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The Future of China's Grain Market

Frederick W. Crook and W. Hunter Colby

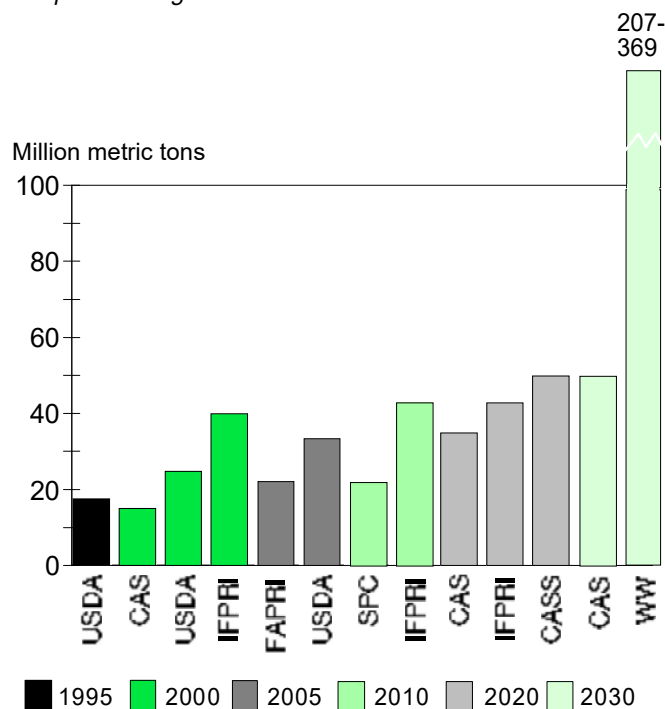
In this report...USDA's Economic Research Service projects that China's demand for grain will outpace domestic supplies in the next 10 years. By the year 2005, China will become a net importer of 32 million tons of grain. (All tons in this report refer to metric tons.) In the last two decades, China's trade with the rest of the world and the United States expanded dramatically. China has participated in international grain trade both as a buyer and as a seller. Since both China and the United States have large agricultural economies and both are major grain producers, a natural question is: in future decades how will the grain trade develop between these two economies? Will China's farmers be able to produce enough grain to keep pace with population increases and increased demand for feed grains to produce meat, eggs, and milk products for consumers?

A number of institutions in and outside of China have examined these questions and have produced a wide range of projections (fig. 1). For example, China's Academy of Science estimates that imports could reach 45 million tons. (USDA definition of grain includes wheat, rice (on a milled basis), corn, sorghum, millet, barley, and oats. This definition is referred to as (USDA definition) throughout the rest of this report.) The Worldwatch Institute projects that China's import needs by 2030 could reach from 207 million tons to 369 million tons (USDA definition).

As a major grain exporter, U.S. agriculture has a vital interest in the development of China's grain import demand. The following types of questions need to be addressed: To what extent can China's farmers increase grain production? What economic and policy constraints are they up against? As economic development occurs in China and incomes rise, will consumers demand more livestock products? How large could grain imports be? Will the government of China

be willing to rely more heavily on the world market for imports? This paper examines these issues and presents USDA's views on the future grain demand and supply situation in China out to the year 2005.

Figure 1
Estimates of China's future grain imports
Different projections show that China's grain imports will keep increasing in the future.



USDA = U.S. Department of Agriculture.
CAS = China's Academy of Science.
IFPRI = International Food Policy Research Institute.
FAPRI = Food and Agricultural Policy Research Institute.
SPC = China, State Planning Commission.
CASS = Chinese Academy of Social Science.
WWI = Worldwatch Institute.
Sources: (4, 7, 19, 20, 21, 24, 27, and 51).*

*Numbers in parentheses refer to sources listed in the References at the end of this report.

Overview

China's consumers in the coming decade will rely primarily on their own farmers for grain supplies. At the same time, grain self-sufficiency is likely to decrease from 95 to 91 percent and government authorities will obtain more supplies from international grain markets.

China's economy is expected to develop rapidly in the coming decade. From 1996 to 2000, the annual average growth rate is projected at 8.8 percent. The growth rate is expected to slow from 2001-2005 to 7.5 percent per year. Per capita incomes are expected to rise accordingly, which will drive consumer demand for wheat and livestock products, such as meat, eggs, and milk.

While livestock output is expected to expand, the demand for these products will outpace domestic supplies, highlighting requirements to import meat or feed grains.

With rising incomes, consumers are expected to eat less rice, corn, sorghum, and millet as food grain, which will leave more grain available for livestock feed. But demand for feed grains is projected to exceed domestic supplies.

China has more arable land per capita than its East Asian neighbors, but most of its land is already in production. Additional land can be brought into production only at high cost. Economic growth in the coming decade will reduce China's bank of cultivated land and we project that for this and economic reasons, area sown to grains will decline in the coming decade.

China's grain yields are relatively high by developing-country standards but by developed world standards China's grain yields have considerable potential to increase. Higher yields can be obtained by using high-yielding seed varieties, applying better balanced chemical fertilizers, and making more efficient use of irrigation water and pesticides.

USDA forecasts that grain production in China will increase in the coming decade primarily because of rising yields, but demand for grains will outpace supplies (fig. 2).

China has a long history of storing grain. Stocks have been held for decades when China both exported and

imported grains. We forecast that grain stocks will be reduced marginally through time and we expect that grain imports will continue in spite of large stock holding.

Rising grain imports will stretch China's grain-handling facilities. China's seaport cargo throughput more than tripled from 217 million tons in 1980 to 744 million tons in 1994. But the expansion of China's foreign trade also strained China's domestic railroad, highway, and port cargo-handling facilities. China plans to boost grain-handling facilities in the coming decade and we assume that this capacity will keep pace with rising grain imports.

In past decades, leaders aimed at near grain self-sufficiency (allowing imports to account for 0 to 5 percent of total consumption). China has since softened its position and currently leaders anticipate imported grain to account for 5 to 12 percent of total consumption (fig. 3). USDA projects that by 2005 China will import 32 million tons of grain (fig. 4).

Wheat—Wheat imports are projected to rise from 12 million tons in 1996/97 to 18.2 million tons in 2005/06 (32).

Corn—USDA assumes that China will use various kinds of policy measures to constrain corn imports but will allow corn imports to rise from 2 million tons in 1996/97 to 11.8 million tons in 2005/06.

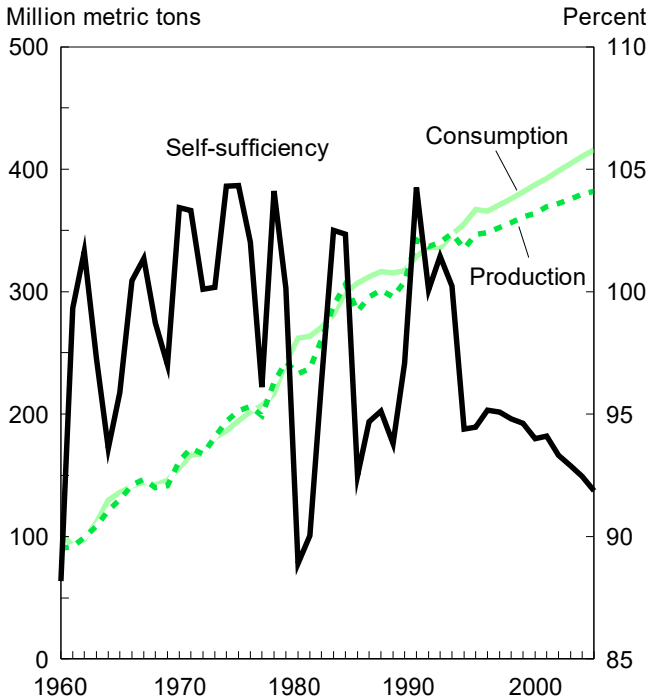
Rice—Rice imports are projected to rise slightly from 900,000 tons in 1996/97 to 1.1 million tons in 2005/06.

Meat—China is expected to become a net meat importer in 2000 and by 2005 net imports are projected to reach over 400,000 tons (fig. 5).

Figure 2

Grain production and consumption gap

China's grain production will increase in the coming decade.



Sources: (44 and 45).

Figure 3

Self-sufficiency in grains and meat

China's self-sufficiency in grains and meat will remain high.

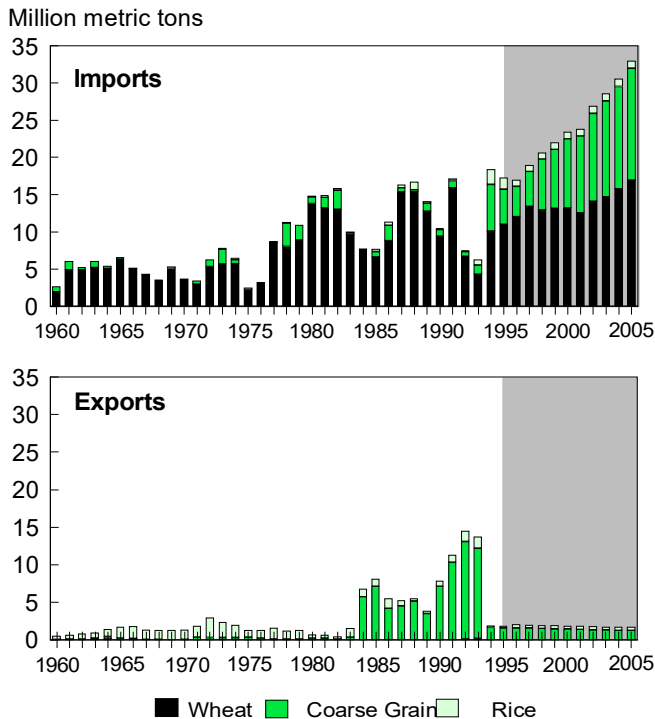


Sources: (44 and 45).

Figure 4

Grain import and export projections

By 2005, China will import 32 million tons of grain.

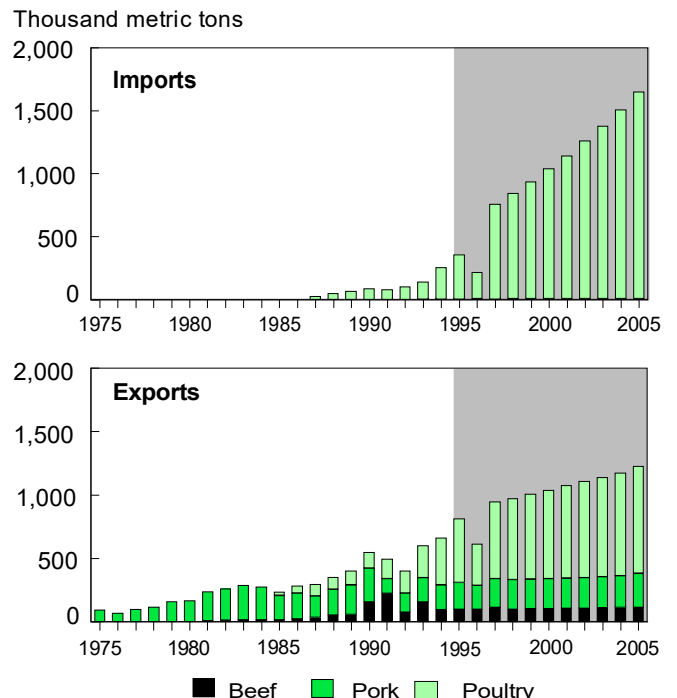


Sources: (44 and 45).

Figure 5

China's meat import projections

By 2005, net meat imports are projected to reach over 400,000 tons.



