few assets to secure loans. The risk of reallocation or tenure insecurity may discourage long-term investments in orchards, forestry, or other projects with long-term payoffs.⁵ Limited tenure may also discourage soil conservation and encourage unsustainable practices with short-term payoffs, such as high usage of chemicals. Ambiguous property rights may also encourage the cultivation of marginal or fragile land that is susceptible to erosion.

How these effects will influence agricultural production and trade in China is difficult to assess. China will likely maintain higher levels of grain production under this tenure system than it would if land could be more easily transferred. The effects on labor mobility also may hinder urbanization and with it, maintain relatively high per capita consumption of staple grains because urban residents consume less grain than rural residents.

Can Land Be Privatized?

Several factors make it unlikely that China will privatize farmland. The current ownership of land is not

⁴ Staple-grain production is often an important part of a village leader's performance evaluation.

⁵ Some argue, however, that by making substantial investments households receive more secure tenure rights.

What We Need to Know

How are land-rental markets and other tenure institutions developing and what effects will they have on land use and agricultural productivity?

What effects does the unique tenure system have on labor and credit markets?

What implications do land-tenure institutions have for environmental degradation and agricultural sustainability?

How will land tenure affect urbanization and the location of industrial facilities?

What new tenure institutions are emerging to accommodate some of the conflicts outlined above? How do they work and what are the implications of these new tenure forms?

How does the lack of land ownership affect the food security of the elderly who can no longer rely on land assets to fund their retirement?

well defined, and there are already disputes among villages and village groups over this issue. Lack of a land registration system, poor credit markets, and a weak legal system make privatization of land ownership unrealistic, if not dangerous, at the present time (Brandt). Also, many farmers appear to prefer the current system, especially in poorer villages, because it guarantees households access to land (Ho).

The framework of China's existing collective ownership system will likely undergo changes. The latest land law, passed in 1999, uses much stronger language to ensure that households are extended 30-year leases

to promote household tenure security. The law also aims to reduce the frequency and capriciousness of land reallocations. Villages and townships in more developed coastal provinces are independently experimenting with new methods of consolidating collective land, such as cooperatives, land trusts, and joint-stock companies where households pool their land to form a large-scale farm or other operation. Villages are employing a wide variety of tenure practices, and those systems that allow for growth while distributing gains in a politically acceptable way will become models for future land-tenure reforms.

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Will Water Scarcity Affect Agricultural Production in China?

Bryan Lohmar and Jinxia Wang

China has achieved impressive increases in grain production over the last 50 years due in large part to the expansion of irrigation, but many observers are beginning to question whether irrigated agriculture is sustainable in areas of China where water is relatively scarce. Despite competition from rapidly growing industry and increasingly wealthy consumers, farmers still receive over two-thirds of China's water, even in water-stressed regions.

Most observers agree that the increasingly acute water problems in China will affect agricultural production, particularly on the north China plain, where irrigation is extensive but water depletion is severe. Some scholars have argued that rapid depletion of water resources will reduce China's grain production capacity, leading to massive grain imports that will dominate world markets. Others argue that a shift to less water-intensive crops and other measures will help China solve many of its most pressing water problems, averting the crisis scenario predicted by others. The actual changes that take place will depend largely on the effectiveness of reform policies presently being discussed and implemented in China.

Does China Have a Water Crisis?

While there is widespread concern that China faces a water crisis in the future, disruptions in water supplies to date have been isolated and water is still generally available at low prices. Industrial production continues to surge, even in China's northern coastal regions where water depletion is most rapid. Ever-wealthier urban consumers continue to use water with few restrictions (water rationing has been implemented in some northern cities during dry years). Farmers also have maintained access to water at prices well below its marginal value in agricultural production, which is much lower than its value in nonagricultural uses. China has expanded irrigated acreage in recent years and plans to continue expanding it. To date, there are no indications that water scarcity has significantly affected aggregate agricultural production or economic activity.

Disruptions in water supplies, however, have occurred in some areas of China and the rapid depletion of both surface and ground water resources in northern China has caused many observers to conclude that a far more serious crisis looms. The most notorious event associated with water overexploitation in China is the reduced flow of the Yellow River, which failed to reach the ocean for some period of every year between 1972 and 1999. In the river's driest year, 1995, it failed to reach the ocean for over 200 days. Similar reduced flows have occurred on the Huai and Hai Rivers, the two other major river basins on the north China plain. Tributaries of the Hai River often dry up before connecting to the main stream. Many downstream users cannot rely on surface water deliveries during the irrigation season because upstream users deplete water supplies. Poor maintenance of the existing surface water systems has resulted in large water withdrawals. Only about 30 percent of water withdrawals reach the crop root zone due to conveyance losses and inefficient irrigation practices (World Bank).

Unreliable and unavailable surface water deliveries have led to a heavy reliance on ground water. The combined effects of urban/industrial and agricultural water withdrawals are rapidly drawing down water tables on the north China plain. Heavy ground water withdrawals have caused wells to go dry in some villages. Private entrepreneurs have raised capital to sink deeper, more powerful wells, from which they sell water for a profit (fig. L-1). While this practice maintains irrigated acreage in the short run, it may further deplete ground water levels.

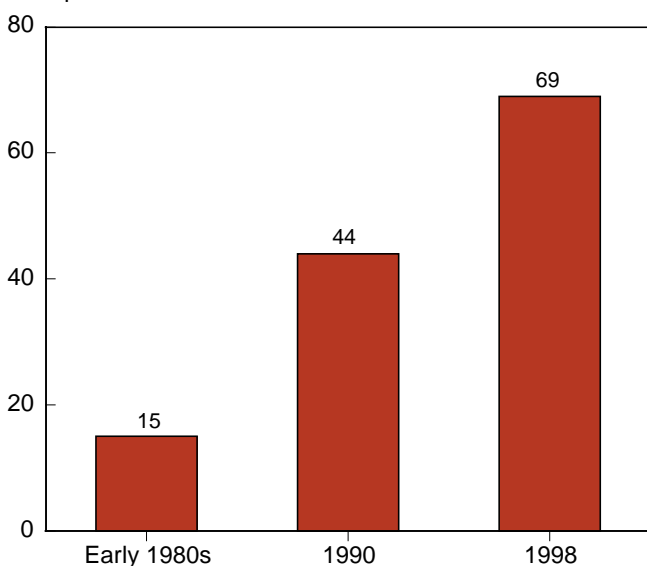
How Is China Responding?

Water managers and users, from the national level to the village level, are developing water-saving strategies and plans to secure future water deliveries. China's national government has renewed its commitment to invest in water storage, delivery infrastructure, and maintenance. The government has also strengthened the enforcement of national laws meant to restrict

Figure L-1

Percentage of private wells, sample villages in Hebei province, 1980s-1998

% of private wells



Note: Primary survey data collected from a sample of villages.

