Occasional Paper n° 19

Agricultural Development and Nutrition: the Policies behind China's Success

Jikun Huang
Centre for Chinese Agricultural Policy
Chinese Academy of Sciences

Scott Rozelle
Stanford University

November 2009

WFP
World Food Programme
wfp.org

Study funded by the Bill and Melinda Gates Foundation.

The views expressed in this paper are the authors'
and should not be attributed to WFP.

Occasional Paper n° 19

Agricultural Development and Nutrition: the Policies behind China's Success

Jikun Huang
Centre for Chinese Agricultural Policy
Chinese Academy of Sciences

Scott Rozelle
Stanford University

November 2009

WFP
World Food Programme
wfp.org

Foreword

China's success in economic development is nothing short of extraordinary and has been the subject of countless studies. Relatively little attention, however, has been paid to the fundamental role that improvements in agriculture and nutrition played in lifting hundreds of millions of people out of poverty and hunger.

Thirty years ago, when the World Food Programme (WFP) was first invited to China, one in three Chinese citizens was undernourished. Food shortages had plagued the vast nation for centuries and were at the root of many of the dynastic changes that have marked its history. Today, China grows sufficient food to meet the needs of a fifth of the world's population from less than a tenth of its arable land. In recent years it has even been a net exporter of cereals.

At a moment when the number of hungry people is rising again and when questions are raised about the world's ability to continue to produce enough food for a growing population in the face of climate change and rising costs, it is helpful to look at China's experience to learn lessons from its success and from areas that still require improvement.

Perhaps the single-most important factor in China's success in agricultural development was a stable government that understood the fundamental importance of food security to national stability. "With food in our hands, our hearts can be at peace." This old Chinese adage seems to have underpinned much of the government's work on agriculture and food production.

Starting with the shift in 1978 from a planned agricultural economy to the household responsibility system (HRS), agricultural production improved dramatically. That had multiple positive effects on individuals and the economy: caloric intake and dietary diversity improved, rural labourers were freed to take more profitable off-farm work, new enterprises to process food and other goods created jobs, and incomes rose. Limiting population growth helped to control demand for scarce resources.

Improvements in food security and nutrition over the past 30 years have largely been attributed to improved food supply and incomes. Surprisingly, there were very few direct nutritional interventions. A few initiatives did take place, for example provision of vitamin A supplements, but they were rarely available nationwide. China is yet to mandate the fortification of wheat flour.

Despite the tremendous progress made and continued government commitment to meet the most basic needs of its people – food, clothing and shelter – a study of China's food security status commissioned by FAO, the International Fund for Agricultural Development (IFAD) and WFP found that 90 million people in 266 of China's poorest counties are vulnerable to food insecurity. Deficiencies in micronutrients such as iron

and vitamin A are widespread, especially in poor rural areas. The incidence of neural tube defects, often caused by a lack of folic acid, is among the highest in the world.

Reaching people at risk of malnutrition, which is increasingly difficult because they are scattered across the poorest and most remote areas of the country, will require specific nutritional interventions, promotion of exclusive breastfeeding, improvements in health, education and sanitation and improved food safety. These are the areas targeted in a United Nations joint programme to improve nutrition, food safety and food security for China's most vulnerable women and children.

As the balance tipped towards greater prosperity, the challenges changed too. With higher incomes came greater demand for better quality food. Arable land became even scarcer because it was more profitable if used for residential or industrial purposes. Water also came under pressure, with increased demand, reduced supply, greater pollution and the possibility that climate change will affect its availability.

With urbanization and better living standards, conditions associated with sedentary lifestyles such as diabetes, cardio-vascular disease and obesity are increasing. The prevalence of diabetes in China is 2.4 percent; the number of people diagnosed with diabetes is projected to double to 42 million between 2000 and 2030.

Obesity is appearing: according to the World Health Organization (WHO), 3.4 percent of Chinese women over 15 are obese; the figure for Chinese men is 2.4 percent. In 2002, 9.2 percent of Chinese children under 5 were overweight for their age; 11 percent were underweight.

The Government of China recognizes the magnitude of the challenges it faces. It has adopted a national food security strategy that aims to increase grain production to 550 million mt by 2020. To do this, it plans to protect agricultural land and invest further in science and technology, rural infrastructure and land and water management. Reforms are under way in health and social security.

Notwithstanding the challenges China faces to ensure that its people enjoy the benefits of rapid economic growth, its achievement – reducing the number of undernourished people from one in three to less than one in ten – stands as a beacon of hope that hunger can be banished within a generation.

Anthea Webb
Director, WFP China

Table of Contents

Agricultural Development, Nutrition and the Policies behind China's Success*

Introduction

The emergence of China is one of the miracle growth stories of the last part of the 20th century and the early part of the 21st century. Its economy has been the fastest growing when compared with world economies since 1980 (World Bank, 2002). Growth has occurred in all sectors, including agriculture. Poverty has fallen. In the past 30 years the absolute level of poverty fell from 260 million in 1978 to 14.8 million in 2007 on the basis of China's official poverty line (National Statistical Bureau of China [NSBC], 2008). The general welfare of most of the population has increased markedly. Many indicators of nutritional status have improved: for example the number of children with low body weight fell by more than half (Ministry of Health, 2004). And by the end of 2007 China had achieved most of its Millennium Development Goals (MDGs).

These accomplishments are impressive, but there are still major challenges ahead. Income disparity, for example, rose with economic growth: there are significant disparities among regions, between urban and rural areas and among households in the same location (Cai *et al.*, 2002; World Bank, 2002). There are also regional differences in nutritional status (Chen, 2004). In China's poorest areas there is still a high incidence of anaemia, which impedes educational performance and reduces physical strength and productivity, thus contributing to chronic poverty (Chen, 2004).