Sources: (44 and 45).

Implications for the United States

Rising grain demand in China will affect: a) China's domestic grain economy and its rural environment; b) the grain economies of grain exporting countries including the United States; and c) grain supplies in international markets for grain importing countries.

As a major grain producer and exporter, the United States has a vital interest in the projected increases for China's grain imports. Larger China grain imports likely will mean larger U.S. grain exports either to China directly or to other markets as China withdraws from markets and other suppliers begin to ship more grain to China.

The United States actively participated in China's grain trade since the early 1970's. The volume of U.S. grain exports to China, however, has been volatile, accounting for 0 percent of China's total grain imports in 1975 to a peak of over 9 million tons and 63 percent in the early 1980's (fig. 6).

In the early 1990's, China's rising corn exports made it the world's second-largest corn exporter after the United States. China's exports were partially responsible for a sharp decline in the U.S. share of the South Korean grain market in 1991-93.

But things changed dramatically in the last 2 years. Stocks-to-use ratios for grains are lower than they were in the early 1970's, with global grain consumption in 1995/96 projected to exceed output for the third year in a row. These developments occurred while China's grain prices were rising, leading its government to curb exports and expand imports starting in late 1994.

Since 1993, China has shifted from net exports of 7.5 million tons of grain to net imports of 15.5 million tons—a swing of 23 million tons, or about 10 percent of global grain trade (fig. 7). In 1985, the USSR imported more than 50 million tons of grain and world grain prices continued to fall. Previous swings in China's grain imports have been significant but only about half as large as the 1993-96 swing. In 1995, China accounted for 21 percent of world grain production (USDA definition).

China's temporary entry into the coarse grain market and subsequent withdrawal aided U.S. grain sales to

Asia. About 80 percent of the 24-million-ton gain in U.S. coarse grain exports in 1995 went to Asia.

Besides China, big gainers were Japan, South Korea, and Malaysia (fig. 8). Some of the gains were due to expanding markets, but most were due to a rising U.S. share as China withdrew from neighboring markets. U.S. coarse grain exports to China rose from 36,000 tons in 1994 to 5.4 million tons in 1995.

Exports to Japan in 1995 rose 32 percent (from 13.8 million tons in 1994 to 18.3 in 1995). Shipments to South Korea more than tripled from 2.4 million to almost 9 million tons in 1995 as China exported less and South Korea's compounders used more U.S. corn and less feed wheat.

U.S. sales of all farm products to China increased, from less than \$400 million in 1993 to over \$2.5 billion in 1995, reflecting the sharp ups and downs typical of U.S. agricultural trade with China over the past 15 years. Wheat and cotton are the main commodities in this trade. U.S. coarse grain exports to China were relatively minor until last year (fig. 9).

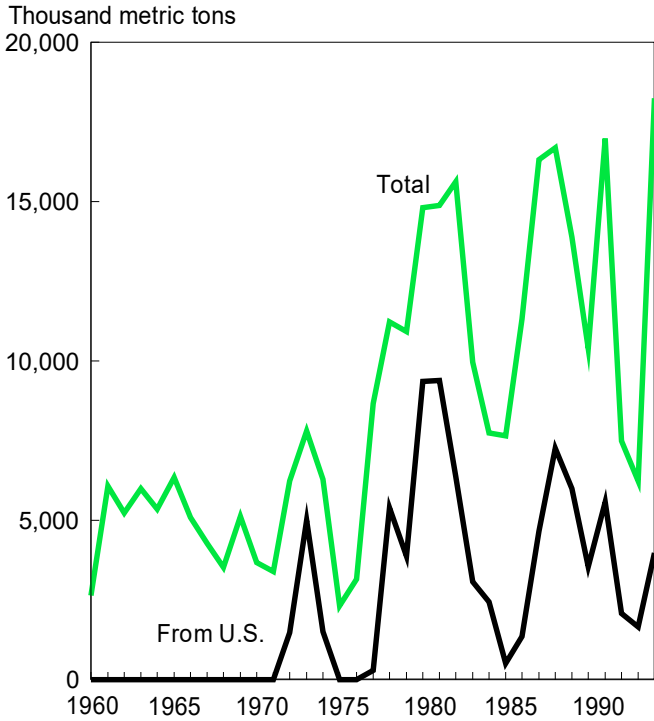
Increased domestic grain and animal production in China in the coming decades will have economic and environmental impacts on China's land, labor, and water resources. China's imports of grains and meats likely will spur production in supplying countries, including the United States, and this increased production will likewise have economic and environmental impacts.

USDA's definition of grain includes wheat, rice (on a milled basis), corn, sorghum, millet, barley, and oats. China's State Statistical Bureau (SSB) defines "grain crops" to include not only the USDA grains (with rice on a paddy basis), but also potatoes converted to their grain weight equivalent, soybeans, pulses, and other grains such as buckwheat. In 1995, China produced 465 million tons of grain crops according to the SSB definition but only 355 million tons according to USDA's definition.

Figure 6

China's grain imports and U.S. share

The volume of U.S. grain exports to China has been volatile.

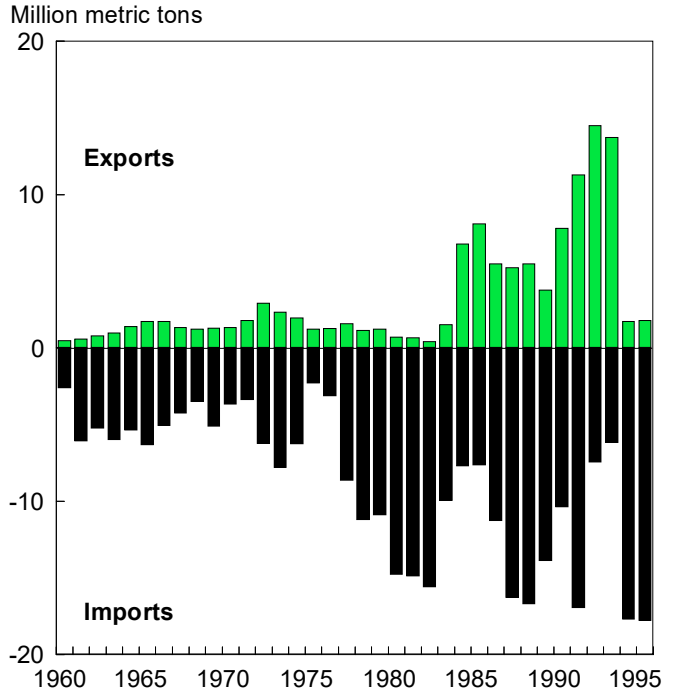


Sources: (45 and 46).

Figure 7

Switch from net grain exporter to importer

Since 1993, China shifted from net exports of 7.5 million tons of grain to net imports of 15.5 million tons.

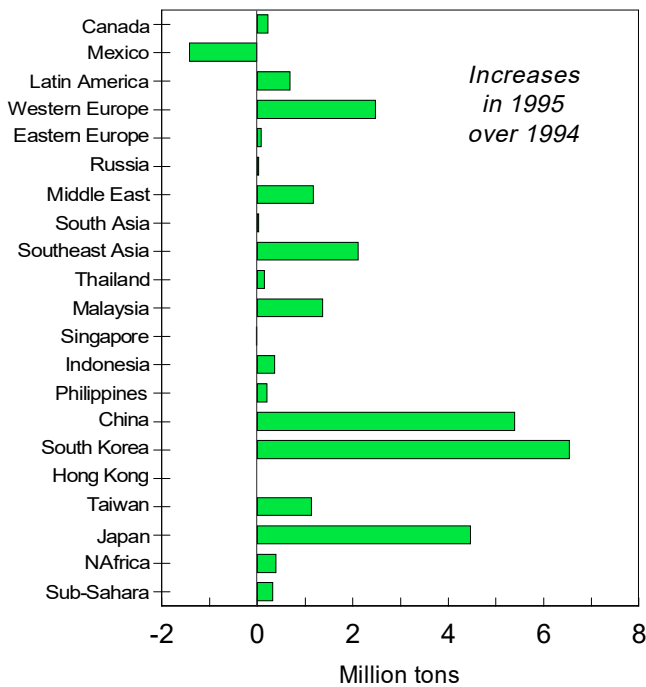


Sources: (45 and 46).

Figure 8

Big gains in U.S. feed grain sales

Besides China, big gainers included Japan, South Korea, and Malaysia.

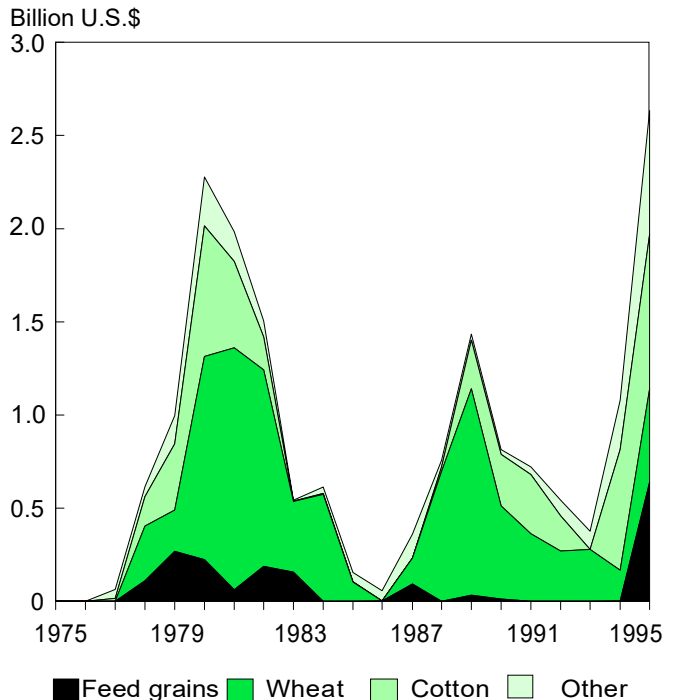


Source: (11).

Figure 9

U.S. agriculture exports to China

U.S. exports to China are primarily wheat and cotton. Exports of feed grains set a record in 1995.



Sources: (45 and 48).

Meat Consumption and Production Will Rise

China's farmers will increase production of feed grains and meat but the gap between demand and supply will widen. Feed grain and meat imports will increase to fill the gap, but government authorities will use trade restrictions to limit these imports.

Real per capita incomes rose rapidly since reforms began in the early 1980's. Real rural per capita incomes rose from 191 Renminbi (RMB) in 1980 to 465 RMB in 1995. Renminbi is China's currency and in 1995 the RMB to U.S. dollar exchange rate was 8.3 RMB to the dollar. Urban real per capita incomes rose from 439 RMB in 1980 to 984 RMB in 1995 (fig. 10). Growth in urban per capita incomes is more important for understanding the dynamics of feed grain and meat imports because most imported feed grains and meat are delivered to meet the demands of urban residents. China's urban population is expected to rise from 350 million in 1995 (29 percent of total population) to 500 million people in 2005 (35 percent).

Pork will remain the dominant meat, but government grain-saving policies will favor chickens, which are better grain-to-meat converters than hogs. Government authorities are currently focusing administrative energy and investments to expand poultry production as a grain-saving strategy. Also, we assume that authorities will support ruminant animal (beef and sheep) production because these animals can produce meat from forage grasses and hence conserve grain. As demand pressures for feed grains weigh ever more heavily on available supplies, we assume that government authorities will increase their emphasis on poultry and ruminant meat production (fig. 11).