Source: Lohmar et al.

withdrawals from major river basins. Urban and industrial centers are experimenting with reforms to better rationalize water management and treat more urban and industrial water runoff so that it can be used for agriculture. In rural areas, local water managers and farmers are experimenting with new management systems intended to improve the reliability of water deliveries, maintain irrigated acreage, and encourage water saving.

It is unclear whether policy initiatives and new institutional arrangements will help China avert a severe water crisis in the future. Because water is of fundamental importance to industry, agriculture, and the general population's well-being, government agencies and managers that oversee water use have substantial power and clout that they do not want to relinquish. This factor will make reform of the management infrastructure difficult and politically costly. These costs, however, are far lower than the costs of running out of water entirely.

From an economic perspective, pricing irrigation water on a volumetric basis would increase water-use efficiency in agriculture but would be difficult to implement. With nearly 200 million farm households cultivating an average of 1.5 acres of land spread across several small plots, the high cost of monitoring

What We Need to Know

How will increases in water price or water rationing affect cropping patterns in China?

Which policies to reduce water consumption are most effective?

How does industrial water policy affect water availability for agriculture?

How effective is the extension system for introducing water-saving irrigation technologies and practices?

What role does poor water quality play in China's overall water-scarcity situation?

water deliveries to each tiny plot would outweigh the benefits to be gained from volumetric water pricing.

Effects on Agricultural Production

Increasingly scarce, less reliable, and/or more expensive water is expected to significantly affect China's agriculture. Cropping patterns are already being affected by water scarcity, but only on the margins, and effects on aggregate agricultural production are not yet apparent. Of all crops, wheat produced in the north China plain is the crop most threatened by water scarcity. Large production increases over the last 40 years are almost entirely due to the introduction of irrigation systems into much of this region, which now suffers some of the most severe water depletion in China.¹ Many farmers who lack secure access to ground water are already giving up wheat production because surface water supplies are not reliable. Farmers also complain that the low wheat/water price ratio reduces wheat profitability.

It is difficult to predict how China's agriculture will change cropping patterns in response to water scarcity. Prices, of course, will help determine which crops become more profitable, but so will research into high-yielding and less water-sensitive seed varieties. Farmers may forgo irrigated wheat and adopt a full season of corn to achieve high corn yields. Others may switch from wheat to cotton because cotton yields are

¹ Over 70 percent of the rainfall in this region comes between July and September—after the wheat harvest, but during the corn-growing season. Thus, wheat relies on irrigation, while corn is generally rain fed.

less dependent on irrigation. In other areas where transport costs to urban areas are low and water-saving irrigation technologies and information is accessible, farmers may choose to grow high-valued vegetables.

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Agricultural Labor: Where Are the Jobs?

Fred Gale, Agapi Somwaru, and Xinshen Diao

The transfer of labor from agriculture to industry and service employment that typically accompanies economic development was stifled in China for many years. The household registration system instituted in the 1950s made clear distinctions between rural and urban residents. Rural residents could not freely move to urban areas, so there was no outlet for growth in the rural labor force. When China began its economic reforms in the late 1970s, nearly all rural residents were engaged in subsistence farming because there were few opportunities for rural nonfarm employment. Rural nonfarm employment has grown rapidly over the past two decades, but nearly half of China's labor force is still engaged in agriculture. Farm earnings are low because each worker is limited in both land and capital. In 1999, rural per capita income in China was just \$360, reflecting low earnings in agriculture, which accounted for 60 percent of rural income.

China's high agricultural share of employment and low ratio of land per farm worker are not unusual among developing countries in Asia. However, middle-income and developed countries in Asia have 10 percent or less of their workers in agriculture and ratios of land per worker are much higher than that of China (table M-1). To raise per capita output and income in farming, China's economy needs to shift large numbers of farm laborers to employment in industry and services, where earnings are higher. Creating nonfarm opportunities will become an even higher priority as China's agriculture sector becomes more integrated with the world economy.

How Many Farmers?

China's policymakers and planners need better information about rural employment. Until recent years, "rural" and "agricultural" were essentially synonymous, and the number of farmers could be easily counted as the number of persons with agricultural household registrations. However, during the 1990s, many agricultural people found jobs in cities (though still mostly illegal) and in growing rural nonfarm

enterprises. The number of people with agricultural registrations (over 900 million, including children and retired people) now overstates the farm population.

Estimates of the number of rural people employed in farming and rural nonfarm industries vary widely. In 2000, official statistics reported a rural agricultural labor force (including forestry and fishing) of 328 million and a rural nonagricultural labor force of about 170 million (table M-2). In a 1998 paper, Rawski and

Table M-1—Agricultural labor force share and land per worker, selected countries and regions, 1999

Country/region	Agricultural share of labor force	Land per agricultural worker ¹
	Percent	Hectares
Laos	76	.44
Cambodia	70	.82
Vietnam	67	.21
Africa - developing	60	.83
India	60	.61
Thailand	56	.70
Bangladesh	56	.21
Indonesia	48	.36
Pakistan	47	.87
China ²	47	.39
Sri Lanka	46	.23
Philippines	40	.45
Mexico	21	2.84
Latin America and Caribbean	20	3.02
Malaysia	19	1.03
South Korea	10	.71
Europe	9	9.36
Taiwan ²	8	1.10
Australia	5	107.34
Japan	4	1.63
Canada	2	116.82
United States	2	58.46

¹ Arable/cultivated land divided by agricultural employment.

² Computed from statistical yearbook data. China agricultural employment reported in FAOSTAT is much higher than reported in *China Statistical Yearbook*.

Source: ERS calculations based on data from United Nations Food and Agriculture Organization, FAOSTAT database, except where noted.

Table M-2—China employment and growth by sector, 1990-2000

Sector	Employment	Growth
	2000	1990-2000
	<i>Million</i>	
Agriculture, forestry, and fishing	328	-5
Rural township and village enterprises	128	35
Rural private enterprises	11	10
Rural self-employment	29	14
Urban employment	213	47
Total	710	101

Note: Components do not sum to total due to rounding.

Source: China National Bureau of Statistics, *China Statistical Yearbook 2000* and *China Statistical Abstract 2001*.

Mead argued that official statistics published in China's statistical yearbooks underestimate rural employment in nonfarm industries and overestimate farm employment by perhaps 100 million. However, China's 1997 agricultural census, the first attempt to obtain a comprehensive nationwide count of rural employment, reported an even larger number of 425 million persons primarily employed in agriculture, forestry, and fishing and 136 million rural persons employed in nonagriculture (including 57 million working primarily in urban areas).

