Why China will not Starve the World

by Scott Rozelle, Jikun Huang, and Mark Rosegrant

The debate is on: Will China starve the world? Or will it emerge as a serious competitor to the world's grain exporting nations? Yang and Tyers have forecast that China will import around 50 million metric tons (MMT) per year in the late 1990s. Garnaut and Ma argue that China will face up to a 90 MMT shortfall in grain in the year 2000. In the most controversial of recent attempts to gauge China's future import demand, Lester Brown has predicted that rising consumption and stagnating supply could force Asia's fastest growing economy to import more than 200 MMT of grain two or three decades into the next century.

Brown argues that China's emergence as a large importer will drive up world grain prices and divert trade flows away from less competitive but more needy nations, and may cause massive starvation. While Brown's arguments have been countered by those who claim he ignores producer and consumer responses to higher prices and China's historical ideology, which places high priority on grain self sufficiency, no one has seriously attempted to estimate how Brown's primary concerns—increasing environmental stress, a weakening technological base, and a rapid growth in demand—will affect China's food production, consumption, and imports.

China's own economists disagree with Brown. Researchers in the Chinese Academy of Agricultural Sciences have long predicted, and some still believe, that the nation will remain at least self-sufficient (Mei). In fact, China's net imports of grain decreased steadily between 1989 and 1993. In 1993, China had an overall agricultural trade surplus with the United States, and in the last decade China has taken away the South Korean feed-maize market from the U.S. Some observers expect China to continue to export maize in the near future. Other forecasters believe the nation can supply rice to the newly emerging Northeast Asia markets well into the twenty-first century.

Here we examine the effect of China's income growth, urbanization, and market development on food demand, and the effect of technology, agricultural investment, environmental trends, and institutional innovations on China's food supply. In short, we clarify the debate on China's future grain balance, show the circumstances under which China might reestablish itself as an active player on international grain export markets, and identify the kinds of structural transformations and policy decisions which might cause huge grain deficits—that threaten to "starve the world."

Annual grain production and utilization in China

Total grain production (in trade weight) rose to 385 million metric tons (MMT) in the early 1990s, making China the largest producer of cereals in the world. The country's farmers produce more rice and wheat than any other country in the world and more maize than any country except the United States. Chinese use most grain for direct food consumption, about 67 percent in the early 1990s.

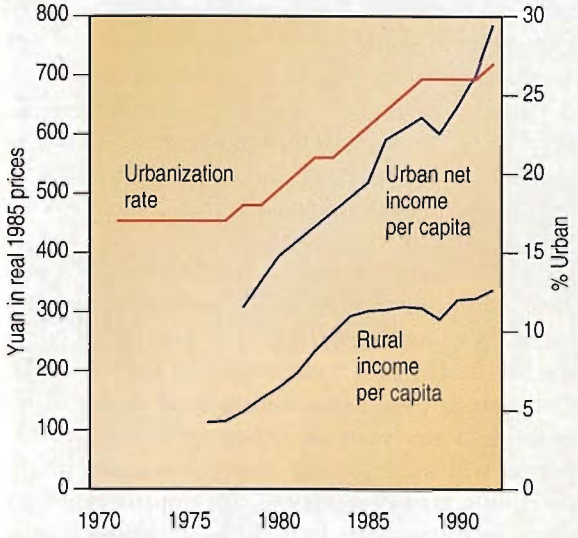

Figure 1. Forces affecting demand for grain in China

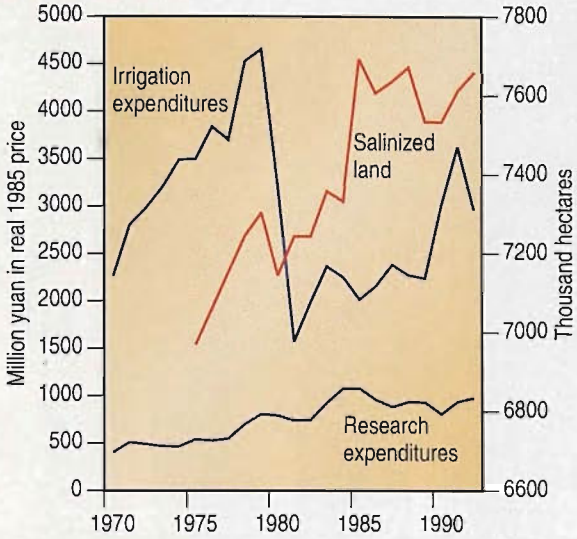

Figure 2. Key determinants of China grain output

Each resident in China ate about 225 kilograms—high even by Asian standards—and several times the amount of cereal products directly consumed by the average consumer in the United States. Feed grain was used to meet China's burgeoning demand for meat and accounted for 20 percent of all usage in 1990. In the early 1990s, China became the largest meat producer in the world, even though per capita consumption of animal products still falls below that in Taiwan, Korea, and Japan.