Meat production is projected to increase 60 percent between 1995 and 2005, with production of beef, pork, and chicken increasing 92, 45, and 113 percent, respectively. Self-sufficiency will largely be maintained for meats, except in the case of poultry meat (mainly parts such as wings), imports of which will rise to more than 1.5 million tons by 2005 (fig. 12). Poultry meat exports are projected to rise to 800,000 tons by 2005.

The increase in demand for feed grain is driven by China's rapidly growing livestock sector, which in turn

is responding to China's growing appetite for meat. Meat consumption in China has risen rapidly from 13.4 kilograms (kg) per person in 1980 to 41.2 in 1995. In 1995, China's per capita consumption of red meat (beef, mutton, and pork) was about the same as Japan's and slightly higher than South Korea's, but much lower than Taiwan's (fig. 13). ERS projects China's meat consumption to rise from 37 kg per capita in 1996 to 61 kg in 2005, a 65-percent increase (fig. 11).

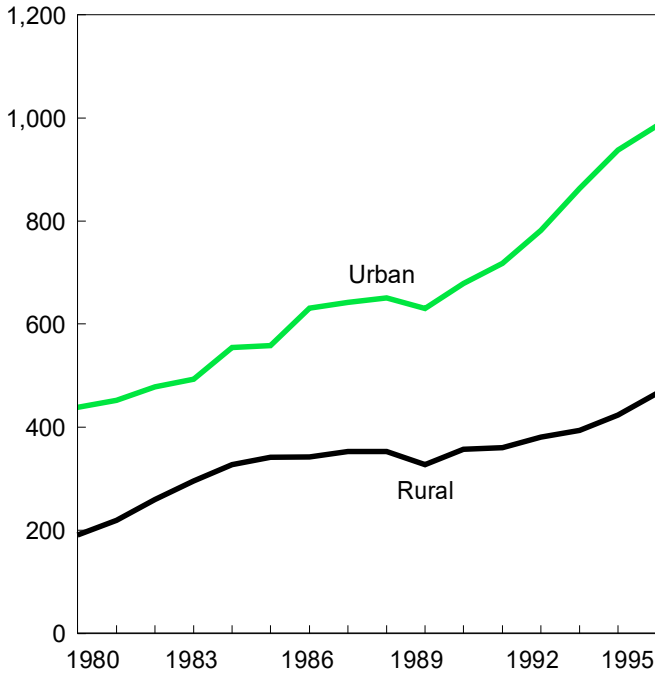
The meat consumption projections assume real GNP growth of about 8 percent per year in the next 10 years. The projections also assume that despite robust economic growth in the coming decade, disposable income available to urban residents for the purchase of food will not keep pace with income growth. Lower urban subsidies for rent, education, and food will constrain the growth in income for expenditures on meats.

China's leaders likely will constrain meat imports to levels that do not exceed 5 percent of domestic production and grain imports to levels that do not exceed 10 percent of production. Since 1949, China's leaders have managed imports with a bias toward importing capital goods and technology. They are likely to treat feed and meat imports in the future as luxury items (6). They are likely to use foreign trade control instruments like those used in Taiwan, South Korea, and Japan to restrict meat as well as feed grain imports. For example, in April 1996, China announced a new tariff rate quota system and tariff rates. The tariff rates on in-quota corn are low at 1 percent, but the tariff rate jumps to 114 percent for over-quota imports. These tariff rates suggest that China's authorities intend to use the quota system and tariff rates to constrain feed grain imports. The tariff rates on beef are 50 percent, pork 45 percent, mutton 45 percent, and poultry meat 45 percent.

Figure 10

Real rural and urban per capita incomes
Urban real per capita incomes increased from 439 RMB in 1980 to 984 RMB in 1995.

Constant 1980 RMB

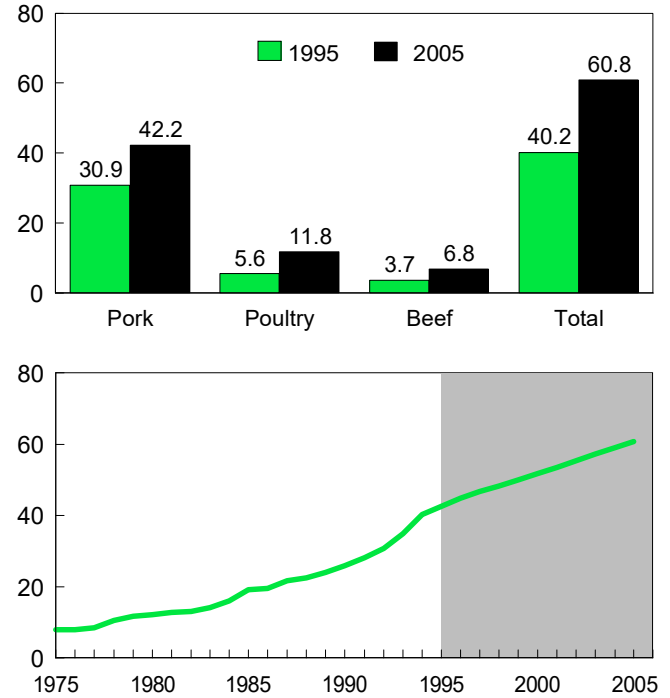


Source: (40).

Figure 11

China's per capita meat consumption
Per capita consumption for all meats is rising.

Kg per capita



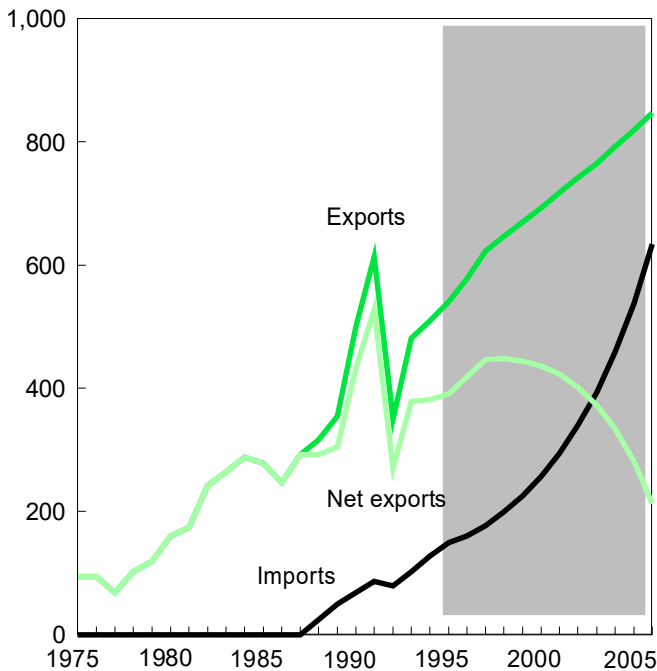
Sources: (45 and 46).

Figure 12

China's total meat trade projections

Meat production will continue to increase.

Thousand metric tons



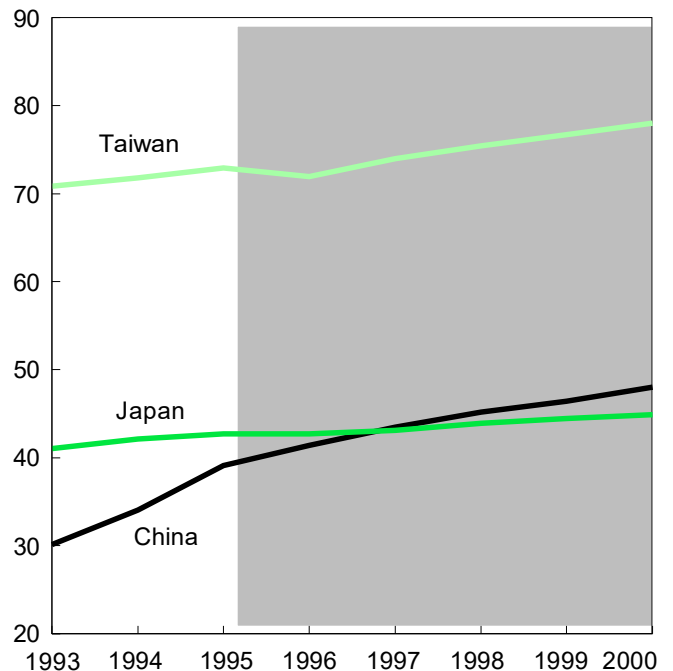
Sources: (44, 45, and 48).

Figure 13

Asia per capita meat consumption

China's per capita consumption of red meat was about the same as Japan's but much lower than Taiwan's.

Kg per capita



Source: (45).

Grain for Food Use Stable, Feed Use Rising

While total grain consumption will increase, per capita food grain consumption will decrease in the coming decade as consumers reduce direct consumption of grain and switch to meat, vegetables, fruits, and processed foods. Feed grain use, on the other hand, will expand.

Grain for food use is projected to increase by 0.7 percent per year between 1995 and 2005, well below the projected population increase, which means that per capita consumption of grains will decrease. Current sample survey results confirm that as incomes have risen, consumers have chosen to eat less grain and eat more fruits, vegetables, processed foods, and meat products (fig. 14). Urban per capita grain consumption, especially coarse grains and potatoes, has fallen since the mid-1980's.

Grain for feed use is projected to rise from 120 million tons in 1995 to 152 million in 2005. In the last decade, citizens shifted grain consumption preferences from potatoes, corn, sorghum, barley, and oats to wheat and rice. Low-quality rice in south China was fed to livestock. In the coming decade, farmers are projected to increase plantings of higher quality rice. Potatoes and

coarse grains for food use will continue to decrease and these grains will be fed to livestock (fig. 15).

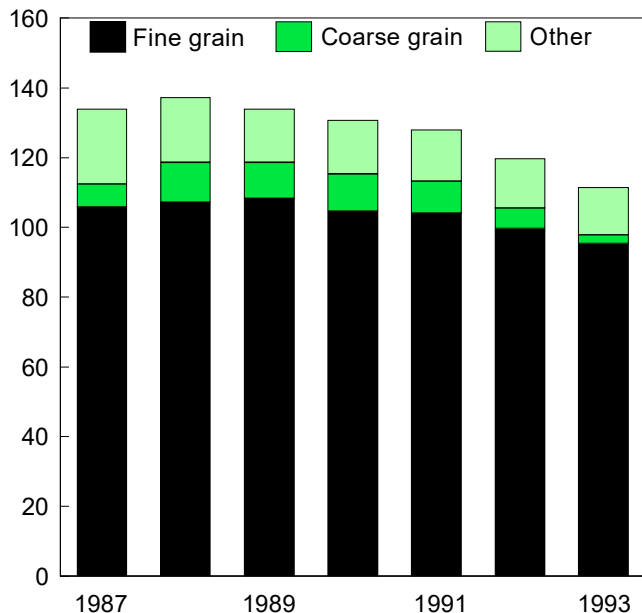
As grain supplies become tighter in the coming decade, government authorities likely will increase efforts already begun to conserve grain. Each year millions of tons of grain are lost during and after harvest. A large World Bank project has allocated funds to help China find ways to cut storage losses and improve the capacity to ship grains from surplus to deficit areas. Efforts are also underway to improve the efficiency of grain use in manufacturing alcohol, feed, milled grain products, and grain used in food processing. Government authorities already are concerned that about 30 million tons of grain each year are used to manufacture alcoholic beverages. Constraining output of alcoholic beverages would boost grain supplies for direct human consumption. Government research and policy need to be directed toward minimizing post-harvest losses so that more grain actually ends up in family rice bowls.