Where Are the Jobs?

China faces an enormous task in moving labor out of agriculture. Johnson estimated that China would need to create 15 million jobs per year over three decades to reduce its farm employment to 10 percent of the labor force (about the level of South Korea and Taiwan). This rate is nearly three times the average 5.9 million workers per year that transferred from agricultural to nonagricultural activities from 1978 to 2000, according to China's National Bureau of Statistics. A 20-percent agricultural labor force share (similar to that of Malaysia) is probably more realistic but would also require China to accelerate job growth over current rates.

Rural job growth faces a number of challenges (see "Can Rural Income Growth Accelerate?" in this report). Rural township and village enterprises (TVE) have absorbed much farm labor but are now trying to raise productivity and workforce quality, which tends to reduce hiring. TVE employment grew by 35 million during the 1990s but fell by 7 million from 1996 to 2000. Private enterprise and self-employment in rural areas added 24 million jobs during the 1990s but still account for less than 10 percent of rural employment.

Because population growth adds more people to the rural labor force each year, any effort to shrink China's farm labor force will be difficult. The creation of 57 million rural nonfarm jobs during the 1990s decreased farm employment by only 5 million from 1990 to 2000. The aging of the rural labor force presents another obstacle to nonfarm job growth because older persons are less likely to enter off-farm employment than younger persons.

From 1990 to 2000, urban areas provided 46 percent of China's employment growth—much higher than their 30-percent share of the country's population in 1990. According to China's 1997 agricultural census, 40 percent of rural residents working in nonagricultural activities worked in urban areas. Thus, much of the labor moving out of agriculture will likely find jobs in urban areas. As economies develop, most employment growth is in service sectors, and these jobs tend to cluster in urban areas, especially large cities, which are geographic centers for trade and incubators for high-tech industry. Labor-intensive low-skill services will be a logical sector for absorption of China's rural labor force. Manufacturing industries in both rural and urban areas will be under pressure to keep labor costs competitive and increase capital, skill, and productivity per worker. Textile manufacturers, an important employer of rural labor, have already undergone significant consolidation and downsizing.

Institutional Reforms May Aid Mobility

Studies of rural migration in China find that migration tends to follow networks established by village members. Migration is largely temporary, circular, and over short distances. Migrants tend to be young unmarried adults who are members of households with limited farmland. Remittances sent home by migrants are an important source of capital for rural households.

While mobility of rural labor has increased at a rapid pace, it is still constrained by limits on urban migration, grain procurement obligations and land-tenure systems, and lack of rural credit markets (see "Does China's Land-Tenure System Discourage Structural Adjustment?" in this report). As China relaxes some of these barriers to migration, what we know about migration from previous studies may become outdated.

Who Will Stay Behind?

Increased education will make China's rural workers more productive and employable. Rural education

What We Need to Know

Will nonfarm labor demand grow fast enough to absorb farm workers and reduce the agricultural labor force?

Will new jobs be in rural or urban areas?

Will long-distance and permanent migration become more common?

Which workers will be most likely to participate in nonfarm work?

How will labor productivity, earnings, and the structure of the agricultural sector be affected by outmigration?

levels have increased dramatically since the 1950s, especially for women, but many observers believe rural schooling levels are now in decline. Rural local governments must fund their own schools, and many poorer areas have little resources to support education. Rural residents view schooling as a means to migrate to an urban job. In other Asian countries, rural residents see better educational opportunities in urban areas as an important motive for moving to cities. Studies of the impact of education on farmer productivity have found mixed results. Persons with the highest level of education and skill are the most likely to enter nonagricultural work, leaving the less skilled in farming. However, a general rise in rural education seems likely to improve the ability of farmers to understand and adopt new technologies and process market information.

Part-time farming in China is becoming much more prevalent as farm household members commute to off-farm jobs. New institutional innovations in land tenure may allow farm households to maintain “ownership” of their land while devoting their labor to nonfarm work. In Taiwan, for example, over 80 percent of farm households have at least one member working off-farm. The fairly uniform distribution of small land plots among farm households in China may become more skewed as labor migration and consolidation of land occurs in some villages. Marketing arrangements and contract production for processors that need steady supplies of uniform products are becoming more common, which may speed up the commercialization and modernization of farming in China, turning “peasants” into modern farmers.

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Can Rural Income Growth Accelerate?

Fred Gale and Albert Park

Since the beginning of rural economic reforms in the late 1970s, rural incomes and living standards in China have improved dramatically, most notably during the early 1980s when productivity increased rapidly following the return to family farming. Real rural per capita incomes were nearly six times higher in 2000 than in 1978 (fig. N-1). However, income growth began from a very low base, and was uneven over time. Urban incomes grew even faster over the reform period, and China now has one of the largest urban-rural income disparities on record anywhere. According to China's official statistics, rural incomes in 2000 were only 36 percent of urban incomes on average, compared with 77 percent in the United States. The growing urban-rural gap is partly attributable to policies historically biased in favor of urban areas, such as extractive rural procurement and taxation policies, biased investments, and a strict resident permit system that clearly divided urban and rural populations. The gap also is the result of rapid industrial growth in urban areas and restrictions on labor mobility

that have prevented rural workers from benefiting fully from that growth.

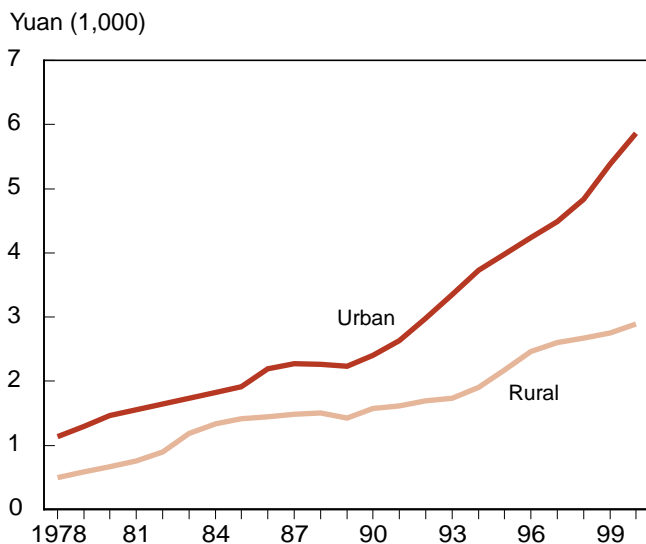
As China enters the new century, there is growing concern about whether the country can maintain momentum in increasing rural productivity and incomes. These concerns are punctuated by slow rural income growth in the late 1990s, the recent decline in employment in rural industry, and concerns that China's entry into the World Trade Organization (WTO) will weaken the country's agriculture. The recent relative stagnation of rural incomes in comparison with urban incomes highlights the importance of taking active steps to stimulate rural income growth. If effective, such steps will affect not only the welfare of millions of Chinese citizens but also the structure and competitiveness of the country's agriculture and trade.