Agriculture is responsible for much of the improvement in the incomes and nutritional status of the poor. Since 1978 average annual growth in China's agricultural sector has been much higher than population growth, but high input levels in many areas and diminishing marginal returns may mean that increasing inputs will not provide large increases in output. Many have predicted that in future almost all gains will have to come from new technologies that significantly improve agricultural productivity (Fan and Pardey, 1997; Huang *et al.*, 2003; Huang *et al.*, 2002a, 2002b and 2004). Trade liberalization and tensions between the environment and development will further challenge China's agricultural and rural economy.

How has China achieved this growth? How will it maintain the growth? At a time when the rest of the world is struggling to prevent many of the MDG indicators from deteriorating, how has China been able to move so aggressively towards meeting its MDGs? What is the policy basis that has helped produce this success?

The aim of this paper is to examine the policies that China has used to develop its agricultural economy, reduce poverty and improve the nutrition of the nation. To do this, we shall: i) outline the progress China has made in developing its agricultural sector and review its achievements in the reduction of nutritional problems; ii) review a number of policy initiatives that the Government has used to support the development of agriculture and poverty reduction; and iii) discuss the policy implications and lessons of the findings.

---

* The statistics and observations in this paper refer to the mainland of the People's Republic of China, excluding Hong Kong Special Autonomous Region (SAR), Macao SAR and Taiwan.

China's Agriculture in the Context of Overall Economic Development

OVERALL ECONOMIC GROWTH

China's leaders implemented reform measures that have gradually liberalized the institutional and market structure of the economy. Although there is a cyclical pattern in China's growth rates, its economy has had the fastest growth rates in the world since 1980.

In the early reform period,[1] annual growth rates of gross domestic product (GDP) increased from 4.9 percent in 1970–1978 to 8.8 percent in 1979–1984 (see Table 1). High growth was recorded in all sectors. Institutional reforms involving a shift from collective agricultural production systems to individual household production were the main source of agricultural growth in the early reform period (Lin, 1992; Huang and Rozelle, 1996). The growth of agriculture provided the foundation for the successful transformation of China's reform economy. Rising income in the initial years of reform also stimulated domestic demand; the high savings rate was transferred into physical capital investments in the non-agricultural sectors in rural and urban areas, which led to annual growth rates of 8.2 percent in industrial GDP and 11.6 percent in services (see Table 1). During the same period, family planning reduced population growth, enabling rapid per capita GDP growth. The annual growth rate of per capita GDP more than doubled from 3.1 percent in the 1970–1978 pre-reform period to 7.4 percent in 1979–1984.

Despite the Asian financial crisis, an average annual growth rate of 8.2 percent during 1996–2000 was maintained (see Table 1).

China's economic growth accelerated at the beginning of the 21st century. Annual GDP growth rose from 7.3 percent in 2001, with average growth of 9.9 percent in 2001–2005 and 11.8 percent in 2006–2007 (see Table 1). The World Bank predicts growth for 2009 at 7.5 percent (World Bank, December 2008).

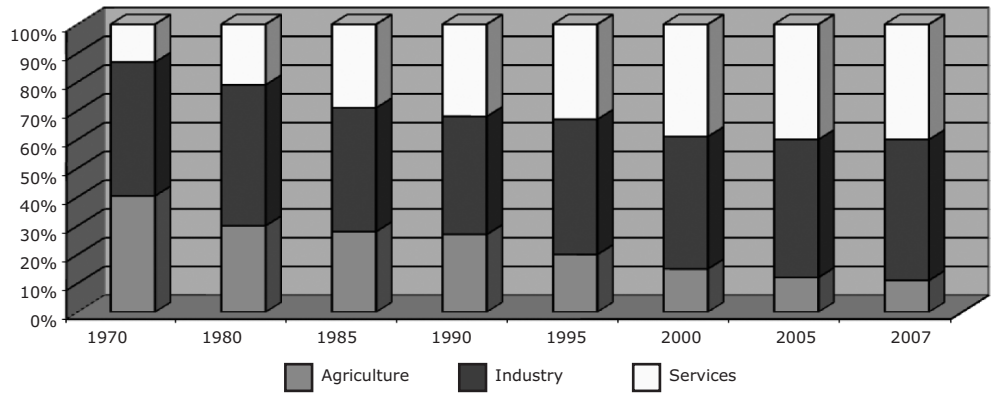
STRUCTURAL CHANGES AND THE ROLE OF AGRICULTURE IN CHINA'S ECONOMY

Overall Change in Economic Structure of Agriculture, Industry and Service sectors

Rapid economic growth has been accompanied by significant structural changes in China's economy. Agriculture accounted for more than 40 percent of GDP in 1970, but it fell to 30 percent in 1980, 20 percent in 1995 and 11 percent in 2007 (see Table 2). The share of the industrial sector in national GDP fluctuated between 1970 and 1985, gradually increasing after the late 1980s and rose from 41 percent in 1990 to 49 percent in 2007. In contrast to agriculture, the service sector expanded rapidly. The share of service sector in national GDP increased from 13 percent in 1970 to 21 percent in 1980 and 40 percent in 2007. This trend is expected to persist in the coming years as China continues to promote its structural adjustment policies and economic reforms in response to domestic demand and changes in external trade patterns.