Figure 14

Urban per capita direct grain consumption

Urban per capita grain consumption has fallen since the mid-1980's.

Kg per capita



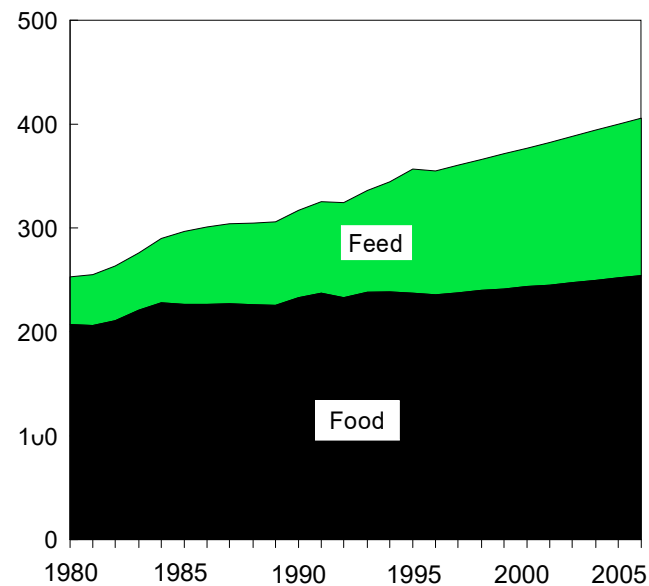
Source: (40).

Figure 15

Food and feed grain use

Food grain use stable, feed use rising.

Million metric tons



Sources: (44, 45, and 48).

Reports Suggest Large Grain Stocks in China

Over the past 2,000 years, governments in China have typically held large grain stocks. Large grain stocks are currently held by both government units, commercial companies, and mills, and by farmers. Government-controlled stock data are considered secret and it is very difficult to obtain information on the grain reserves. As economic reforms continue, these stocks likely will decline.

Current On-Farm Stocks Very Large

The irony of rising grain prices and grain imports in China is that current on-farm stocks in China are very large. ERS analysts estimate (using rural household surveys) on-farm stocks to have risen from 344 million tons in 1991 to 458 million in 1994 (fig. 16). About 40 percent of this grain, or about 183 million tons in 1994, was estimated to have been carried over; that is stocks in storage bins when new production was harvested and delivered to granaries. For 1991, ERS estimated that on-farm grain stocks were composed of 77 million tons of wheat, 130 million tons of paddy rice, and 137 million tons of other grains: corn, sorghum, barley, potatoes, and other grains (14).

Farmers store substantial quantities of grain as insurance against drought and other disasters. Stock levels

are highest in the north where the growing season is short and the probability of drought and early and late season frost is high (10).

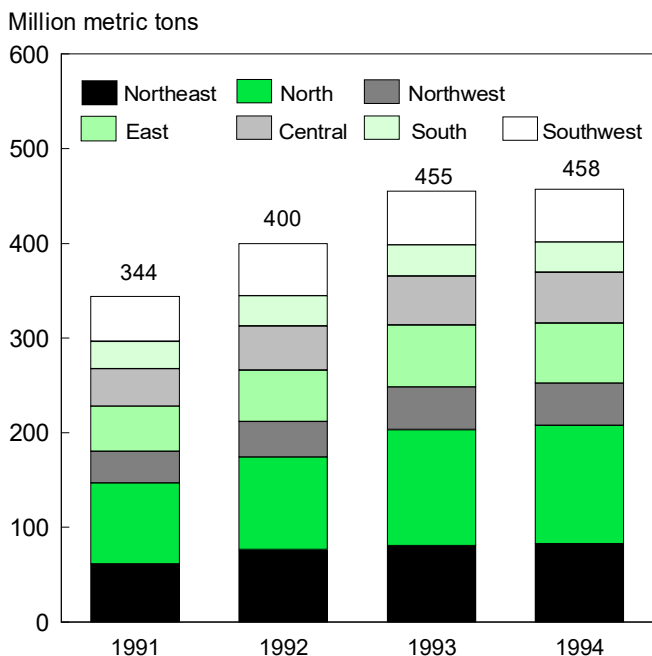
Public and Commercial Grain Stocks To Fall

Contemporary grain storage programs in China rest on more than 2,000 years of tradition. In periods of stability, it is China's historical norm to hold grain stocks. Since 1961, the government vigorously pursued a grain storage program. Off-farm stocks rose to a peak of 106 million tons in 1983 and then, as market reforms were instituted, off-farm stocks dropped to an estimated 72 million tons in 1995. Stocks-to-use ratios are expressed in percent on the right margin (fig. 17). Off-farm stocks include some commercial working stocks and strategic reserves held by the central government. The Food and Agriculture Organization of the United Nations has suggested that the average loss rate of stored grain in the world averages 8 to 10 percent, but in China the rate is from 12 to 18 percent.

Figure 16

On-farm grain stocks

On-farm stocks have risen by 33 percent from 1991 to 1994.

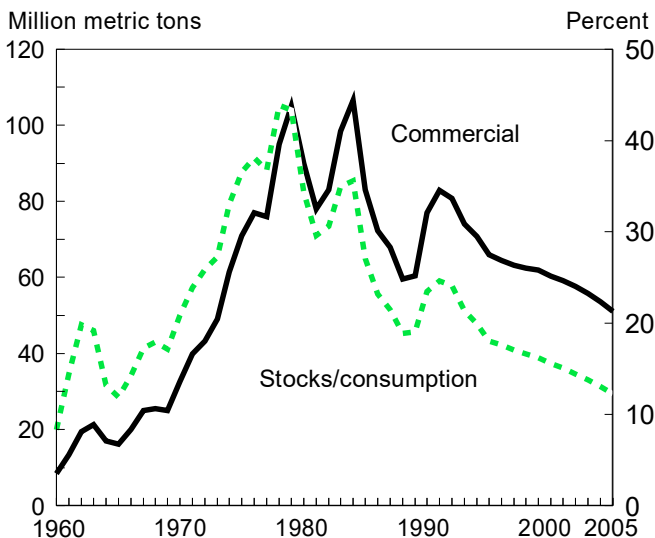


Sources: (15 and 41). Not official USDA data.

Figure 17

Government stocks

China's grain stocks forecast to decrease in next decade.



Sources: (45). USDA data and estimates.

Grain Area Expected To Decline

China is a relatively land-poor country but has 40 percent more arable land than is reported. Urban sprawl and infrastructure projects will take more land out of production than can be reclaimed. But increased intensity of land use will compensate for this loss so total sown area remains unchanged. Area sown to grains will decrease as farmers switch to more profitable crops such as fruits and vegetables.

According to official statistics, arable land area in China totals 95.3 million hectares, with 88 million hectares devoted to grain production in 1995 (USDA definition). While China's land area on a per capita basis is higher than its neighbors' (3.3 times more than Japan; 2.5 times more than South Korea; and 2.8 times more than Taiwan), compared with the United States, China is relatively land poor (fig. 18). Limited arable land and a large rural labor force mean that China will tend to have a comparative advantage in the production of labor-intensive (land-saving) crops such as fruits and vegetables and a disadvantage in the production of land-extensive crops such as grains and oilseeds.

There is controversy about the amount of arable land that actually exists in China today. A report published in 1992 notes that the actual amount of arable land more than 10 years ago was 44 percent greater than the 97 million hectares of arable land officially reported by China's State Statistical Bureau (SSB) (40 and 49) in that year (fig. 19). The 1997 census of agriculture in China will provide a basis for more reliable arable land estimates. China surely is losing arable land each year to urban development, road and rail construction, factory sites, dams, docks, bridges, and airfields. At the same time, new farmland is being reclaimed (49).

China's arable land in southern latitudes could be used more intensively year round. The ratio of sown area to cultivated area is currently 1.56, much higher than in Japan (1.03) and in Korea (1.14), and could be pushed higher to 1.6 by 2005.

From 1960 to the mid-1990's, the economies of Japan, Korea, and Taiwan grew very rapidly. Industrial growth boomed, infrastructural projects were constructed and agricultural economies were transformed. Rural laborers shifted from raising grain crops to raising other crops and livestock. These workers also

found employment in both rural and urban industries. On the basis of comparative advantage, these countries revamped their cropping patterns, decreased area sown to grain, and increased area sown to other crops—horticultural crops, flowers, fruits, and vegetables. Despite industrialization and the encroachment of factories, roads, railroad, docks, and airfields on agricultural land, the quantity of arable land declined only slightly (fig. 20).

As noted above, China is better endowed with arable land than its East Asian neighbors. Nonetheless, China likely will follow the central trend of its neighbors. Industrialization in the coming decades will not decrease China's stock of arable land very much. But total area sown to grains will fall because losses of arable land are expected to outpace reclamation. Some marginal land sown to grain crops will be returned to pasture and forest which will improve China's environmental land use balance. Farmers will switch some grain area to more profitable crops such as fruits and vegetables. Area sown to grain is expected to decrease from 87.4 million hectares in 1995 to 86.7 million hectares in 2005 (fig. 21).

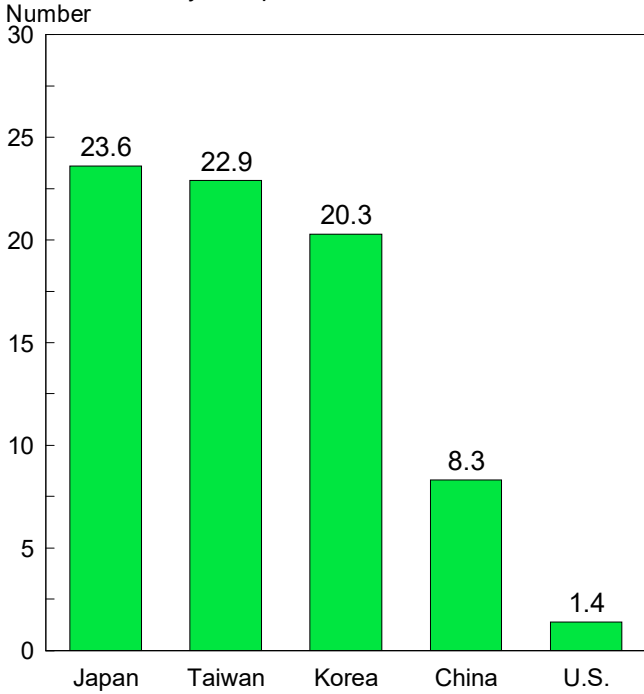
Farmers are projected to reduce area sown to rice crops from 31 million hectares in 1995 to 28 million hectares in 2005. Wheat area is projected to remain roughly constant at about 29 million hectares through 2005.

Demand for coarse grains (corn, sorghum, millet, barley, and oats) for feed use is expected to rise. Prices likely will rise, which will encourage farmers to expand from 28 million hectares in 1995 to 29 million in 2005, an annual increase rate of 0.2 percent. In 1994, the area sown to corn accounted for 80 percent of total coarse grain area. Corn area is projected to increase at 0.6 percent a year, faster than area for other coarse grains.

Figure 18

Persons per hectare of cultivated land

While China's land area on a per capita basis is higher than its neighbors; compared with the United States, China is relatively land poor.