Supporting Structural Change

As a developing country, China is in the midst of rapid structural transformation, a process that will likely accelerate with WTO entry. Although two-thirds of China's population still live in rural villages and agriculture still accounts for the majority of rural income, the country continues to rapidly urbanize and the share of labor and output accounted for by agriculture continues to fall steadily. Increases in productivity per rural worker and growth in per capita incomes will require *accelerating* this process of transferring agricultural labor to nonagricultural jobs, as well as making appropriate complementary investments to raise labor productivity in agriculture (see "Agricultural Labor: Where Are the Jobs?" in this report).

China will be challenged to generate new jobs to draw labor out of agriculture. Employment in rural enterprises has fallen in recent years, reflecting the difficulties such enterprises have faced due to intense competition, slower overall growth, and poor credit access. Many cities have severe unemployment problems associated with painful enterprise restructuring that may limit their ability to absorb rural labor.

Figure N-1
Urban and rural real per capita income, 1978-2000



Note: Deflated and converted to 2000 RMB yuan using China's Consumer Price Index.

Source: *China Statistical Yearbook* and *China Rural Household Survey Yearbook 2000*.

Foreign competition after China's WTO accession may put further pressure on enterprises to minimize labor costs to remain competitive, dampening employment growth. On the positive side, in recent years China's small private sector has been the largest generator of new jobs in urban areas, and this labor-intensive sector stands to benefit from more open trade. Thus, policies that support private enterprises and promote more open labor markets could help create more jobs for rural surplus farm labor. On the supply side, reforms of the land-tenure and grain-quota systems that now tie rural people to the land could significantly increase the mobility of rural labor (see "Does China's Land-Tenure System Discourage Structural Adjustment?" in this report).

Modernizing Agriculture

Another aspect of raising rural labor productivity is modernizing agriculture, transforming it from traditional semi-subsistence household production to larger scale, more commercialized and specialized production, especially in export-competitive sectors, such as the production of horticultural products, fruit, and livestock. The government should encourage policies that increase the ratio of land and capital per worker and allow farmers to realize economies of scale (e.g., consolidate small plots, promote mechanization). Rural financial institutions must provide financing for necessary capital purchases, which could be facilitated by land reforms that allow farmers to collateralize land ownership or use rights.

The most direct way to increase agricultural productivity is through investments in agricultural research, for which most agree there are high potential returns. China's agricultural research system has provided important breakthroughs but needs increased funding. Higher yields will also help China meet its food security goals in an era of more open trade. During the reform period, agricultural productivity growth has had the broadest impact on raising rural incomes and alleviating poverty. Another key aspect of raising rural productivity is increasing investments in rural infrastructure, which still accounts for a very low share of government expenditures (see "How Might China Protect Its Agricultural Sector?" in this report). Part of the necessary infrastructure investments are those that make land use more sustainable over time, especially in China's interior regions. The Western Development initiative may help reverse the urban bias in rural investment.

Developing agricultural processing and vertical coordination in the supply chain could play a role in promoting capital investment and technology transfer in rural China. Contract arrangements with processors can help farmers obtain loans, modern inputs, and technical assistance. New investment and trade opportunities after China's WTO accession could help support such vertical linkages. China's government structure must be adjusted to coordinate vertically linked production activities that involve both agriculture and industry.

Educational Access and Quality Uneven

In a world of increasing globalization and technological sophistication, investments in human capital become increasingly important, especially when workers, whether in agriculture, industry, or services, switch jobs frequently in response to changes in economic structure or in the international trading environment. In China, the returns to education have continued to rise over time, especially in the nonagricultural sector, and this will continue as the labor market becomes more developed. Primary education has become nearly universal in China's rural areas and China's Education Ministry is committed to raising school effectiveness and to achieving universal minimums of 9 years of education for the population. However, institutional inertia is strong, and budget shortages, fiscal decentralization, and rising regional income inequalities have led to growing inequities in educational access and school quality, leaving the poor and minority populations particularly vulnerable.

Limited Access to Capital

Although China's financial system has become more commercially oriented in recent years, rural financial institutions are still hampered by restrictions on interest rates, lending, and borrowing that constrain their institutions' ability to provide ready credit access to rural enterprises and farmers. Studies have documented how financial reforms in the mid-1990s made borrowing more difficult for both enterprises and households. Credit is important for facilitating the purchase of necessary capital to start new ventures or expand existing businesses, and thus is critical for realizing rapid structural adjustment in response to shifting comparative advantage. Rural finance supports more capital-intensive agricultural production and rural enterprise growth, both essential aspects of raising rural labor productivity. Interest rate liberalization would likely increase available funds for rural households, although at a higher price,

What We Need to Know

How will migration and urbanization affect the agricultural sector?

What are the payoffs to rural infrastructure investments?

How can village governance be reformed to maintain stability in the countryside?

How flexibly can China's rural economic structure adapt to new market opportunities and competition in a world of more open trade?

and would provide higher returns to savings, which are another key source of finance for new projects. Improving bank governance and management in rural financial institutions also should be a priority to increase available funds by reducing nonperforming loans. Innovative microfinance programs are expanding loan access to some of the rural poor, but only on a very small scale. Foreign bank entry following China's WTO accession is unlikely to lead quickly to direct foreign bank lending to rural households, but greater financial competition should benefit private, labor-intensive enterprises and reduce the share of state bank lending to state-owned enterprises, potentially freeing up funds for rural lending.

Urbanization Will Increase

China's degree of urbanization is lower than would be expected given its level of economic development, probably as a result of strict controls on population movement. Cities are important for realizing the advantages of agglomeration, such as economies of scale, concentrated markets, and greater specialization in production. Because earlier policies restricted rural-urban migration and supported inefficient, relatively capital-intensive enterprises in cities, much of China's industrial employment growth was in rural enterprises. However, in the future more rural labor is likely to migrate to cities, and China will need to find ways to accommodate more urban migrants. Chinese authorities project a 50-percent urban share of population within the first two decades of the 21st century. To facilitate this process, the Chinese government seeks to channel the rural-urban migration stream into small towns and small cities. The government has promised investments in such towns and cities and recently announced the relaxation of its strict resident permit (*hukou*) system in such areas. However, distance from markets, lack of technology,

low skills, and poor infrastructure will pose significant challenges in creating jobs in new small towns in central and western regions. China will need to allow population to move freely in response to incentives rather than fully plan the urbanization process.