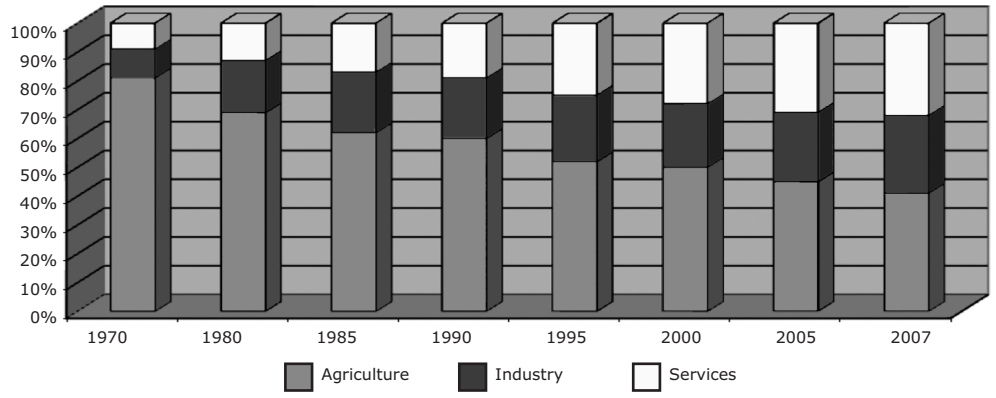
1 The "reform period" refers to the years since 1978, when the Government of China instituted its policy of "reform and opening up." The years 1979 to 1984 are known as the "early reform period".

Figure 1. Share of GDP by Sector



Structural changes in the economy have also resulted in substantial changes in employment patterns. In 1970, agriculture employed 80 percent of the nation's workforce. This percentage declined to 60 percent in 1990 and 41 percent – including part-time agricultural labour – in 2007 (see Table 2, row 4). The industrial sector share of employment doubled in 1970–1985, steadied at 20–24 percent in 1990-2005 and reached 27 percent in 2007 (see Table 2, row 5). The share of employment in the service sector rose even more rapidly, from 9 percent in 1970 to 19 percent in 1990 and 32 percent in 2007.

Figure 2. Employment by Sector



In rural areas, 40 percent of the labour force was employed in the non-agricultural sector in the late 1990s (de Brauw *et al.*, 2002). Expanding non-agricultural employment has contributed substantially to the growth of farm household income since the late 1980s (Rozelle, 1996). Non-agricultural farm household income exceeded agricultural income in 2000 for the first time; the share rose to nearly 60 percent in 2007 (NSBC, 2008).

Numerous factors have simultaneously contributed to China's structural changes in terms of economic composition and employment. Rapid economic growth, urbanization (Huang and Bouis, 1996), market liberalization (Lardy, 1995; Huang and Rozelle, 1998) and China's open-door policies (Branstetter and Lardy, 2005) among others have had significant impacts on internal and external consumption and demand patterns. Together with the rapid development of factor and output markets, these largely explain the changes in China's economic structure in the past three decades (Brandt *et al.*, 2005; Sonntag *et al.*, 2005).

Move to More Liberalized Economy and Rapid Growth of the External Sector

Rapid economic growth has also been associated with remarkable changes in China's international trade. Throughout the reform era, foreign trade expanded even more rapidly than GDP. Annual growth rates for foreign trade reached 15 percent in the 1980s and early 1990s (see Table 1). China's foreign trade grew by 10 percent annually between 1996 and 2000, when world economies were hit by the Asian economic crisis. Since China's accession to the World Trade Organization (WTO) in late 2001 the growth of imports and exports has been tremendous: the average annual growth rate for trade reached 25.3 percent in 2001–2005 and 19.4 percent in 2006–2007 (see Table 1).

With the rapid growth of China's external sector, foreign trade has played an increasing role in the national economy since the beginning of the reforms. China's export-to-GDP ratio increased from less than 6 percent in 1980 to 23 percent in 2000 and 37 percent in 2007 (see Table 2, row 8). Over the same period, the import-to-GDP ratio increased from 6 percent to 21 percent and 29 percent. These ratios place China among the most open economies in the world.

The rapid expansion of the external economy is largely explained by China's long-term development strategy to open its economy. Prior to economic reform, China adopted a highly centralized and planned foreign trade regime (Lardy, 2001). This system, however, has been substantially decentralized by grants to more firms of direct foreign trading rights; export subsidies and import tariffs were significantly reduced after the late 1980s. By 1991 all export subsidies were phased out, though China occasionally applied them for specific products such as maize and cotton to avoid a major fall in domestic prices before accession to WTO (Huang *et al.*, 2004). Reduction of import tariffs has also been remarkable: China's average tariff, which was 56 percent in the early 1980s, was reduced to 47 percent in 1991, 23 percent in 1996 and 15 percent on the eve of WTO accession in 2001. Import protection has also been significantly reduced in the agricultural sector: the simple average agricultural import tariff fell from 42.2 percent in 1992 to 23.6 percent in 1998 and to 21 percent in 2001 (Ministry of Foreign Trade and Economic Cooperation, 2002).

China's openness to imports progressed even faster than the decline in formal trade barriers might indicate. This is due to the many special privileges that the Government has extended to firms involved in export processing and strategically important imports to balance domestic shortages. Actual tariff revenues have thus been far below average formal tariff rates: for example, tariff revenue as a percentage of total import values was 17 percent in the mid-1980s and slightly more than 2 percent in 2004 (Lardy, 2001; Branstetter and Lardy, 2005).

AGRICULTURAL DEVELOPMENT

Agricultural Production Growth

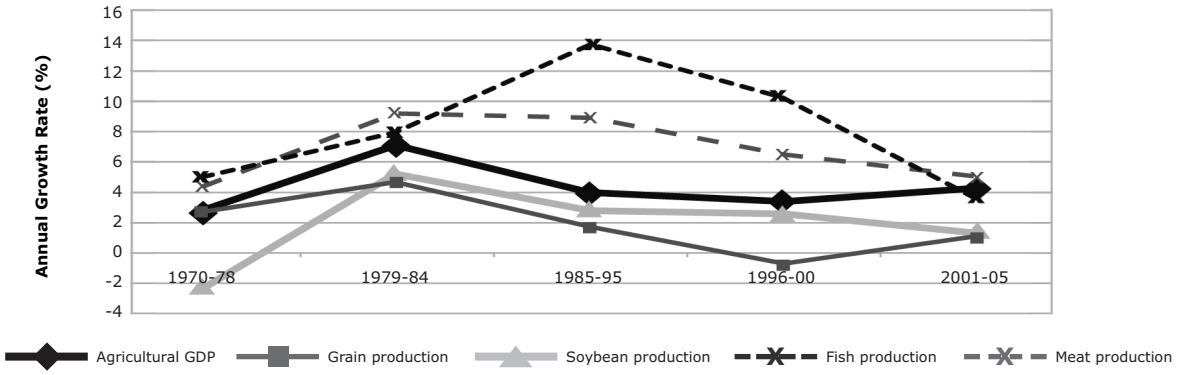
The growth of agricultural production in China since the 1950s has been one of its main development accomplishments. Apart from the famine years of the late 1950s and early 1960s, the country has enjoyed rates of production growth that have outpaced the rise in population. Although yields and total production rose during the pre-reform period, total factor productivity did not, and rural incomes were stagnant (Rozelle *et al.*, 2008).