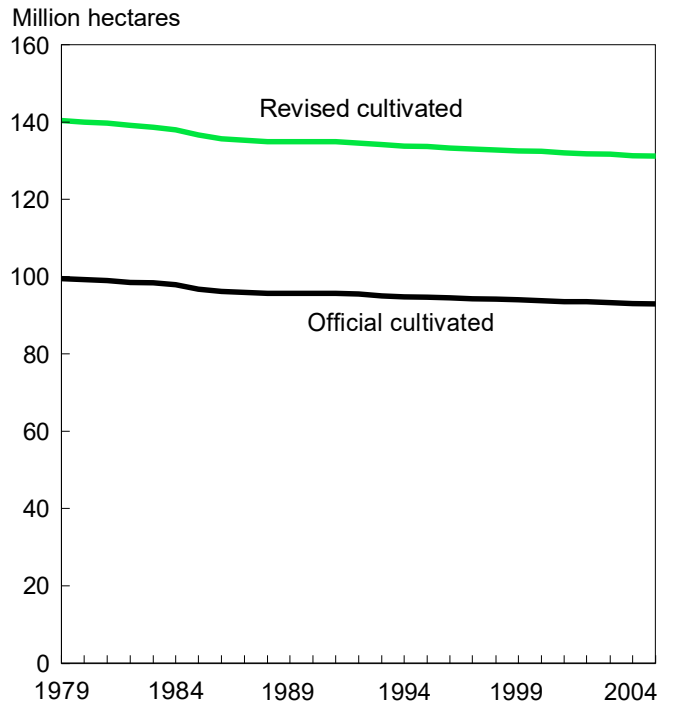


Source: (45).

Figure 19

Arable land in China

Amount of arable land in China is larger than reported.

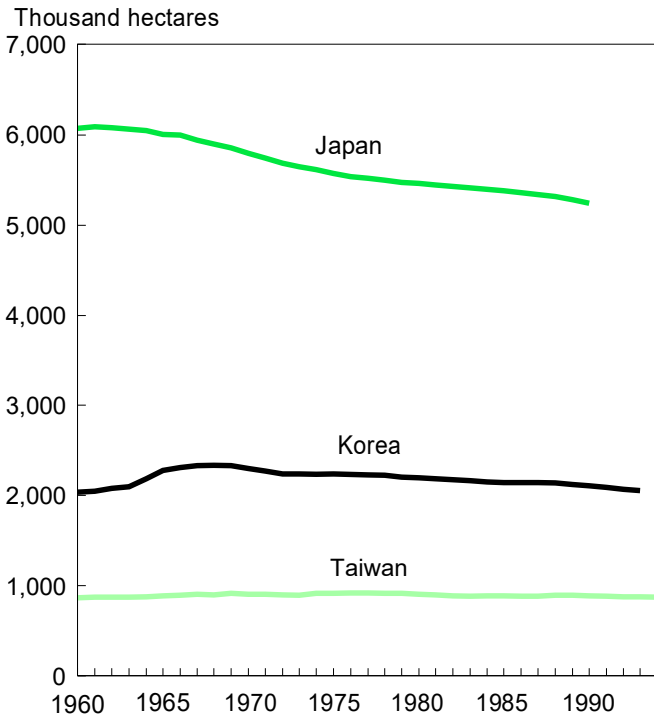


Sources: (40, 45, and 49).

Figure 20

Patterns of arable land use in East Asia

During rapid industrialization, arable land decreased slowly.

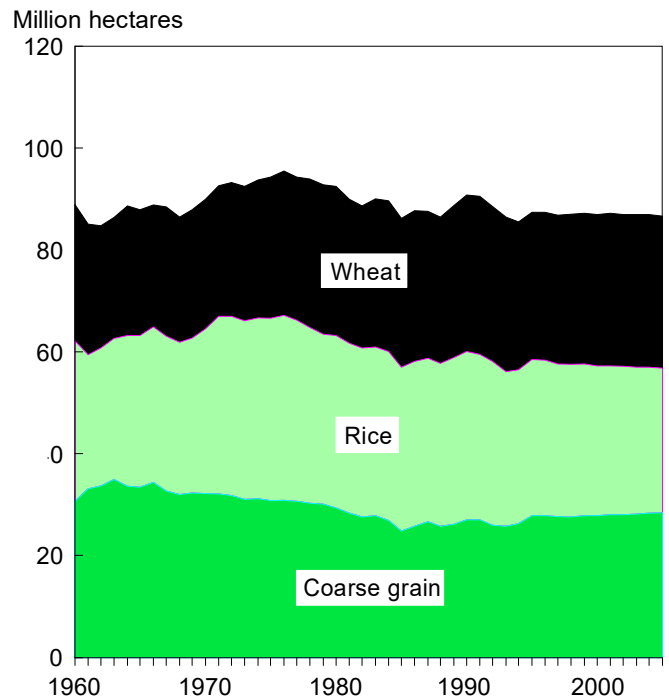


Source: (45).

Figure 21

Grain sown area projections

China's grain area to decline.



Sources: (44, 45, and 48)

China's Farmers Have Potential To Raise Yields

Underreporting of arable land has led to inflated grain yield estimates. With judicious investment in seed research, chemical fertilizer production, and water resources, grain yields can be increased.

While ERS does not provide an alternative set of grain area numbers to SSB data, it takes into account the implication of underreporting on the future growth potential of China's grain yields.

Underreporting of arable land in China has led to inflated estimates of grain yields and the appearance that China's yields are high by world standards. SSB statisticians have admitted that they have overstated grain yields to compensate for the underreported land area.¹ They rely on sample survey cuttings to determine actual yields, and then inflate them 20 to 30 percent.

Because of such underreporting, China's grain yields have ample room to increase above current levels (fig. 22). Higher yielding seeds, additional inputs (such as fertilizer and irrigation), and better pest management can help yields continue to rise.

Science and Technology

Government investment in agricultural research as a percent of total government expenditures dipped in the 1980's and early 1990's. In the ninth 5-year plan (1996-2000), however, government authorities have pledged to increase investment.

¹China's statistical officials focus most of their energy on estimating grain production. They know that cultivated area is underreported and adjust yields to more closely approximate actual grain production. Sample survey statistical workers adjust sample survey yields by using a verification coefficient (12).

$$\text{Verification coefficient} = \frac{\text{Verified area}}{\text{Farmer reported area}}$$

Cultivated land area data are controlled by local government authorities who have financial interest in land taxes and grain procurement quotas and not statistical officials. These tax and financial issues have put a strain on relations between central and local governments (local areas are better off financially if they pay less land taxes and show lower grain area so they won't have to sell more grain at low fixed quota prices). Authorities likely will not revise cultivated area data until the financial and tax issues are resolved (12 and 49).

Higher Yielding Seeds

China's leaders soon will be faced with three choices about higher yielding seeds: 1) increase investment to build up domestic seed-breeding capacity; 2) increase imports of high-yielding grain seeds; and 3) create a business environment in which domestic/foreign seed companies will invest in seed development. Hybrid corn and rice varieties currently account for about 80 and 50 percent of China's total corn and rice crop area, respectively. We assume that China's leaders will respond to seed development requirements and choose one or a combination of these options.

Fertilizer Use

Grain yields can be increased through fertilizer use in three ways. First, there is room to increase the quantity of fertilizers applied (fig. 23). Fertilizer usage remains low in many interior provinces. China's ninth 5-year plan calls for investment to expand and upgrade chemical fertilizer plants and the output target for 2000 is 28.4 million tons (nutrient weight basis)—up 16 percent.

Second, a less volatile form of nitrogen, like urea, can be used. Thirty percent of fertilizer applied in China now is ammonium bicarbonate, a volatile form of nitrogen, in which much of the nitrogen escapes into the atmosphere before it becomes available to crops.

Third, yields can be raised by applying a better mix of chemical fertilizers (N,P,K). On a nutrient weight basis, nitrogen (N) accounted for close to 75 percent of China's fertilizer production in 1994. Phosphorus (P) output has risen sharply in the last decade, but in 1994 it still accounted for only 23 percent of total output. Only small quantities of potassium (K) are produced (400,000 tons nutrient weight basis in 1994). In 1995, compound fertilizer imports surged dramatically, reaching a record 19.9 million tons (of which 4 million tons were potassium fertilizers—product weight basis). China plans to expand the production and use of phosphorus and potassium in compound fertilizers (fig. 24).

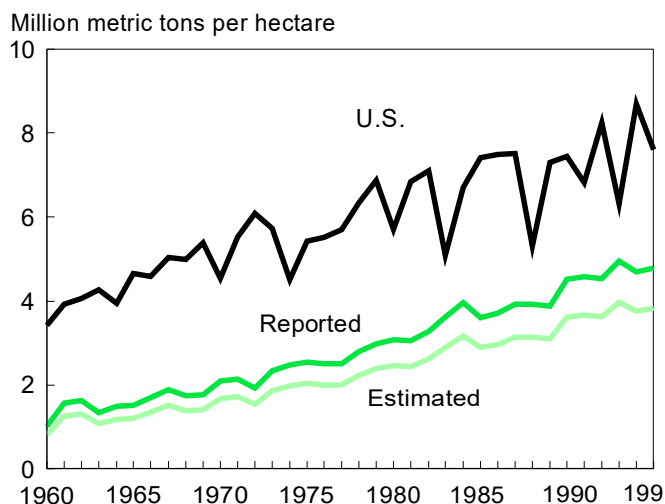
Water Resources

While central and south China have adequate water supplies, western and northern China have serious water deficits. The problem of water shortages in north China has been known for decades. Farmers expanded irrigated area in the North China Plain in the 1970's by drilling shallow tube wells and using pumps to provide irrigation water when summer rains failed to deliver the necessary moisture. Rainfall provides most of the moisture required for crops and farmers irrigate when rainfall is not timely. This added quantity of water and chemical fertilizer, however, enabled farmers to greatly boost grain yields in the 1970's and 1980's. We have assumed in our projection that water supplies in the North China Plain will hold out for the period under study—1996-2005.

Evidence of a falling water table in the North China Plain may spur government leaders to look for creative solutions. These could range from using concrete ditch liners for water conservation to charging water user fees as incentives for more efficient use of water resources. China has also considered diverting water from the Yangzi River to the North China Plain—a very large and expensive civil engineering project.

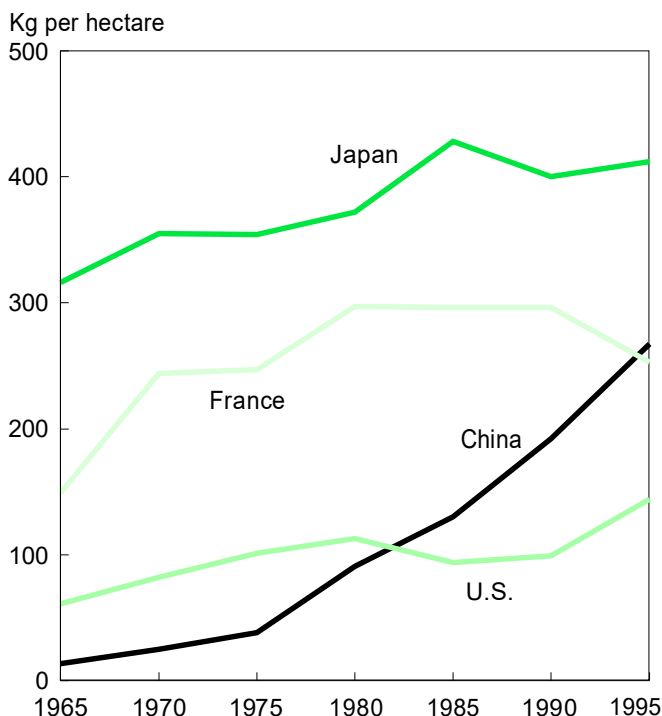
A separate but related problem—water quality—could be addressed by constructing sewage treatment facilities in rural and urban areas.