Taxation and Governance

Excessive taxation of farmers through ad hoc fee and tax assessments remains a significant problem in many rural areas, occasionally leading to farmer protests. To adequately meet local development needs, local leaders need discretionary authority to tax and spend, especially when fiscal authority and responsibility have been decentralized. But discretion is easily abused without accountability, and governments in poor areas with few revenue sources have little recourse but to tax farmers to pay wages. For this reason, reform of rural local government institutions and public finance has become one of the most pressing issues in China's rural development. Upper levels of government must take measures to ensure adequate budgetary resources for poorer regions. Whether through village elections or through other forms of participatory decision-making, reform efforts to incorporate local voices into government decisions deserve high priority.

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China's Statistics: Are They Reliable?

Fred Gale

Analysis of China's economy is made more challenging by the uncertain accuracy of the country's official statistics. The politicization of statistics, reliance on bottom-up administrative reporting, use of nonstandard definitions, and parallel reporting systems in multiple agencies often make Chinese statistics confusing and potentially misleading. Many analysts believe that macroeconomic statistics overstate economic growth and understate unemployment. Bilateral trade statistics with the United States and Europe have had large discrepancies. For a number of years, agricultural statistics understated cultivated land area by 40 percent and overstated livestock inventory and output. In 2001, Canadian fisheries biologists argued that China's fish catch statistics were overstated, distorting the trend in world fish populations.

China's official statistical agency is the National Bureau of Statistics (NBS, formerly called the State Statistical Bureau). Like the U.S. Census Bureau, NBS conducts population censuses and periodic censuses of industry and governments. NBS conducts annual surveys of urban and rural households and reports China's national accounts and industrial and agricultural statistics. NBS conducted China's first modern agricultural census in 1997. Other agencies and state-sponsored agribusiness entities have their own statistical reporting capabilities for policy and business purposes, but NBS is the official source for most national statistics.

NBS publishes major statistical series in its annual *China Statistical Yearbook*. More detailed agricultural and rural statistics are published in NBS's annual *Rural Statistical Yearbook* and *Rural Household Survey Yearbook*, and *County Social and Economic Statistical Yearbook*. China's Ministry of Agriculture (MOA) publishes an annual *Agricultural Yearbook* that contains data on some commodities that NBS does not cover. NBS also publishes yearbooks for urban household surveys, prices, population, labor, township and village enterprises, and various industries. Monthly trade statistics are published by China's customs administration.

Agricultural Statistics

In China's Soviet-style bureaucracy, which was installed after 1949, statistics were gathered through bureaucratic administrative reporting. (Modern probability-based statistical survey methods have only recently been reintroduced in China.) Statistics became an integral part of the planning process and the rewards system. Rigid hierarchies were established for managing each aspect of the economy, and targets and quotas were handed down from the central government in Beijing to provincial authorities, to counties, to cities and townships, and to villages. At the end of the year, reports of production, income growth, crop yields, and other items were handed back up through the bureaucracy, and these reports, once aggregated, became the country's statistics. Officials at each level had incentives to pad the statistics to reach their targets or to avoid handing over taxes, procured commodities, or other obligations that are based on production, population, or other numbers. In recent years, many observers speculated that provincial statistical bureaus were exaggerating economic growth numbers to ensure that they met targets set by central authorities. It was widely reported that NBS did not have confidence in provincial numbers and reported national growth rates below rates reported by the provinces.

In recent years, international organizations and foreign governments have provided considerable technical assistance to help NBS modernize and improve its data collection and reporting capabilities in agricultural and other statistics (Food and Agriculture Organization; NBS). NBS is integrating sample surveys with traditional bottom-up complete reporting system. NBS and MOA each have a parallel complete reporting system that was put into effect when China was a centrally planned economy (Vogel). Village heads provide their township (the next administrative level) with estimates of basic data, such as household numbers, labor force, crop planted area, yields, and livestock numbers. Townships compile the data and report them to county statistical offices, which send the data to provincial offices. National totals are aggregated by NBS or MOA in Beijing. The accuracy of the complete

reporting system depends on the initial accuracy of the village head's report. Data on individual farms or households are not available to higher level statisticians to check for accuracy.

In 1997, NBS conducted China's first agricultural census, enumerating over 200 million rural households, as well as nonhousehold farm operations, administrative villages, towns, and townships. The census provided benchmark data (for 1996) on cultivated area, sown area to crops, livestock numbers, labor force, and other basic data that will be used to improve annual survey work (NBS). The agricultural census provided a more accurate estimate of cultivated land, which had been underreported for years (presumably to boost reported yields). Estimates of cultivated land area went from 95 million hectares (pre-census) to 130 million hectares (post-census). Similarly, China overreported livestock estimates until the census was taken. NBS now reports its livestock series beginning in 1996 (the year for census data), and cultivated land is reported only for 1996. It is still uncertain whether planted area is measured accurately (Vogel). At the local level, there are varying standards for measuring a mu, the traditional Chinese measure for land area (15 mu = 1 hectare = 2.471 acres), and it is difficult to verify the number of small land parcels in terraced areas.

Less Control, Less Accuracy

In most cases, China's statistics are becoming more reliable as modern survey methods are implemented. However, as the government's tight control over the population loosens and more of the economy moves toward privatization, the accuracy of many statistics is being challenged. Some observers question the accuracy of China's 2000 population census because of reports that many illegal migrants, unregistered children, and others evaded census takers (Becker). Rawski suggested that employment statistics undercount employment in tertiary industries, where a large share of employees are illegal migrants. More efforts are now being made to collect employment statistics from small firms—such as tertiary businesses—which were often left out of commercial and industrial statistics, which historically were collected from large state-owned enterprises.

As China's economy has become liberalized, the accuracy of bottom-up reporting systems for agricultural statistics has declined because leaders have less detailed knowledge of individual households than they

did when government control over farmers was tighter. Increased competition in agricultural markets, which may accelerate as a result of China's WTO accession, is reducing government control of agricultural procurement and marketing. The government grain bureau, cotton procurement, and other monopolies have been important sources of statistical information, but new ways of counting commodities in the supply pipeline will be needed as these monopolies erode.

"State Secrets" Keep Analysts in the Dark

Historically, Chinese authorities have kept secret market information that was available only to privileged government officials. Data on stocks of grain, oilseeds, cotton, and other major field crops held in China are not publicly available and are considered to be a state secret. Information about on-farm stocks is collected by NBS surveys, and information about commercial and government stocks is collected by the grain bureau system and agricultural development banks, but these data are not published. USDA and the United Nations Food and Agriculture Organization publish estimates of China's grain stocks, but those estimates are based on minimal information and are limited in detail. Gradually, China's government is making more *neibu* (internal use only) information available to the public, and the country's WTO accession commitments will mandate publication of even more information.