Sources of demand growth

Recent changes in the urban economy have made urban consumers almost entirely dependent on markets for their food needs. Prices and income changes will, to a very considerable extent, determine future consumption. Income growth rates (figure 1), among the highest in the world, will sharply increase the demand for food.

Rural consumers have different consumption patterns and their incomes have grown slower than their city counterparts (figure 1). Meat and fresh fruit are not always available in rural areas. Markets that are only partially freed, lack of refrigeration, and generally high transaction costs for procuring food in rural areas limit food choices in rural China. While the rural economy has changed rapidly, in 1992 farmers purchased only 48 percent of the food they consumed. As markets develop, consumption patterns will change.

Across Asia, as countries urbanize, diets have changed quite dramatically (Huang and David). Urban dwellers consume more wheat and less rice and demand more meat, milk, and fish than their rural counterparts, even after accounting for income and price differences. The ratio of urban to rural residents in China is changing rapidly (figure 1). The urban population grew from 19 percent in 1980 to 28 percent in 1992.

Sources of supply growth

While one-time institutional changes did contribute to the high growth enjoyed by China's agricultural economy in the early 1980s (Lin), technology was at least as important in the early reform period, and was responsible for almost all of the growth in the agricultural economy in the late 1980s and early 1990s (Huang and Rozelle). China's technological base grew rapidly during the prereform and reform periods. For example, hybrid rice, a breakthrough pioneered by Chinese rice scientists in the 1970s, increased yields significantly in many parts of the country, and rapidly spread to nearly 50 percent of China's rice area by 1990. Heavy government investment in research helped create these dramatic changes. Some observers, however, worry that China's research system may be suffering from neglect after more than a decade of reform. Real investment in research fell in real terms (in 1985 prices) from 1.08 billion yuan in 1984 to 0.98 billion in 1992. The ability of China's research system to maintain a constant stream of technical innovations will affect the nation's grain balance.

We project production after 2000 to reaccelerate, assuming that policy makers renew their commitment to investment in agricultural research within the next few years.

Investment in agricultural infrastructure, espe-

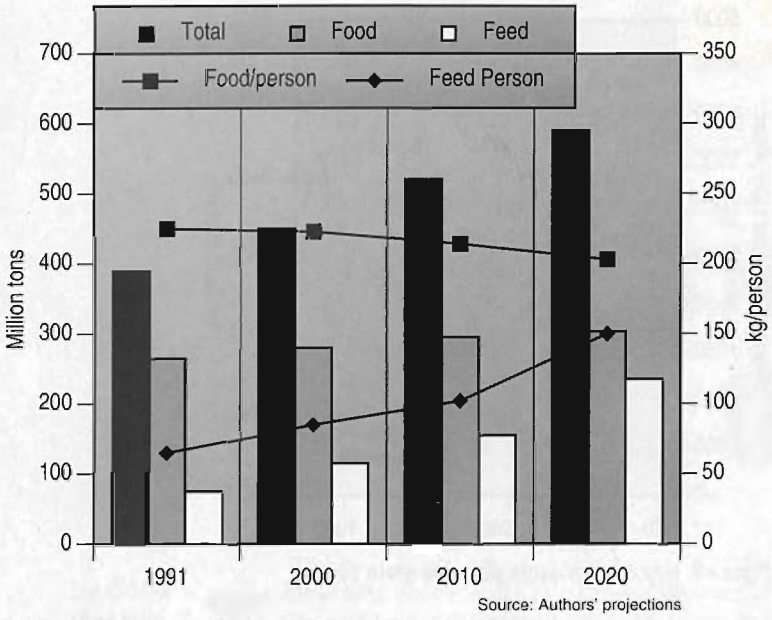

Figure 3. Baseline grain demand projections, 2000-2020

cially irrigation (figure 2), also boosted China's agricultural growth in recent decades. Since the early 1950s, Chinese agricultural officials have invested heavily in irrigation, raising irrigated area from 18 to nearly 50 percent of cultivated area. Real annual expenditures rose during the first twenty-five years of the People's Republic period. Annual irrigation investment, however, has been stagnant since the late 1970s.