Figure 22
U.S. and China corn yields compared
China's grain yields have ample room to increase above current levels.



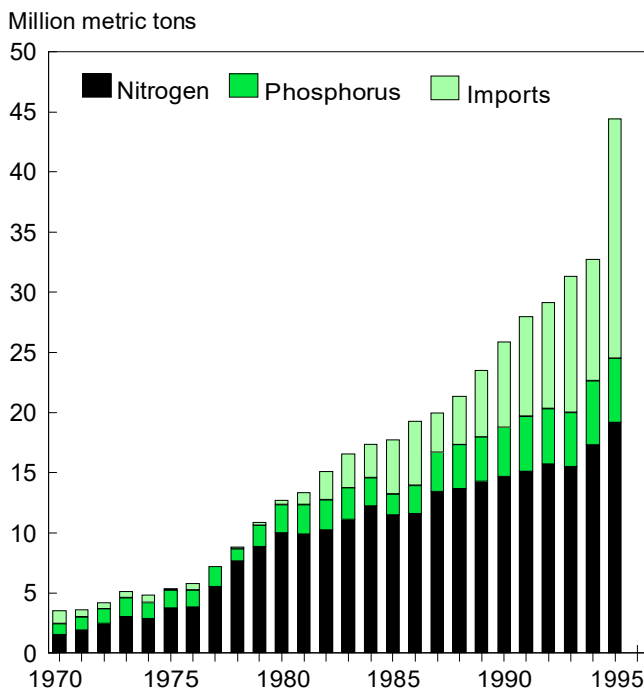
Source: (45).

Figure 23
China's fertilizer use
China's fertilizer use is below Japanese levels.



Sources: (40 and 46).

Figure 24
China's fertilizer production and imports
China's fertilizer production and imports have risen sharply from 1970.



Source: (40). Imported fertilizers include nitrogen, potassium, and compound ones which contain N,P,K and other elements.

China's Grain Yields and Production Will Rise

Wheat, rice, and corn yields are projected to rise in the coming decade. These yield increases will compensate for the decrease in area sown to grain crops so that total grain output is projected to increase 1 percent a year.

Based on projected investments in seed development, increased and better balanced fertilizer use, improved pest control programs, and more efficient use of irrigation water, grain yields are projected to rise at an annual average growth rate of 1.3 percent over the next 10 years (fig. 25). ERS projects total grain production in China to increase 1 percent a year, from 346 million tons in 1995 to 382 million tons by 2005 (fig. 26). China is currently the world's biggest grain producer, accounting for 20 percent of the global total.

China's wheat yields are relatively high by world standards because a significant amount of wheat area can be irrigated if water shortages develop. These yields are projected to annually increase by 0.7 percent to 2005. Rapid economic growth rates, rising incomes and changes in consumer preferences for quality wheat products, a projected population growth of 100 million people, and a projected increase of 150 million people in urban areas (from about 350 million in 1995 to 500 million in 2005 for the coming decade) will boost domestic demand for grain above supply (fig. 28). China's domestic wheat output is projected to rise about 1 percent a year (99 million tons in 1996 to 108 million tons in 2005).

Rice yields in coastal provinces are already comparatively high by world standards but yields in interior provinces have substantial potential to increase. Use of high-yielding varieties will slow as farmers plant higher quality (but lower yielding) rice varieties. Overall, rice yields are projected to increase slowly over the next decade at an annual average rate of 0.7 percent. Because of the drop in area sown to rice, rice production is projected to decrease slightly from 127 million tons (milled) in 1996 to 126 million in 2005. China likely will follow the general pattern of rice consumption as her East Asian neighbors—as incomes rise per capita rice consumption will hold steady or decrease (fig. 27).

Coarse grain yields other than corn are projected to increase modestly in the coming decade. But there is considerable room for seed breeders to develop high-yielding corn varieties for specific localities and for

farmers to boost yields by applying better balanced chemical fertilizers (fig. 22). Corn yields are projected to rise by 1.7 percent per year (from 4.76 tons per hectare in 1996 to 5.55 tons in 2005). With projected increases in area sown to corn and yield increases, corn output is projected to rise on an average annual rate of 2.3 percent (from 108 million tons in 1996 to 133 million tons in 2005).

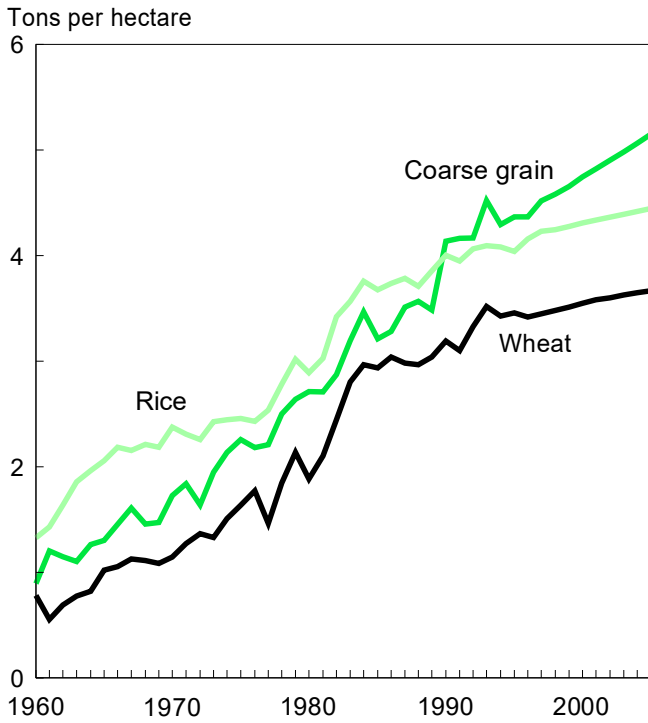
Assumptions Underlying USDA Projections

- Growth in grain yields depends on investment decisions and policy measures and commitment by the government. Low investment in agricultural research could lead to a slowdown in grain yield growth rates.
- The quantity of arable land at present is not certain. This will hopefully be resolved in the next few years after the 1997 census.
- Government intervention in grain markets and the fixing of procurement prices has an effect on grain production. These policies have been in flux, but we assume that current policies would continue, and that market forces would become increasingly important in decision making in the grain economy.
- A primary assumption made by USDA was that China's government would continue to control the imports of feed grains and meats. If this constraint is relaxed, grain and meat imports could be larger.
- USDA has been aware of the water shortages in the North China Plain for many decades. But for the period 1996 to 2005, we assume that water would be sufficient to allow for increases in grain output in that region of the country.
- USDA also assumes a stable political situation in China.

Figure 25

China's grain yield projections

China's grain yields to grow.

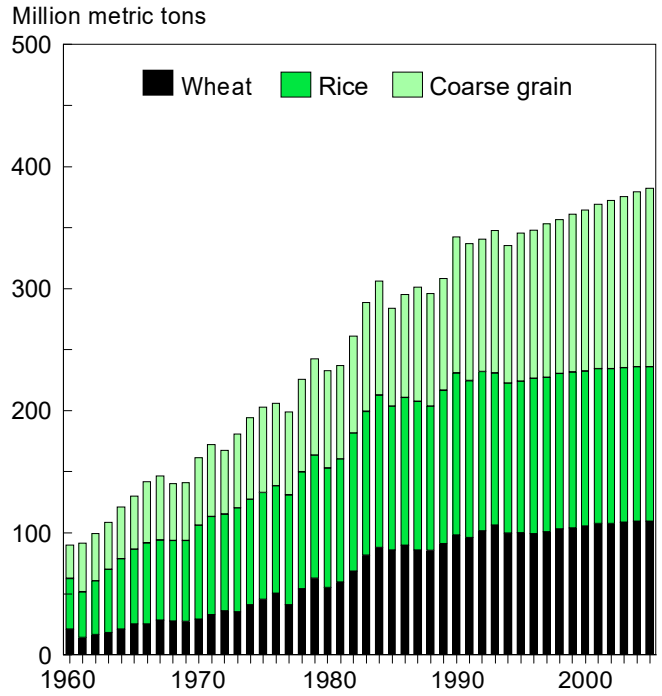


Sources: (45 and 48).

Figure 26

China's grain production projections

China's grain production is projected to rise 1 percent per year, 1996-2005.



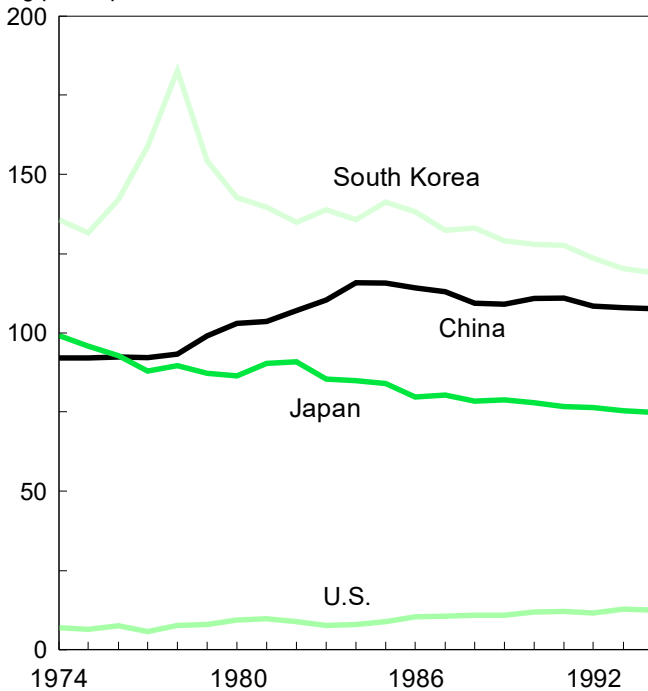
Sources: (45 and 48).

Figure 27

Per capita rice consumption comparison

Per capita rice consumption falling in South Korea, China, and Japan.

Kg per capita



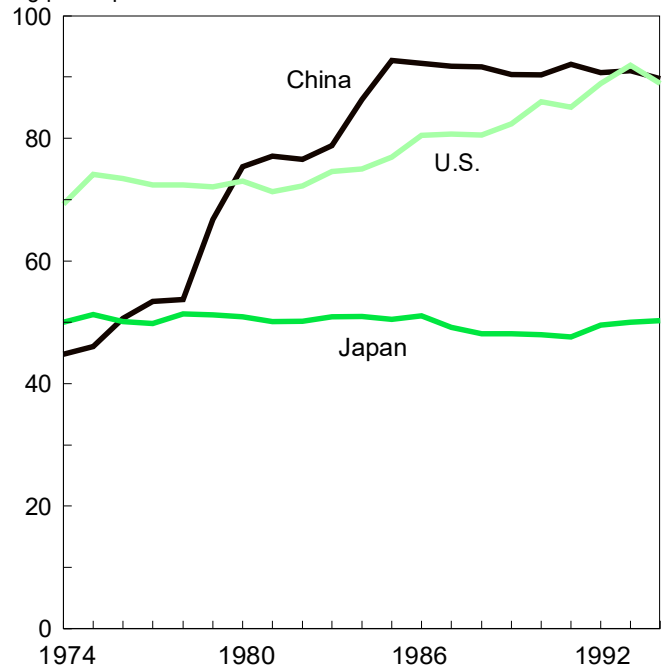
Sources: (45 and 48).

Figure 28

China's per capita nonfeed wheat consumption

China's per capita nonfeed wheat consumption parallels that for the United States.

Kg per capita



Sources: (45 and 47).