Duplicative reporting systems in different agencies create uncertainty for market analysts. For example, multiple agencies report their own production estimates for important crops, such as grain and cotton, and the estimates from different agencies are often inconsistent. Publication of data from the agricultural census was delayed for many months while the census estimates of land area were reconciled with contradictory estimates from other sources. NBS and MOA have parallel reporting systems and surveys. Some villages are covered by both agencies' surveys, while others are not. Greater interagency cooperation and reconciliation of differing estimates among agencies would improve the reliability of China's statistics.

Trade Statistics Discrepancies

Discrepancies between U.S. and Chinese statistics on bilateral trade were widely discussed in the early 1990s, when each country claimed to have a trade deficit with its counterpart. Since then, the statistics of both countries have shown the same trend—rapid

What We Need to Know

Will survey methods adequately replace bottom-up reporting systems?

Will greater transparency requirements after WTO accession improve the flow of information?

Will different organizations find means of sharing and reconciling data?

How much do distortions in the economy affect statistical measures of purchasing power?

growth in China's exports to the United States—but discrepancies remain.

The largest discrepancies are due to differences in counting China's exports to the United States via third countries or regions, mostly Hong Kong. In the early 1990s, the U.S. Census Bureau estimated that such transshipments constituted 80 percent of U.S. imports from China (China claimed the figure was 60 percent). The United States counts Chinese goods transshipped through Hong Kong as imports from China. The Chinese argue that the value added to goods in the "third place," estimated at 29 percent of import value (Dougherty), should not be counted as imports from China.

U.S. exports to China are also transhipped through third countries, but there is less discrepancy in export statistics because only about 25 percent of U.S. exports go through a third country or region. Another important conceptual difference between the two countries is that U.S. statistics include costs of shipping in exports, while China's do not. Some trade is not covered by statistics due to errors, misclassification, underinvoicing, or smuggling, which also leads to discrepancies.

Is Income Really That Low?

Per capita income figures converted to U.S. dollars with the official exchange rate usually understate the actual purchasing power of China's consumers. Urban consumers often receive subsidized health care, housing, utilities, education, and other services that are not counted in their incomes. Taxes are not paid directly by most urban residents, and prices for many items are much lower than in other countries. Much of the food, housing, and services consumed by the rural population

is produced at home or by informal labor; thus it may not be captured by income or spending statistics.

The concept of purchasing power parity (PPP) is used to improve cross-country comparability of incomes (Chen, Gordon, and Yan). The World Bank's PPP estimate of China's gross domestic product (GDP) per capita for 1999 was \$3,940, much larger than the official estimate of \$840 and probably a more accurate reflection of Chinese purchasing power. As China develops, reforms its socialist welfare system, and becomes more integrated with the world economy, many of these distortions are becoming less serious as health care, housing, and other goods and services are marketized and subsidies are reduced or abandoned.

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Appendix table 1—China, basic economic statistics, 2000

Item	Unit	Number
Population ¹	Billion	1.27
Percent urban	Percent	36
Percent rural	Percent	64
Under age 14	Percent	23
Age 65 and over	Percent	7
Population, projected, 2010 ²	Billion	1.4
Population, projected, 2050 ²	Billion	1.5
Education level:		
Illiterate or semiliterate	Percent	7
Primary school (1-6 years)	Percent	36
Lower middle school (7-9 years)	Percent	34
High school (10-12 years)	Percent	11
College or vocational school	Percent	4
Labor force		
Urban	Million	712
Agriculture, forestry, fishing	Million	213
Rural	Million	6
Agriculture, forestry, fishing	Million	499
Agriculture, forestry, fishing	Million	328
Gross domestic product		
Per capita	Trillion dollars	1.07
Agricultural share	Dollars	856
Agricultural share	Percent	15
Total exports		
Billion dollars		249
Total imports		
Billion dollars		225
Exchange rate		
Yuan per dollar		8.28
Average annual salary per employed worker ³		
Dollars		1,143
Per capita income:		
Rural	Dollars	272
Urban	Dollars	758
Average annual food expenditures:		
Rural	Dollars	99
Urban	Dollars	237

¹ Does not include Hong Kong or Macao.

² U.S. Census Bureau projections.

³ Excludes farmers and self-employed.

Source: China National Bureau of Statistics, *China Statistical Abstract, 2001*.

Appendix table 2—China, basic agricultural statistics, 2000

Item	Unit	Number
Total land area	Million hectares	9,600
Cultivated land area ¹	Million hectares	130
Sown land area	Million hectares	156
Irrigated area	Million hectares	54
Usable grassland	Million hectares	313
Forest area	Million hectares	159
Inland water surface area	Million hectares	17
Value of output:		
Agriculture, forestry, and fishing	Billion dollars	301
Crops	Billion dollars	168
Livestock	Billion dollars	89
Forestry	Billion dollars	11
Fishing	Billion dollars	33
Crop production:		
Rice paddy	Million tons	188
Wheat	Million tons	100
Corn	Million tons	106
Beans	Million tons	20
Tubers	Million tons	37
Cotton	Million tons	4
Peanuts	Million tons	14
Rapeseed	Million tons	11
Sugar crops	Million tons	76
Tobacco	Million tons	26
Fruit	Million tons	62
Animal products output:		
Pork	Million tons	40
Beef	Million tons	5
Mutton	Million tons	3
Poultry and other meats	Million tons	13
Eggs	Million tons	23
Milk	Million tons	9
Wool	Thousand tons	293
Fresh water aquaculture	Million tons	17
Seafood	Million tons	25
Employment in agriculture, forestry, and fishing		
Million		334
Fertilizer use		
Million tons		41

¹ 1997.

Source: China National Bureau of Statistics, *China Statistical Yearbook, 2001*.