After 1978, introduction of the individual HRS, price increases and relaxation of trade restrictions on most agricultural products accompanied the growth of China's food economy. Between 1978 and 1984 grain production increased by 4.7 percent per year; the output of fruit rose by 7.2 percent (see Table 3).

In 1985–2000, agricultural growth was remarkable for all agricultural products except grain and cotton. Fish production experienced the fastest growth in 1985–1995 with 13.7 percent annual growth (see Table 3). Over the same period, meat production and areas sown with vegetables expanded at 7–9 percent annually. Other cash crops such as vegetable oil, soybean and fruit also grew at rates much higher than population growth.

Overall growth of the agriculture sector has maintained an average of 4 percent per annum in recent years (see Table 3). Comparison of the growth rates of individual commodities between the early and late reform periods indicates a fall in production growth in terms of quantity for many agricultural commodities, which may indicate that China's agricultural production has been shifting from aggregate production to value-added and quality food production.

Figure 3. Agricultural Production Growth Rates



Structural Changes in Agricultural Production

China's agriculture has undergone significant changes since the early 1980s. Rapid economic growth, urbanization and market development are major factors in the changes. Rising incomes and urban expansion have increased the demand for meat, fruit and non-staple foods. These changes have stimulated sudden shifts in the structure of agriculture (Huang and Bouis, 1996; Huang and Rozelle, 1998). For example, the share of livestock output value rose 2.5 times from 14 percent to 35 percent between 1970 and 2005 (see Table 4). Aquatic products increased even faster. One of the most significant signs of structural change in the agricultural sector is that the share of crops in total agricultural output fell from 82 percent in 1970 to 51 percent in 2005–2007.

The importance of the three major crops – rice, wheat and maize – has waxed and waned: the share of major cereal grains increased from 50 percent in 1970 to a peak of 57 percent in 1990, then gradually declined to less than 50 percent in 2005 (see Table 5). Most of the fall was a result of a decrease in areas sown with rice and wheat. In contrast, the share of maize areas rose from 10.8 percent in 1970 to 19.2 percent in 2007 (Table 5). The increase in the area under maize, China's main feed grain, is correlated with the rapid expansion of the nation's livestock production during the same period.

The areas under other cash crops such as vegetables, vegetable oil, sugar and tobacco have expanded rapidly in recent years. In the 1970s, vegetables accounted for 2 percent of the total crop area; by 2007 the share had increased six-fold

(see Table 5). Fruit experienced similar rates of expansion, and the area devoted to edible oil grew two-fold. Field interviews reveal that the livelihoods of the poor rely more on crops than livestock and fisheries than those of richer farmers. Poor farmers produce more grains, particularly maize, than cash crops. These figures suggest that the poor have gained less from the diversification of agricultural production during the reform period.

Driving Economic Forces of Agricultural Growth

Studies have demonstrated that a number of economic factors contributed to agricultural production growth during the reform period. The earliest empirical studies focused on measuring the role of the HRS, which gave farmers land use rights, in increasing wealth and concluded that most of the rise in productivity in the early reform years was a result of institutional innovations, particularly the HRS (McMillan *et al.*, 1989; Fan, 1991; Lin, 1992).

More recent studies show that since the HRS was completed in 1984, technological change has been the primary engine of agricultural growth (Huang and Rozelle, 1996; Fan, 1997; Fan and Pardey, 1997; Huang *et al.*, 1999; Jin *et al.*, 2002). Improvements in technology contributed by far the largest share of crop production growth, even during the early reform period. These studies show that reforms other than de-collectivization also potentially affect agricultural growth. Price policy has been shown to have had a significant influence on the growth and decline of grain and cash crops during the post-reform period. Favourable output to input price ratios contributed to rapid growth in the early 1980s, but this new market force is a two-edged sword: a deteriorating price ratio caused by increasing output prices at a time of sharply rising input prices was an important factor behind the slowdown in agricultural production in late 1980s and early 1990s.

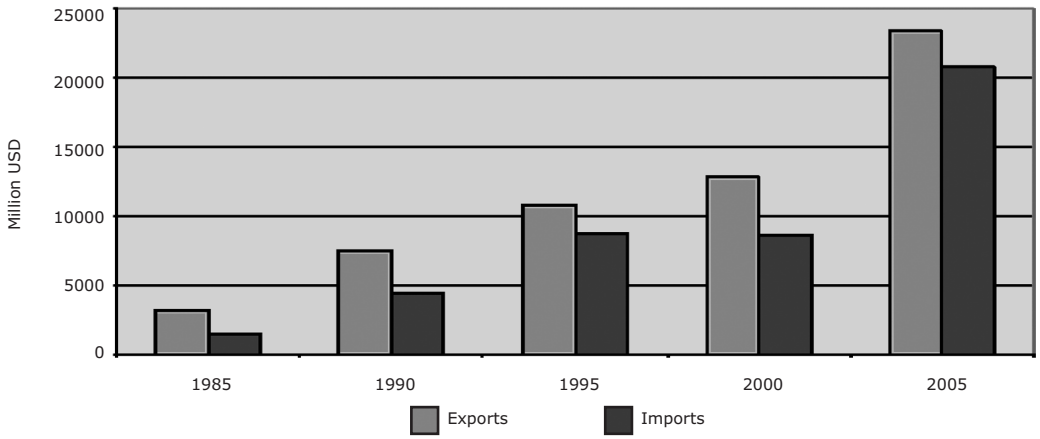
Irrigation has been critical in establishing the highly productive agronomic systems in China (Wang, 2000): the proportion of cultivated areas under irrigation increased from 18 per cent in 1952 to approximately 50 percent in 2007 (Ministry of Water Resources, 2008). But rising demand for domestic and industrial water is a serious constraint for irrigated agriculture, and water scarcity is seen as a major challenge to China's future food security and people's well-being, especially in the north.