China's Imports Will Rise Steadily Despite Infrastructure Constraints

Investments in grain handling facilities in the past and coming decade will permit increased grain imports, which are projected to increase from 16 million tons in 1995 to 32 million by 2005.

Infrastructural Constraints to Grain Imports

Rapid economic growth since 1980 has put an enormous burden on China's ports and transportation systems (fig. 29). Over the coming decade, China will expand its overworked rail system and build a road system to link farms, factories, consumers, and ports. China has a large number of excellent seaports but much work will be required to expand the number and capacity of berths and improve efficiency of port operations (30) (fig. 30).

The World Bank estimates that China should invest \$300 billion in the coming decades to upgrade its transportation infrastructure. The World Bank currently has a \$490-million project to improve the grain-handling systems, elevators, and pneumatic loading, which will greatly aid China's grain imports. One should note that China's seaport cargo throughput more than tripled from 217 million tons in 1980 to 744 million tons in 1994 and by 2000 the target capacity will be 1 billion tons. Domestically, most grains are transported via highways and railroads (fig. 31). We assume that from 1995 to 2005 China's port, rail, and road infrastructure will improve to handle the additional forecasted 16.5 million tons of grain imports. Building new grain-handling facilities at China's ports will cost several billion dollars.

Steady Grain Importer

By most calculations, China will neither import huge volumes of grain nor return to being a large net exporter of grains as it was in 1992-93. Instead, it will gradually become a more significant importer of grains by 2005 and probably beyond. This forecast arises from the likelihood that demand for feed grains will accelerate faster than production increases, and that China's government policies will accommodate these changes. ERS projections are in line with forecasts made by a number of other institutions with the exception of one (fig. 1). Lester Brown of the Worldwatch Institute projects that by 2030 China will import 207 million tons assuming no change in livestock product

per capita consumption and decreasing grain output (5). If per capita livestock product increases, then he projects China will import 369 million tons by 2030.

There are mitigating factors that rule out such a large increase.

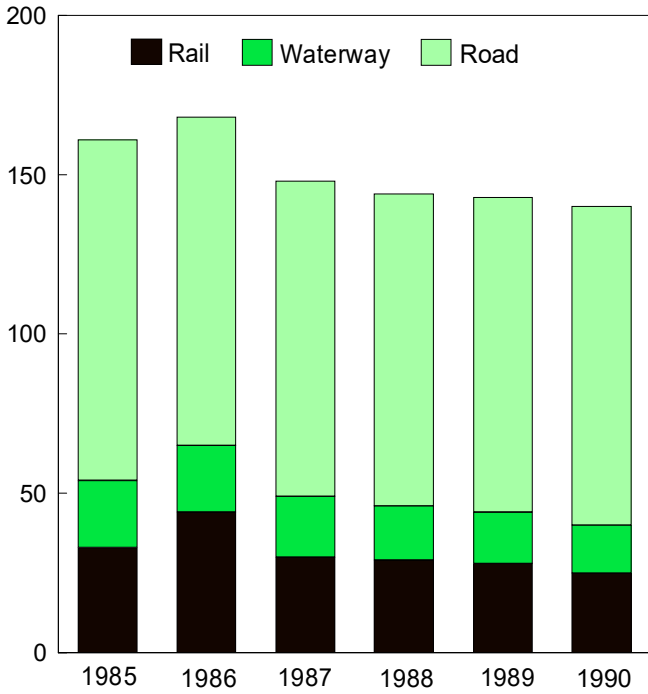
- Long-term projections need to take into account the self-correcting mechanisms in market economies. Grain shortages would lead to rising prices, stimulating production and reducing consumption, in China as in the rest of the world.
- China still can expand grain production. Because local authorities underreported cropland areas by an estimated 40 percent in the past, China's yield statistics have been overstated. The actual yields leave much room for future improvement through better management, higher yielding seeds, and greater use of inputs.
- Although China's meat demand will rise in the future, its growth will slow since it is already at a high level for a country at China's level of development. Per capita annual meat consumption (40 kg) is roughly on par with that of Korea (37 kg) and Japan (44 kg).
- Even supposing that China meets the requirements to become a member of the World Trade Organization, China's policymakers probably will restrain meat consumption, on the grounds of promoting domestic self-sufficiency and by claiming that meat is a luxury good (as in Korea and Japan). Such a policy would permit imports of feed grains but restrict imports of meats. This would keep meat prices inside China high and consumption relatively low.
- Limited grain handling capacity in China's ports will constrain the quantity of grain China can effectively import. Likewise limited container handling facilities and cold storage space will constrain the amount of chilled/frozen meat that can be imported.

Figure 29

China's freight handling capacity

China's capacity to handle freight increased.

Million metric tons



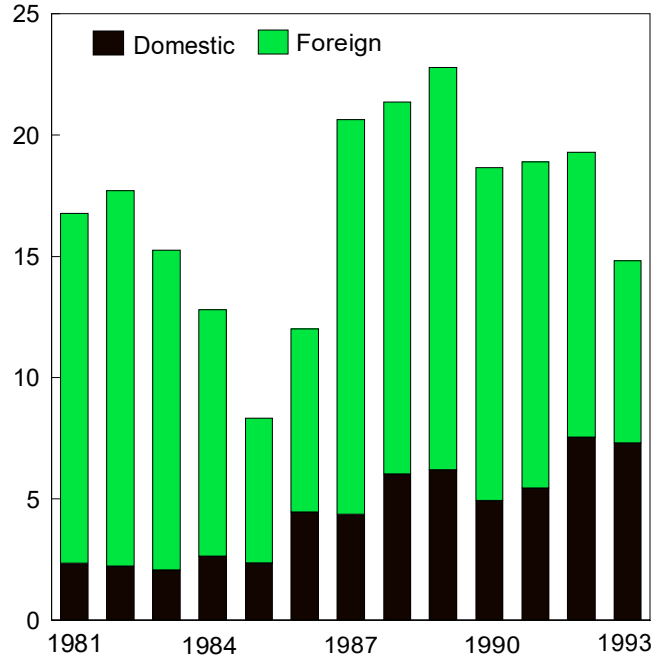
Source: (40)

Figure 30

Grain handled at China's ports

Coastal ports have handled large quantities of grain in past years.

Million metric tons

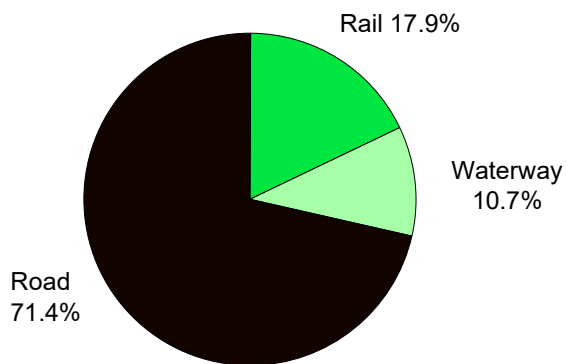


Source: (40)

Figure 31

China's grain distribution modes

Domestic grain transport is mainly by road and rail.



Source: (40)

References

An effort was made to list studies that contained material relevant to the central topic of the future of China's grain markets. In such a short work, it was impossible to reference all those who have contributed to this discussion. The list of references therefore serves two purposes. First, it guides readers to the source of specific data in the report. Second, it lists the works of other researchers so that interested readers can pursue questions further.

1. Alexandratos, Nikos. Chief, Global Perspective Studies Unit. "FAO's Cereals Projections to 2010 and Recent Developments: Response to Lester Brown." Food and Agriculture Organization, Rome, May 1996.
2. Alexandratos, Nikos (Editor). *World Agriculture: Towards 2010, An FAO Study*. J. Wiley and Sons, Chichester, UK, and New York, 1995.
3. Anderson, Kym, Betina Dimaranan, Tom Hertel, and Will Martin. "Asia-Pacific Food Markets and Trade in 2005: A Global, Economy-Wide Perspective." A paper commissioned for the International General Meeting of the Pacific Basin Economic Council, Washington, DC, May 20-22, 1996.
4. An Xi-Ji, Beijing Agricultural University. "2010 nian wo guo liang shi xu qiu yu gong ji qing kuang" ("Grain Demand and Supply Situation in China by 2010"), *Journal for Rural Sociology and Economy*, No. 2, 1995, Beijing, China.
5. Brown, Lester. *Who Will Feed China? Wake Up Call for a Small Planet?* Worldwatch Institute, Sept. 1995.
6. "China's Grain Outlook and Strategy," *Zhongguo Nongcun Jingji (China's Rural Economy)*, No. 8, August 20, 1995, pp. 3-18.
7. Chen Xi-Kang. Chinese Academy of Sciences. Paper presented at round table meeting convened by Rural Development Research Center (RDRC) and printed by RDRC. Summary of paper printed in *China's Rural Economy*, No. 8, 1995, Beijing, China.
8. Colby, W. Hunter, Frederick W. Crook, and Shwu-Eng Webb. *Agricultural Statistics of the People's Republic of China, 1949-1990*. SB-844, U.S. Dept. Agr., Econ. Res. Serv., December 1992.
9. Council of Agriculture, Statistics Office. *Agricultural Production Statistics Abstract*. Taiwan District, the Republic of China, 1994.
10. Crook, Frederick W. "China's Grain Stocks: Background and Analytical Issues," *China: Situation and Outlook Series*. WRS-96-3, U.S. Dept. Agr., Econ. Res. Serv., July 1996.
11. Crook, Frederick W., and Bill Coyle. "China's Rising Imports Will Not Cause Global Grain Shortage," *APEC Agriculture and Trade Report*. U.S. Dept. Agr., Econ. Res. Serv., May 1996.
12. Crook, Frederick W, and others (Robert Neenan, Peter Riley, and Paulette Sandene, U.S. Corn Team). "China Trip Report," Science and Technology Exchange Program between the U.S. Department of Agriculture and the Ministry of Agriculture, People's Republic of China, OICD, FAS, and ERS, USDA, Washington, DC, October 1994, 88 pages.
13. Crook, Frederick W. "Could China Starve the World? Comments on Lester Brown's Article," *Asia and Pacific Rim Agriculture and Trade Notes*. U.S. Dept. Agr., Econ. Res. Serv., September 1994, pp. 17-19.
14. _____. "An Examination of China's Grain Reserve System," a chapter in Andrew Watson and Christopher Findlay, editors, *Food Security and Economic Reform: The Challenges Facing China's Grain Marketing System*, forthcoming, Macmillan.
15. _____. "A View of Current Food Production Trends in China." Paper prepared for conference sponsored by Harvard University, Center for International Affairs, Ford Foundation/ Beijing and the Freeman Foundation, Feeding China: Today and Into the 21st Century, Cambridge, Massachusetts, March 1-2, 1996.
16. Crosson, Pierre. "Perspectives on the Long-Term Global Food Situation," Issue Number 2, Spring 1996, Federation of American Scientists, 307 Massachusetts Avenue, NE, Washington, DC 20002.
17. Garnaut, Ross, and Ma Guo-nan. *Grain in China*. East Asia Analytical Unit, Department of Foreign Affairs and Trade, Canberra, Australia, 1992.
18. Holloway, Nigel. "No Pain, No Grain," *Far Eastern Economic Review*, November 16, 1995.
19. Hu An-Gang. Chinese Academy of Social Sciences. Paper presented at round table meeting convened by Rural Development Research Center (RDRC) and printed by RDRC. Summary of paper printed in *China's Rural Economy*, No. 8, 1995, Beijing, China.
20. Huang Ji-Kun, Scott Rozelle, and Mark W. Rosegrant. "China's Food Economy to the 21st Century: Supply, Demand, and Trade." IFPRI's 2020 discussion paper. International Food Policy Research Institute, Washington, DC. 1995.