In Brown's shocking article, he projects a 20 percent drop in grain production between 1995 and 2030. Brown believes environmental degradation will be one of the principle causes of grain output declines. While Brown cites only anecdotal evidence, government data show that erosion and salinization (figure 2) have increased since the 1970s, although in a somewhat erratic pattern. These factors have been shown to affect output of grain, rice, and other agricultural products in a number of the authors' recent studies.

China's grain economy in 2000 and 2020

Based on our micro- and macroeconomic studies conducted over the last several years, our baseline estimates show that China's per capita food grain consumption hit its zenith in the late 1980s and early 1990s (figure 3). From a high of 225 kilograms in the early 1990s, food grain consumption per capita falls over the forecast period ending in 2020. Although the average rural resident will consume greater amounts through the year 2000, before falling off in the first decade of the next century, urban demand for food grains is nearly at a point where it will fall with further rises in income. Expected population shifts from rural to urban areas will compound the decline in food grain consumption. In contrast, per capita demand for red meat is forecast to more than double by 2020. The projected rise in meat and other animal product demand will simultaneously put pressure on aggregate feed grain demand, raising the proportion of feed grain in total utilization from 20 percent in 1991 to 38 percent in 2020.

Our baseline projections also show that grain production will not keep up with escalating demand. We predict that aggregate grain supply will reach 410 MMT (in trade weight) by the year 2000. Constrained by a technological base weakened by more than ten years of falling investment, grain output will increase only about 7 percent during the 1990s, far below the more optimistic estimates given in recent years by China's agricultural officials who had hoped to meet a target of 455 MMT by 2000 (or 500 MMT in nontrade weight figures). We project production after 2000 to reaccelerate, assuming that policy makers renew their commitment to investment in agricultural research within the next few years.

Under the authors' most plausible scenario, total grain consumption will rise at 1.72 percent per year in the 1990s, 1.28 percent from the rise in population and 0.44 percent from increasing per capita grain demand, mostly in the form of feed. Grain production during this period will grow at an annual rate of only 0.64 percent. We project

imports will increase the fastest in the 1990's, reaching 40 MMT by 2000, a level of imports nearly three times greater than the historic high. By 2020 we estimate that imports will stabilize at 43 MMT.

How can China starve the world?

To check the stability of the baseline projections just described, we made other estimates by altering the baseline annual growth rates of income (3.5 and 3.0 percent for consumers residing in urban and rural regions, respectively), population (on average about 1.0 percent), and public investment in agricultural research and irrigation (3 percent—see table 1). We generate one set of alternative projections by using annual growth rates of per capita income ranging from 2.5 percent to 4.5 percent for urban residents (2.0 to 4.0 percent for those in rural areas), simulating the outcome of China's food balance sheet if the economy were to expand faster or slower than expected. Population growth rates, which decline over the thirty-year forecast period, are allowed on average to vary from about 0.8 percent in the low-growth scenario to over 1.1 percent per year in the high-growth scenario. We also test how our projections change when the annual growth rates of public investments in agricultural research and irrigation drop to 2 percent and rise to 4 percent.

In the year 2000, we project imports for all of these alternative scenarios to be substantially above the highest levels ever experienced in China—15 MMT in the mid 1980s (table 1, row 1). In the longer run (rows 2 and 3, columns 3–8), our forecasts of imports become more variable under the

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Table 1. Estimated net imports (MMT) of total grain under alternative scenarios

		Population		Income		Ag. Research Investment			
Year	Baseline[a]	Low (1.142 to 0.374)	High (1.410 to 0.844)[b]	Low (2.5%)	High (4.5%)[c]	Low (2%)	High (4%)[d]	Research Investment Declines by 1% per Year	Growth in Eroded and Salinized Area by 8% per Year
2000	40	35	45	30	49	42	38	44	89
2010	43	26	57	20	67	70	14	130	154
2020	43	9	70	–2	96	106	–30	232	228

Source: Authors' projections. For more details see Huang, Rozelle, and Rosegrant.

[a] Baseline assumptions are given in full in Huang, Rozelle, and Rosegrant, appendices 5 and 6. For the baseline, annual population growth is 1.283 percent in the 1990s and 0.649 percent in the 2010–20 decade; per capita urban income grows at 3.5 percent and rural income at 3 percent; agricultural research investment increases annually by 3 percent.