Agricultural Trade

Agricultural trade grew even faster than agricultural production. The value of food and feed exports increased four-fold from US$3.2 billion in 1985 to US$12.8 billion in 2000, and almost doubled from 2000 to 2005 (see Table 6). Food, feed and fibre imports also increased rapidly, but in the past two decades exports of food and feed have risen faster than imports. Since the early 1980s China has been a net food and feed exporter. Significant rises in fibre imports and a large deficit of fibre, mainly cotton, is largely a result of the rapid expansion of the export-oriented textile industry in China.

Just as trade liberalization has affected growth in the domestic economy (Lardy, 2001), changes in the external economy have affected the nature of China's agricultural trade patterns (Huang and Chen, 1999). As trade expanded, the share of agriculture fell sharply despite the growth of the agricultural trade

Figure 4. China's Food and Feed Trade



because the growth of non-agricultural trade was much higher.

Disaggregated trade trends in agriculture show equally sharp shifts (see Table 6). The data in Table 6 suggest that exports and imports are increasingly moving in a direction consistent with China's comparative advantages. In general, net exports of land-intensive bulk commodities such as grains, fibres, oilseeds and sugar have fallen. At the same time, exports of higher-value and more intensive products such as horticultural, animal and aquatic products have risen. Grain exports accounted for a third of food exports in the mid-1980s, but from the late 1990s horticultural, animal and aquatic products accounted for 70–80 percent of food exports (see Table 6).

FOOD SECURITY AND NUTRITION

Ensuring national food security is one of the main goals of China's agricultural policy. China feeds 20 percent of the world's population with about 9 percent of the world's cultivated land. By producing most of the food it needs for its large population, China contributes significantly to world food security and accounts for much of the decline in the number and percentage of the world's population who are undernourished. The increase in food availability and the decrease in under-nutrition were achieved primarily through increases in domestic agricultural production.

China's success in increasing the supply of food and fibre in the last 50 years to meet the needs of its growing population is well recognized. Per capita daily energy supply reached 2,990 kcal, well above the recommended level of 2,100 kcal in the MDGs and 14 percent higher than the average daily energy supply in developing countries and 8 percent higher than the world average (FAOSTAT database, 2008).

At the national level, grain security has received the attention of national leaders: in the late 1990s, a target of 95 percent grain self-sufficiency was set. To achieve this, China invested heavily in irrigation and other agricultural infrastructure (Wang, 2000), research and extension (Huang *et al.*, 2000) and domestic production and marketing of chemical fertilizer and pesticides (Nyberg and Rozelle, 1999).

China has been a net exporter of grain since the 1980s. Although it imports high-quality indica rice, China exports japonica rice and has been a net exporter of rice since the early 1980s. Imports of wheat have declined from 10 million mt annually in the 1980s to nearly zero in recent years (NBSC, 1986–2007). China was one of the

world's major maize exporters during the late 1990s and early 2000s, with annual maize exports reaching 12 million mt in 2002 and 16.4 million mt in 2003. Even though maize exports have declined significantly in recent years, China has not yet become a net maize importer. In the coming decade China will probably have to import maize to help to meet growing demand for feed resulting from expansion of the livestock sector.

At the household and individual levels, food security depends on a number of factors that are largely related to various forms of entitlement to income and food-production assets. The links between domestic and external markets and access to external markets by small low-income and resource-poor producers and consumers are also important.

Access to food in rural China has changed over time. In the early years of reform, de-collectivization policies gave all farm households the right to use a piece of land. But markets did not function well during this time and most farmers produced mainly for subsistence. Access to food was primarily through the land allocated to farmers by the state.

As China has changed, so has the rural economy. And nowhere has the change been more noticeable than in access to food. From a largely subsistence economy China has in recent years developed a rural economy that is one of the most commercialized in comparison with other developing economies. On average, the shares of marketed products in total production ranged from 54 percent for grain to 90 percent for fish (Huang *et al.*, 2004). Even the poorest of the poor marketed most of what they produced, though the rate of commercialization is lower than among richer Chinese farmers.

China's rural consumers still face uncertainties in access to food. The nature of these uncertainties is probably different from those in other developing countries, where production risk is often one of the most significant sources of risk affecting rural residents; in China this is less likely to be the case. A much higher share of China's land – 48 percent – is irrigated (Ministry of Water Resources, 2008), and 80 percent of households have at least one family member earning an income in the off-farm market (de Brauw *et al.*, 2004). Giles (2000) shows that risks in China come from a number of non-traditional sources such as wage and policy risks. With an increasing number of households relying on markets to procure their food, they also face rising market price risks.

Stability of food supplies and access to food by the poor are the other dimensions of food security. In this regard, the Government has developed its own disaster-relief programme and has run a national food-for-work scheme with a view to long-term investments. China's capacity to deal with emergencies was demonstrated repeatedly during the reform period: for example the Government responded massively and rapidly during the Yangtze river floods in the 1990s and the Sichuan earthquake in 2008. Through such actions, the Government showed that its capacity to deal with the consequences of natural disasters is adequate.