Appendix table 3—Value of China's major agricultural exports, 1995-2000

Item	1995	1996	1997	1998	1999	2000
	<i>Million dollars</i>					
Live animals	503	487	476	441	385	385
Swine	278	294	302	291	237	232
Poultry	125	121	114	96	99	104
Meat	1,021	1,086	963	839	692	754
Pork	245	215	195	180	67	69
Poultry	621	691	608	523	539	587
Fish and seafood	2,087	1,738	1,886	1,732	1,949	2,271
Dairy, eggs, and honey	162	195	165	175	164	188
Other animal products	711	678	699	648	622	757
Live trees and plants	28	30	32	29	31	32
Vegetables	1,713	1,542	1,510	1,474	1,521	1,545
Edible fruit and nuts	480	461	464	433	426	417
Citrus	60	67	76	48	42	47
Apples	45	69	77	65	76	97
Spices, coffee, and tea	465	492	547	520	491	506
Tea	275	283	332	370	339	347
Cereals	76	187	1,174	1,497	1,135	1,639
Corn	13	30	856	532	450	1,047
Rice	16	112	265	927	652	561
Milling products	101	218	186	106	80	93
Wheat flour	55	158	125	74	46	45
Oilseeds and miscellaneous grain	1,170	1,056	868	752	806	877
Soybeans	100	66	73	63	62	64
Peanuts	257	254	137	156	195	232
Lac, vegetable sap, extract	45	50	61	54	45	47
Other vegetables	61	52	50	45	40	43
Fats and oils	459	382	681	324	141	129
Prepared meat, fish	1,116	1,470	1,384	1,212	1,386	1,882
Sugar	234	305	194	183	140	173
Cocoa	41	49	56	44	40	29
Baking products, prepared	211	235	270	262	291	360
Preserved food	1,083	1,047	1,043	1,022	1,127	1,315
Miscellaneous food	216	251	303	327	337	359
Beverages	391	397	465	450	457	494
Beer	53	32	34	26	30	40
Food waste, animal feed	336	347	276	189	215	253
Tobacco	999	976	656	577	336	30
Fertilizers	130	207	212	156	230	323
Rubber	746	832	955	1,006	1,177	1,561
Hides and skins	395	295	355	366	361	544
Silk yarn and fabric	1,173	894	945	751	755	928
Animal hair yarn and fabric	773	819	993	759	965	1,202
Cotton yarn and fabric	3,850	3,158	3,116	2,810	3,292	3,730
Cotton, raw	47	12	3	56	283	305
Total	20,776	19,936	20,985	19,183	19,637	23,138

Source: China customs statistics.

Appendix table 4—Value of China's major agricultural imports, 1995-2000

Item	1995	1996	1997	1998	1999	2000
	<i>Million dollars</i>					
Live animals	37	47	41	54	66	52
Meat	95	157	148	143	499	637
Pork	1	1	2	8	24	58
Poultry	80	140	129	108	410	481
Fish and seafood	599	597	543	667	882	1,212
Dairy, eggs, and honey	64	57	67	89	164	218
Other animal products	72	95	114	98	112	158
Live trees and plants	6	5	8	11	17	21
Vegetables	78	77	74	71	83	82
Edible fruit and nuts	84	197	235	242	258	368
Bananas	42	141	146	163	140	169
Grapes	3	4	5	4	24	35
Spices, coffee, and tea	15	28	10	20	19	23
Coffee	6	17	3	11	8	6
Cereals	3,582	2,555	889	696	497	574
Wheat	2,026	1,890	368	279	86	147
Barley	241	304	382	241	294	313
Rice	434	286	138	120	78	113
Milling products	72	71	68	55	79	64
Wheat flour	10	14	16	15	17	15
Oilseeds and miscellaneous grain	187	412	989	1,344	1,639	3,072
Soybeans	75	320	843	804	890	2,270
Rapeseeds	26	0	16	402	628	658
Lac, vegetable sap, extract	27	21	21	19	29	34
Other vegetables	90	40	33	43	48	83
Fats and oils	2,623	1,695	1,653	1,487	1,359	1,023
Palm oil	865	527	603	592	597	456
Soybean oil	1,024	764	666	521	421	126
Rapeseed oil	413	187	197	175	38	28
Prepared meat, fish	12	8	8	6	12	12
Sugar	935	428	254	177	182	182
Cocoa	59	59	71	64	53	71
Baking products, prepared	23	17	16	15	48	71
Preserved food	15	16	18	24	43	60
Miscellaneous food	66	85	87	83	118	147
Beverages	37	42	68	75	123	161
Beer	4	18	14	21	63	93
Food waste, animal feed	420	1,298	1,785	1,402	619	907
Tobacco	259	457	254	106	88	204
Fertilizers	3,742	3,563	2,995	2,518	2,248	1,730
Rubber	985	1,432	1,245	1,115	1,469	1,906
Hides and skins	2,251	2,359	2,496	2,254	2,330	2,954
Silk yarn and fabric	176	157	176	139	124	138
Animal hair yarn and fabric	1,656	1,536	1,545	1,177	1,265	1,831
Cotton yarn and fabric	3,360	3,530	3,732	2,584	2,357	2,789
Cotton, raw	1,378	1,196	1,330	332	67	74
Total	23,005	22,237	20,973	17,110	16,897	20,858

Source: China customs statistics.

Appendix table 5—U.S. exports of agricultural, fish, and forestry products to China, 1995-2000