21. Huang Ji-Kun, Scott Rozelle, and Mark W. Rosegrant. "China and the Global Food Situation," IFPRI 2020 Brief 20, Washington, DC, May 1995.
22. Johnson, D. Gale. "China's Future Food Supply: Will China Starve the World?" April 1995.
23. Johnson, D. Gale. "Is Agriculture a Threat to China's Growth?" Paper presented for Conference on China: Growth and Inflation, May 1995.
24. Ke Bing-Sheng. "Food and Agricultural Outlook for Mainland China," China Agricultural University, paper presented at Forum on Food and Agriculture of PECC, XI Conference, September 1995.
25. Ke Bing-Sheng. "Grain Production in China: Current Trends, Potentials and Policy Options," China Agricultural University. Paper prepared for Harvard University, Feeding China: Today and Into the 21st Century, March 1-2, 1996.
26. Ma Xiao-He. State Planning Commission. Paper presented at round table meeting convened by Rural Development Research Center (RDRC) and printed by RDRC. Summary of paper printed in China's Rural Economy, No. 8, 1995, Beijing, China.
27. Mei Fang-Quan. Chinese Academy of Agricultural Sciences. Paper presented at round table meeting convened by Rural Development Research Center (RDRC) and printed by RDRC. Summary of paper printed in China's Rural Economy, No. 8, 1995, Beijing, China.
28. Ministry of Agriculture. *Zhongguo Nongye Fazhan Baogao, 1995 (China Agricultural Development Report, 1995)*, Zhongguo Nongye Chubanshe, Beijing, August 1995.
29. Naisbitt, John. *Global Paradox*. Avon Books, New York, 1994.
30. Nyberg, Albert J., Senior Agricultural Economist, World Bank. "Moving China's Grain: Is Infrastructure Adequate?" *Agricultural Outlook*, U.S. Dept. Agr., Econ. Res. Serv., April 1996, pp. 22-24.
31. Paarlberg, Robert L. "Feeding China: A Confident View." Paper for New York Council on Foreign Relations, April 1995.
32. Paarlberg, Robert L. "Rice Bowls and Dust Bowls: Africa, Not China, Faces a Food Crisis," *Foreign Affairs*, Volume 75, No. 3.
33. The Research Institute of Development Assistance (RIDA), The Overseas Economic Cooperation Fund (OECF), *Prospects for Grain Supply-Demand Balance and Agricultural Development Policy*. Tokyo, Japan, September 1995.
34. Republic of Korea, Economic Planning Board. *Korea Statistical Yearbook*, various issues.
35. Republic of Korea, Ministry of Agriculture and Forestry. *Yearbook of Agriculture and Forestry Statistics*, 1967.
36. Rozelle, Scott, Huang Jikun, and Mark W. Rosegrant. "Why China Will Not Starve the World," *Choices*, first quarter, 1996.
37. Smil, Vaclav. "Is There Enough Chinese Food?" *New York Review of Books*, 1996.
38. Smil, Vaclav. "Who Will Feed China?" *The China Quarterly*, No. 143, September 1995.
39. Statistics Bureau, Management and Coordination Agency. *Japan Statistical Yearbook*, annual issues from 1963 to 1991, "Area of Operating Land, Expansion and Dilapidation of Cultivated Land by Prefectures," and "Planted Area and Production of Rice by Prefectures."
40. State Statistical Bureau. *1995 Statistical Yearbook*. Beijing, Zhongguo Tongji Chubanshe (China Statistical Publishing House), August 1995.
41. SSB, *Zhongguo Nongcun Juhu Diaocha Nianjian (China's Rural Household Survey Yearbook, 1992)*. Beijing, Zhongguo Tongji Chubanshe, January 1993.
42. Taiwan Provincial Government, Dept. of Agriculture and Forestry. *Taiwan Agricultural Yearbook*, 1995.
43. Tanzer, Andrew. "China's Ravenous Appetite," *Forbes*, December 18, 1995.
44. U.S. Department of Agriculture, Interagency Agricultural Projections Committee. *Long-term Agricultural Projections to 2005*. World Agricultural Outlook Board, Staff Report WAOB-96-1, February 1996.
45. U.S. Department of Agriculture, Economic Research Service, Commercial Agriculture Division, Asia and Western Hemisphere Branch. China Data Base, 1960-1996 and Long-term Projections to 2005.
46. U.S. Department of Agriculture, Economic Research Service. *World Agricultural Trends and Indicators, 1970-1991*. SB-861, November 1993.

47. U.S. Department of Agriculture, Economic Research Service. *Wheat Yearbook*. WHS-1996, February 1996.
48. U.S. Department of Agriculture, Economic Research Service. Long-term Projections for International Agriculture to 2005. 1996.
49. Wang Tong, Team Leader, and others. *Zhongguo Gengdi Dijian Wenti de Shuliang Jingji Fenxi (An Economic Analysis of the Progressive Decrease in the Quantity of China's Cultivated Land)*, Beijing, Jingji Kexue Chubanshe (Economic & Science Publishing House), May 1992.
50. World Bank estimates.
51. Wu Shou. Ministry of Internal Trade. Paper presented at round table meeting convened by Rural Development Research Center (RDRC) and printed by RDRC. Summary of paper printed in *China's Rural Economy*, No. 8, 1995, Beijing, China.

Appendix table 1—Key assumptions*

Assumptions	Units	1989-91	1994-96	2000	2005
Macroeconomic assumptions:					
Population	Millions	1,151	1,215	1,270	1,315
Population growth	Percent	1.29	1.02	0.78	0.65
GDP growth rate	Percent	7.7	9.4	8.4	7.4
Land use assumptions:					
Arable land	1,000 ha.	95,868	94,423	93,837	92,997
Sown area	1,000 ha.	148,168	148,298	148,670	149,214
Multiple cropping ratio	Percent	154.8	156.5	158.4	160.4

*Not official USDA data; data from various Chinese sources and/or estimated by ERS analysts.

Appendix table 2—Key grain data*

Grain	Units	1989-91	1994-96	2000	2005
Wheat:					
Area	1,000 ha.	30,514	29,160	29,041	29,035
Yield	mt/ha.	3.17	3.41	3.51	3.61
Production	1,000 tons	96,619	99,493	101,910	104,765
Consumption	1,000 tons	107,403	111,677	117,393	125,799
Per capita consumption	kilograms	90.3	89.3	89.6	92.6
Imports	1,000 tons	12,690	11,033	15,100	18,200
Exports	1,000 tons	0	0	0	0
Rice:					
Area	1,000 ha.	32,785	30,405	28,821	27,757
Yield	mt/ha.	3.9	4.1	4.2	4.35
Production	1,000 tons	129,898	125,172	121,593	120,716
Consumption	1,000 tons	126,070	128,479	129,479	129,306
Per capita consumption	kilograms	110.4	105.7	102.0	98.4
Imports	1,000 tons	72	1,142	1,000	1,100
Exports	1,000 tons	649	282	400	400
Coarse grain:					
Imports	1,000 tons	980	4.26	8,900	14,300
Exports	1,000 tons	6,970	820	1,400	1,200
Corn:					
Area	1,000 ha.	21,100	22,184	22,140	23,218
Yield	mt/ha.	4.37	4.74	5.06	5.47
Production	1,000 tons	92,340	105,109	113,457	127,029
Consumption	1,000 tons	79,862	105,860	123,227	143,403
Per capita consumption	kilograms	69.4	87.1	97.0	109.1
Food use	1,000 tons	25,556	24,860	22,133	21,478
Feed use	1,000 tons	53,306	81,000	101,093	121,925
Imports	1,000 tons	147	2,933	6,500	11,800
Exports	1,000 tons	6,646	1,500	1,300	1,100
Barley:					
Imports	1,000 tons	835	1,450	2,000	2,100

*Not official USDA data; data from various Chinese sources and/or estimated by ERS analysts.

Appendix table 3—Key livestock data*

Item	Units	1989-91	1994-96	2000	2005
Beef :					
Production	1,000 tons	1,531	5,003	6,983	9,031
Consumption	1,000 tons	1,381	4,908	6,883	8,922
Per capita consumption	kilograms	1.2	4.0	5.8	7.7
Imports	1,000 tons	0	5	6	6
Exports	1,000 tons	150	100	107	115
Pork :					
Production	1,000 tons	24,561	38,907	46,898	55,576
Consumption	1,000 tons	24,355	38,697	46,662	55,325
Per capita consumption	kilograms	21.1	31.8	36.7	42.1
Imports	1,000 tons	0	0	0	0
Exports	1,000 tons	207	211	236	251
Poultry:					
Production	1,000 tons	3,907	7,778	11,347	15,281
Consumption	1,000 tons	3,854	7,663	11,265	15,441
Per capita consumption	kilograms	3.3	6.3	8.9	11.7
Imports	1,000 tons	77	157	288	628
Exports	1,000 tons	130	270	370	468
Lamb/mutton:					
Production	1,000 tons	1,166	1,705	2,141	2,603
Consumption	1,000 tons	1,162	1,684	2,115	2,577
Per capita consumption	kilograms	1.0	1.4	1.7	2.0
Imports	1,000 tons	0	0	0	0
Exports	1,000 tons	3	23	26	26

*Not official USDA data; data from various Chinese sources and/or estimated by ERS analysts.

Appendix table 4—China's State Statistical Bureau (SSB) and cultivated land survey data for 1985¹

Regional/Province	Total land area	Cultivated land area by survey	Cultivated land area according to SSB	Percent of survey over SSB data
		(1)	(2)	(1-2)/2 x 100
1,000 hectares				
Northwest	79,043	21,229	16,516	29
Heilongjiang	45,436	11,360	8,930	27
Liaoning	14,683	4,507	3,586	26
Jilin	18,924	5,362	3,999	34
North	69,648	32,890	25,303	30
Shandong	15,781	9,137	7,038	30
Hebei	18,827	7,511	6,603	14
Beijing	1,639	531	421	26
Tianjin	1,181	617	447	38
Henan	16,566	8,955	7,033	27
Shanxi	15,653	6,139	3,761	63
Northwest	418,681	25,069	16,464	52
Shaanxi	20,581	5,594	3,627	54
Gansu	40,556	5,880	3,491	68
Nei Monggol	114,333	6,834	4,930	39
Ningxia	5,180	1,836	795	131
Xinjiang	166,312	4,063	3,083	32
Qinghai	71,719	883	538	64
East	35,783	14,596	11,142	31
Zhejiang	10,496	2,618	1,777	47
Jiangsu	10,505	5,483	4,604	19
Shanghai	764	388	340	14
Anhui	14,017	6,106	4,422	38
Central	56,473	12,186	9,295	31
Hubei	18,595	4,437	3,585	24
Hunan	21,183	4,988	3,342	49
Jiangxi	16,695	2,761	2,369	17
South	57,174	11,482	6,859	67
Guangdong	21,303	5,493	3,035	81
Guangxi	23,641	4,344	2,563	69
Fujian	12,229	1,646	1,261	30
Southwest	232,955	22,216	11,241	98
Sichuan	56,547	11,141	6,367	75
Guizhou	17,622	4,906	1,873	162
Yunnan	38,361	5,788	2,777	108
Xizang	120,425	381	224	71
National	949,758	139,689	96,820	44

¹Survey data minus SSB data divided by SSB data times 100 gives the percent undercount.

Sources: (40, 49).