During the 1980s and early 1990s, a major constraint affecting the stabilization of food supplies was poor market and transport infrastructures (Nyberg and Rozelle, 1999), but these have improved markedly since the early 1990s. Huang and Rozelle (2006) showed that China's domestic food markets have been highly integrated since the late 1990s. The percentage change in price for every 1,000 km from the port of entry was only 5 percent, which is comparable with the United States.

Improvement to Nutrition and Challenges[2]

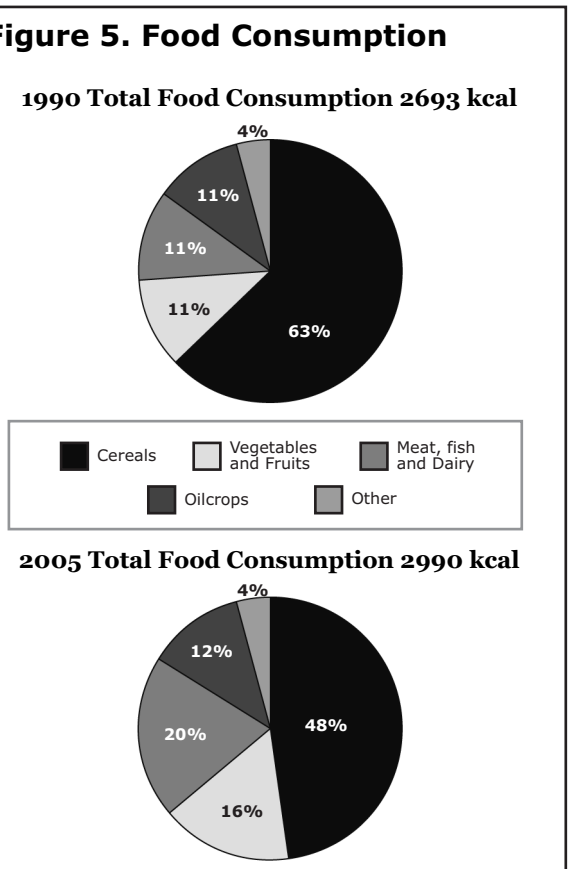
China's agricultural reforms had a huge impact on the capacity of farmers to feed its population. The rural standard of living was significantly improved, leading to a dramatic fall in poverty. On the basis of China's official poverty line, the incidence of rural poverty fell from 31 percent in 1978 to 1.6 percent in 2007. According to the US$1 per day purchasing power parity (PPP) exchange rate, it fell from 31.5 percent in 1990 to 10.4 percent in 2005 (United Nations Development Programme [UNDP], 2008). In 2002, China's households spent an average of 40 percent of expenditure on food, compared with 55 percent in 1990, indicating a significant improvement in the standard of living.

Agricultural reforms had huge consequences for food security and the improvement of the nutritional status of Chinese citizens. According to FAO estimates, the number of undernourished people decreased from 304 million in 1979–1981, 30 percent of the population, to 123 million in 2003–2005, 9 percent of the population.

During this time, the nutritional status of the Chinese population has improved substantially. Rapid economic growth and the development of food markets have increased demand for food and resulted in increased quantity, quality and diversity of foods such as vegetables, fruit and meat.

The Chinese diet has always been principally plant-based, but there have been significant changes since the economic reforms in the late 1970s. Households currently consume fewer cereals – 49 percent of total energy consumption – and more fruit and vegetables – 7 percent – than previously. Daily consumption of fruit reached 38 g per capita in 2004, compared with 12 g per capita in 1990. Daily consumption of animal products rose in urban and rural areas, increasing the percentage of animal-based protein in total protein intake from 17 percent to 31 percent between 1992 and 2002. In 2004, the typical person in China ate 77 g of meat per day,[3] compared with 57 g in 1989. These trends usually constitute positive developments in the diets of adults.

Figure 5. Food Consumption



Since the 1970s the average height and weight of children have increased, a clear sign of better nutrition and health. According to the Chinese Health Ministry's National Nutrition Survey, the average height of 6-year-old boys rose from 112.3 cm in 1975 to 118.7 cm in 2002; the average height of girls of the same age rose from 111.5 cm in 1975 to 117.7 cm in 2002. Children were thus 6 cm taller than they had been 30 years earlier. In 1998–2005, only 4 percent of infants were born with a

2 This section is based on material provided by WFP.

3 Includes pork and other meat; excludes poultry, eggs, fish and dairy products.

low birth weight; the average weight of newborn babies reached 3.3 kg in 2002. The prevalence of underweight children under 5 was 19.1 percent in 1990, compared with 11.2 percent in 2000. The prevalence of stunting among children under 5 fell from 33.4 percent in 1990 to 9 percent in 2005.

Despite major improvements, food insecurity remains a fundamental issue for many poor and remote households. The 10 percent prevalence of underweight children in rural areas in 2005 was five times that of urban children. Even in rural areas the disparities are marked: the Ministry of Health found that 35 percent of children aged 12 months in the poorest rural counties were stunted. The prevalence of underweight children aged 0 to 5 years in western China is considerably higher than in eastern China: 5.8 percent in eastern provinces compared with 12.5 in western provinces (Ministry of Foreign Affairs and United Nations, 2008).

Chronic malnutrition in rural areas may result from insufficient local food production, poor dietary diversity, lack of income, limited access to public health services, lack of distribution, lack of information and technology, inadequate water and sanitation and poor understanding of nutrition; improper use of complementary foods for infants in rural areas is also an issue. Differences in daily intake between urban and rural areas are still significant: in 2004, urban adults consumed 105 g per day of meat compared with 65 g per day in rural areas; urban inhabitants consumed 25 g of milk and dairy products per day in 2004, compared with 6 g among rural households.

Although China has achieved food security at national level, micronutrient deficiencies remain a major nutritional challenge, especially in some poor remote areas. The prevalence of anaemia decreased very slowly: the rates among children under 5 were 19.3 percent in 2005 but up to 80 percent in the poorest counties; 49 percent of rural children have marginal vitamin A deficiency. In 2004, average calcium intake was 430 mg per day among city and suburban residents but only 380 mg per day in rural areas.