Item	1995	1996	1997	1998	1999	2000
	<i>Thousand dollars</i>					
Bulk agricultural total	2,026,726	1,588,091	1,047,396	500,375	441,741	1,105,858
Wheat	499,791	426,381	43,647	45,971	32,877	17,826
Coarse grains	638,278	13,842	31	44,143	15,441	10,050
Rice	63	471	202	289	406	344
Soybeans	50,657	414,476	410,554	273,508	358,735	1,007,653
Cotton	836,657	730,456	582,670	122,763	23,356	58,871
Tobacco	767	250	2,342	6,437	4,508	849
Pulses	123	31	43	131	194	227
Peanuts	6	0	3	14	0	181
Other bulk commodities	383	2,184	7,904	7,119	6,224	9,857
Intermediate agricultural total	539,756	384,658	432,132	708,150	262,980	402,184
Wheat flour	14	110	10	0	32	238
Soybean meal	76	116,700	84,429	159,541	304	20
Soybean oil	341,264	104,467	161,895	319,506	44,404	430
Vegetable oils (excluding soybean oil)	14,125	5,715	3,100	2,558	4,870	7,260
Feeds and fodders (excluding pet foods)	8,142	8,441	10,080	13,496	6,920	13,946
Live animals	9,364	6,402	6,858	4,686	5,251	6,696
Hides and skins	100,145	106,640	111,905	124,800	96,535	228,751
Animal fast	39,178	2,686	3,103	3,831	14,724	12,898
Planting seeds	10,671	2,837	8,174	10,236	12,802	26,862
Sugars, sweeteners, and beverage bases	931	1,142	1,394	1,142	951	2,925
Other intermediate products	15,846	29,518	41,184	68,354	76,187	102,158
Consumer-oriented agricultural total	67,156	106,214	125,250	131,521	149,807	216,117
Snack foods (excluding nuts)	7,432	6,986	11,991	8,549	14,020	20,781
Breakfast cereals and pancake mix	289	1,554	1,598	508	323	661
Red meats, fresh/chilled/frozen	4,674	5,488	11,257	15,278	15,192	22,215
Red meats, prepared/preserved	239	616	1,047	2,918	1,125	863
Poultry meat	33,892	60,345	52,413	38,474	49,477	45,363
Dairy products	5,111	4,560	11,296	13,908	17,744	21,453
Eggs and products	61	76	195	139	343	1,023
Fresh fruit	2,169	683	887	11,333	1,866	23,144
Fresh vegetables	297	1,428	2,728	3,751	3,657	5,172
Processed fruit and vegetables	1,695	4,686	6,780	9,321	15,833	25,811
Fruit and vegetable juices	826	514	711	1,490	1,734	1,210
Tree nuts	250	2,190	2,367	2,337	3,702	9,090
Wine and beer	2,998	1,958	3,158	2,404	3,826	1,420
Nursery products and cut flowers	90	175	1,804	1,029	1,358	1,119
Pet foods (dog and cat food)	124	183	133	490	977	1,454
Other consumer-oriented products	7,009	14,772	16,885	19,592	18,630	35,338
Forest products (excluding pulp and paper)	28,006	32,010	49,850	41,356	57,020	93,991
Logs and chips	13,915	11,041	13,890	11,336	7,870	19,280
Hardwood lumber	5,851	9,136	16,901	13,960	29,904	53,960
Softwood and treated lumber	358	627	1,737	1,318	1,213	2,332
Panel products (including plywood)	4,662	3,891	4,863	6,264	9,888	12,967
Other value-added wood products	3,220	7,316	12,459	8,478	8,145	5,452
Fish and seafood products, edible	71,632	78,587	111,486	69,284	86,498	137,917
Salmon, whole or eviscerated	4,297	3,182	2,513	9,735	8,234	16,300
Salmon, canned	0	0	0	0	102	684
Crab and crabmeat	4,823	5,979	3,187	4,996	20,230	11,208
Surime (fish paste)	1,110	1,061	7,165	2,738	431	3,223
Roe and urchin (fish eggs)	609	3,344	2,326	4,954	4,164	4,781
Other edible fish and seafood	60,794	65,021	96,294	46,860	53,337	101,721
Agricultural product total	2,633,638	2,078,963	1,604,778	1,340,046	854,528	1,724,159
Agricultural, fish, and forestry total	2,733,276	2,189,560	1,766,114	1,450,686	998,046	1,956,067

Source: U.S. Census Bureau trade data.

Appendix table 6—Basic statistics by province, 1999-2000

Region Province	Population 2000	Per capita income, 2000		Value agricultural output, 2000	Quantity produced, 1999				
		Urban	Rural		Wheat	Corn	Soybeans	Rice	Pork
	<i>Million</i>	<i>Yuan</i>	<i>Yuan</i>	<i>Billion yuan</i>	<i>Thousand tons</i>				
Northeast	106.6	5,064	3,593	220.2	3,595	39,064	5,494	17,648	2,996
Heilongjiang	36.9	4,913	3,713	62.5	2,842	12,284	4,466	9,443	871
Jilin	27.3	4,810	3,259	60.9	161	16,926	636	4,059	955
Liaoning	42.4	5,358	3,704	96.7	592	9,854	392	4,146	1,170
North	343.7	5,753	3,127	695.9	65,288	47,548	3,297	6,999	10,024
Beijing	13.8	10,350	5,516	19.5	955	867	20	129	291
Tianjin	10.0	8,141	4,649	15.6	716	563	27	402	173
Hebei	67.4	5,661	3,308	154.5	12,805	10,880	567	931	2,428
Henan	92.6	4,766	2,726	198.2	22,915	11,566	1,152	3,330	3,229
Shandong	90.8	6,490	3,881	229.4	21,177	15,514	969	1,313	2,859
Shanxi	33.0	4,724	2,424	32.2	2,665	3,754	269	33	435
Shaanxi	36.1	5,124	2,033	46.5	4,055	4,404	293	861	609
South Coast	266.9	8,541	4,485	613.9	12,003	3,748	1,221	57,209	6,368
Jiangsu	74.4	6,800	4,542	187.0	10,708	2,648	568	19,373	2,057
Shanghai	16.7	11,718	6,400	21.7	384	49	17	1,543	259
Zhejiang	46.8	9,279	4,542	106.3	723	168	234	11,325	898
Fujian	34.7	7,432	4,104	103.7	144	109	210	7,123	1,065
Guangdong	86.4	9,762	4,590	164.1	44	725	179	16,155	2,068
Hainan	7.9	5,358	2,841	31.2	0	49	13	1,690	21
South Central	463.3	5,744	2,709	807.6	21,063	23,488	3,129	114,798	19,290
Anhui	59.9	5,294	2,586	122.0	8,525	2,133	1,005	13,006	1,848
Hubei	60.3	5,525	3,008	112.6	3,047	2,041	437	16,856	1,935
Hunan	64.4	6,219	3,195	122.2	221	1,268	419	23,606	3,718
Jiangxi	41.4	5,104	2,834	76.0	96	75	237	16,193	1,435
Guizhou	35.3	5,122	1,947	41.3	1,076	3,348	181	4,577	1,048
Sichuan	83.3	5,894	2,830	141.3	5,430	6,400	292	16,878	4,191
Chongqing	30.9	6,276	2,595	41.3	1,058	1,912	68	5,318	1,321
Yunnan	42.9	6,325	2,247	68.1	1,584	4,595	139	5,517	1,726
Guangxi	44.9	5,834	2,649	82.9	26	1,716	351	12,847	2,068
West	82.1	5,245	2,607	151.4	11,931	14,238	1,105	1,835	1,429
Inner Mongolia	23.8	5,129	3,440	54.3	2,731	7,714	825	688	766
Gansu	25.6	4,916	1,958	32.3	3,203	2,552	125	55	389
Ningxia	5.6	4,912	2,820	7.8	782	1,076	42	657	88
Qinghai	5.2	5,170	2,000	5.7	594	22	0	0	70
Xinjiang	19.3	5,645	3,129	46.1	4,309	2,860	112	429	108
Tibet	2.6	7,426	1,732	5.1	312	14	1	6	8
Total	1,262.6	6,280	3,146	2,491.6	113,880	128,086	14,245	198,487	40,056

Note: Regional delineation by ERS. Regional per capita incomes are weighted averages obtained using provincial population as weights.

Source: Calculated by ERS using data from China National Bureau of Statistics, "Communique on Major Figures of the 2000 Population Census (No. 2)," *Abstract of the First Agricultural Census in China*, and *Rural Statistical Yearbook 2000*.