[b] Annual population growth rates decrease throughout period. Figures shown are for 1990–2000 and 2010–2020 decades.

[c] Annual per capita income growth rates for urban residents (shown here) are 0.5 percent higher than rural ones.

[d] Growth rates are annual increases in public investment into agricultural research.

(China, continued from page 21)
alternative scenarios. But if China's government maintains increases in research and irrigation investment to levels regularly found in other fast-growing Asian countries (around 3 percent per year, the baseline growth rate), even when population and income growth rates deviate from current trends, our projections show that while China most likely will be a large importer of grain, it will not demand so much as to swamp world commodity markets.

What assumptions might lead to a deficit of more than 200 MMT predicted by Brown? His huge import demands are based primarily on the breakdown of the supply side of China's grain balance sheet. In our studies, investments in agricultural research greatly affect China's grain imports, a result that is hardly surprising given the large contribution that agricultural research—and the technology it has produced—has made to agricultural productivity in recent years. If agricultural research investments fell by 1 percent per year, instead of rising by 3 percent as assumed under our baseline scenario, we project that by 2020 total grain production would fall to 354 MMT, a level below that of the early 1990s. With no change in the assumption regarding the level of food demand, imports under such a scenario would reach a staggering 232 MMT, about the total amount of grain being traded on current world grain markets.

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Similar cutbacks in the level of irrigation investment lead to much smaller reductions in production and smaller rises in projected imports. At the margin, irrigation in China's agricultural economy contributes less to total production. Less investment is needed to keep up the existing infrastructure, because water control infrastructure depreciates more slowly than agricultural technology. Given that irrigation expenditures already exceed those for agricultural research, policy makers may want to maintain or expand the investment in agricultural research to avoid higher grain imports.

How likely is it that such a supply breakdown could occur? Such a scenario could realistically only happen with a continued decline in investment, and no reaction by the government to rising import levels. Given its ideological commitment to near grain self-sufficiency, China's leaders will almost certainly develop a set of countervailing policy responses if imports become too large. In fact, in 1994 and early 1995, as grain prices rose in response to ever-tightening grain supplies, government policy makers reacted decisively. Concerned government leaders promised greater investment in agricultural. The central government gave provincial governors the responsibility of increasing their region's agricultural output. While most of the new increments in agricultural investments have targeted irrigation, agricultural research also received more emphasis. The government also began to look outside of China for technological products. Currently, several large international seed companies are investigating the China market. If successful, such a move would reduce the expected decline in grain production, and could provide China with more time to revive its own agricultural research system.

It also is difficult to construct a plausible scenario in which environmental problems cause imports to expand as Brown predicts. Doubling rates of erosion and salinity from our baseline levels increases imports by only 1 MMT in the year 2000. Our studies do not show substantial output effects until erosion and salinity growth rates accelerate to five times the current levels. Even at this level of environmental stress, imports in 2020 only increase to 60 MMT. Only under the completely unrealistic assumption that erosion and salinity areas grow at 8 percent per year (i.e., after about thirty years all of China's land is eroded!), do our studies predict imports will exceed 200 MMT, a level which approaches Brown's predictions. Such trends and impacts also assume that the government will take no actions to mitigate the adverse consequences of these environmental factors.

Conclusions

Our results show that China will neither starve the world, nor become a major grain exporter. It does seem likely, however, that China will become a much bigger grain importer in the coming decades. Both potential exporters outside of China and those charged with managing China's food needs through domestic production and imports need to be ready. Exporting nations—especially those dealing with wheat and maize—will undoubtedly be the beneficiaries of these trends.

If China's policy makers believe that the projected level of imports are too high (either politically or because they see some other physical or economic constraint), investment strategies need to be devised in the near future because of long lag times between expenditures and production changes. Immediate attention should be given to the state of China's agricultural research system. Investments

in facilities (ports and bulk handling facilities, for example) and institutions (more commercialized grain trading systems, for example) are needed to handle the increased volume of incoming grain. Such preparation also will smooth the shock of production shortfalls, as well as reduce the time and expense of importing grain. China's foresight in dealing with the upcoming challenge will most likely determine whether the production-demand gap turns into a major agricultural crisis, or whether it will become an opportunity to more effectively develop the nation's food economy. ◘

■ For more information

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