The Policy Environment

The rapid growth and radical transformation of China's economy and agriculture were linked to government policy. In this section we explore five of the main policy areas that have enabled China's economic change and agricultural development: cultivated land management, agricultural research and development (R&D), marketing and pricing, fiscal policy and investment in infrastructure and public services, and labour mobility.

LAND POLICIES

Before the economic reforms in 1978, China's cultivated land was farmed by groups of farmers called collectives. The head of each collective assigned work to the members, who jointly carried out tasks such as ploughing, planting, fertilizing and harvesting. Members were given work points for the number of labour days and at the end of the year, after paying an in-kind tax to the state, they divided the harvest among themselves on the basis of the number of work points earned by each member. The system was put in place to try to take advantage of economies of scale, but during the socialist period from 1950 to 1978 the increase in total factor productivity in agriculture was essentially zero (Rozelle *et al.*, 2008) and per capita income in rural China was the same in 1978 as it had been in the early 1950s.

In response to the perception that the system of collective agriculture was not working, China initiated HRS in 1979. This reform radically altered the organization of production in agriculture and the incentives for rural households (Rozelle *et al.*, 2008). The HRS reforms dismantled agricultural collectives and contracted agricultural land to households, mainly on the basis of family size and the number of labourers in each household. Significantly, control and income rights belonged to individuals after the HRS reforms. Land was not privatized, however: ownership remained with villages of about 300 households or small groups of 15–30 households. Even if they did not own the land, farmers were able to keep all of the grain earnings. In economic terms, farm households became the residual claimants to their effort.

By 1984, 99 percent of agricultural land was contracted to individual households for 15 years; average farm size was about 0.6 ha, but this varied among regions from more than 1 ha in the northeast and nearly 1 ha in northern China to 0.5 ha in southwest China and 0.2–0.3 ha in the south. Because the number of crop seasons per year on a single plot of land increases from one in the northeast to two or three in the south, variations in sown areas in China's regions are less than those of farm size.

The impact of the HRS reforms could not have been more dramatic (Lin, 1992). Productivity rose. Output rose. Incomes rose. It is often thought that this rise in the vibrancy of the rural economy was one of the triggers of the rest of the economic reforms in China (Rozelle *et al.*, 2008).

During the 1980s and 1990s there were concerns about the long-term sustainability of the reforms. Some people worried that land rights were not secure. Contracts were only for 15 years in the early 1980s and would expire in the late 1990s. There was concern that productivity was flagging because of poor land rights (Wen, 1995). Research summarized in Brandt *et al.* (2002) showed that the system of land rights initiated by the HRS reforms was mainly beneficial to farmers and that the cost of insecure tenure was not too serious for agricultural output, at least in the short term.

After several years of policy debate, leaders seemed to come to a consensus. One of the

most important changes in recent years has been the renewal of land-use contracts for an additional 30 years. By 2000, 98 percent of villages had amended their contracts with farmers to reflect these long-term rights (Ministry of Agriculture, 2001). Cultivated land is not private, but the right to use land was granted until 2028.

With the issue of use rights resolved, the Government is seeking a mechanism that would permit the remaining full-time farmers to gain access to additional arable land and increase their incomes and competitiveness. A major new policy is established by the Rural Land Contract Law (RLCL) approved in 2006 by the Standing Committee of the National People's Congress, according to which ownership of land remains with the collectives but other rights are given to contract holders such as they would have under a private property system. In particular, RLCL clarifies the rights of transfer and exchange of contracted land: this may be taking effect already, because researchers are finding that more land in China is being rented. The law also allows family members to inherit land during the contract period. The aim is to encourage farmers to use their land to increase short-term and long-term productivity.

Even after the enactment of RLCL, village authorities in some parts of China have continued to interfere with the conferred rights (Rozelle *et al.*, 2008); other groups have wanted to strengthen the rights of farmers with respect to their cultivated land (Zhang *et al.*, 2008). In response to this debate, China's central leadership has begun to increase the rights of rural families over their cultivated land. The recent pronouncements at the Third Plenary Session of the 17th Central Committee of the Communist Party of China try to bring forward implementation of RLCL. There is a perception that despite RLCL, tenure security is still weak, and as a result farm size and the quality of investments in land are limited. Without secure tenure, rural residents do not have the asset base to access finance that would permit them to move to cities, improve their land or expand off-farm businesses. The debate in China is now whether or not the rural economy is ready for indefinite, titled land security. Fully secure tenure will probably not occur immediately, but with the continued effort of reformers it will gradually become stronger.

DEVELOPMENT AND DISSEMINATION OF AGRICULTURAL TECHNOLOGY

The importance of agricultural research and extension in increasing agricultural productivity in developing countries is now widely recognized. Successful development has been shown to be tied to productivity growth in the agricultural sector (World Bank, 2008). In a country such as China where agriculture is dominated by small farms, it is even more important.

During the reform era, it was not always clear whether China would be able to maintain the pace of technological advance needed to maintain farm incomes in a dynamic economy. HRS was fundamental in increasing productivity (Lin, 1992), but in the early stages of reform it provided only a one-off boost. The evidence suggests that after1985 technological advances were the main engine of productivity growth (Huang and Rozelle, 1996). China was one of the first countries to develop and extend Green Revolution technology in the 1960s, 1970s and 1980s. China's scientists developed hybrid rice in the late 1970s, and until the mid-1990s China was the only country to have commercialized this new technology.

Despite these and other successes, China's system of agricultural research faced major challenges by the late 1980s (Pray *et al.*, 1997). Research investment, almost entirely publicly funded, was declining; incentives were poor, and funding was being allocated in

ways that did not always reward excellence. The system was not responding to many demands for new technologies, and the extension system was chaotic.

Nationwide reform of research was launched in the mid-1980s (Pray *et al.*, 1997) to increase research productivity by shifting funding from institutional support to competitive grants, supporting research useful for economic development and encouraging applied research institutes to support themselves by selling the technology they produced. In the late 1980s and early 1990s, new horticultural seeds, improved breeding livestock (Rae *et al.*, 2006) and new dairy technologies were imported (Ma *et al.*, 2006).

After a decline from the early 1980s to the mid-1990s (Pray *et al.*, 1997), investment in R&D began to rise. Funding for plant biotechnology was increased, but to date only *Bacillus thuringiensis* (Bt) cotton has been commercialized in a major way (Huang *et al.*, 2002, 2003). China is now a global leader in agricultural biotechnology: in the late 1990s, China invested more in agricultural biotechnology research than all other developing countries combined, and its public spending on agricultural biotechnology was second only to the United States. Investment in government-sponsored R&D increased by 5.5 percent annually between 1995 and 2000 and by 15 percent per year after 2000 (Hu *et al.*, 2007). During the past decade the increase in investment in rural R&D has been the most rapid of any large nation.

The investment in R&D has paid off. During China's early reform period, yields of major food crops rose steadily (see Table 8, column 1). Although some of that yield increase arose from greater efficiency in input use, technological improvements appear to have accounted for some of it, because indices of aggregated inputs – measures of land, labour and material inputs – for rice, wheat and maize actually fell during the early 1980s (column 2).

Although there was concern about the effect of the slowdown on R&D spending during the 1980s and early 1990s, Table 8 columns 3 and 4 show that the growth of output continued to outpace the growth of inputs; Table 9 column 2 shows that productivity trends continued to rise. During this time and during the early reform period, China's total factor productivity (TFP) rose at the healthy rate of 2 percent per year. Such a rise, which occurred in all provinces and with all crops, must have increased the incomes of all farmers regardless of whether the crop was being protected or taxed.

It is possible that the extension of new technologies might have favoured wealthier farmers at the expense of poorer farmers, but this does not seem to have happened in China. Huang *et al.* (2002 and 2007) show that when new technologies are released, poor farmers are just as likely to adopt them as wealthier farmers; Jin *et al.* (2001) showed that TFP in poorer areas also rose very fast. There is no measurable negative impact of the extension of new agricultural technologies on the poor in China.

POLICIES TO ENCOURAGE MARKET INTEGRATION AND EFFICIENCY

Price and marketing reforms have been important components of China's transition from a centrally planned to a market-oriented economy. These policies were implemented in a gradual way (Sicular, 1995). In the initial years there was little effort to create an economy in which most resources and factors were allocated according to market price signals. But as officials in charge of economic reform began to be committed to using markets as the primary means of allocating resources for the economy, commitment to allowing markets in agriculture also increased (Sicular, 1995).

As markets began to emerge, China's leaders encouraged market efficiency and, more

important, stepped aside and allowed them to expand in an environment with minimum distortions. National and provincial governments invested in roads, landline telephones and cellular technology, which reduced transaction costs and accelerated the flow of information and goods (Park *et al.*, 2002). Many regional and local governments invested in internet marketing sites and tried to attract commercial interests to set up businesses. Except for a short period in the late 1990s, government officials have stepped back and allowed the entry of private traders and private transport and done little to interfere with markets. Licensing fees and taxes are low or non-existent. Markets were encouraged for agricultural outputs and inputs.

In assessing the health of the rural economy it is important to understand how China's markets function. Markets, whether classical competitive markets or some workable substitute, increase efficiency by facilitating transactions among agents to allow specialization and trade and by providing producers and consumers with information about the relative scarcity of resources through a pricing mechanism. With better markets, producers can begin to specialize, become more efficient and increase their incomes.

According to price data from private sources and information firms, it appears that China's markets function relatively well: maize prices in four different cities in northeast China, for example, track each other closely (Rozelle and Huang, 2003, graph 1). Soybean prices in markets in different regions move in almost perfect concert (Rozelle and Huang, 2004, figure 2). Systematic study of the integration of markets over time shows that the share of markets that are integrated has risen from 50 percent in the early 1990s to virtually 100 percent in the early 2000s (Huang *et al.*, 2004, table 10). Rice markets have also been shown to function as well as or better than those in the United States in terms of the efficiency of moving commodities between China's producing and consuming regions (Huang *et al.*, 2004). Horticultural, dairy and livestock markets are dominated by millions of small traders operating in extremely competitive environments (Rozelle *et al.*, 2008).

The improvement in markets has allowed individual producers to specialize as never before. According to one national survey the number of villages that have become specialized producers of a single commodity rose from 20 percent in 1995 to 40 percent in 2004 (Rosen *et al.*, 2004). Such integration has allowed small farmers to participate in emerging markets and to accrue the substantial income gains associated with moving from subsistence to marketing (Wang *et al.*, 2007; Balat and Porto, 2006). A recent survey of the Beijing area found that small farmers living in poor villages were the main beneficiaries of new demand for horticultural products.

Most important, when markets in China began to become more competitive and efficient they led to increased productivity and efficiency (de Brauw *et al.*, 2004). Even where market and trade liberalization reduced protection and adversely affected incomes, the effects of rising productivity and efficiency have at least partly offset these negative impacts. This interpretation is supported by the modelling in Huang and Li (2003), which finds that trade policy positively affects some prices, for example horticultural crops, but negatively affects others such as wheat and causes farmers to mitigate the downside effects by transferring production into commodities with rising prices.

Since 2004, in the wake of China's domestic market liberalization, policymakers have been concerned about the possible effects on incomes of a possible severe drop in agricultural prices. The Government, fearing that low prices might adversely affect national food production and farmers' incomes, began to plan for such a contingency by

announcing a "minimum agricultural pricing policy". This is intended to work by authorizing managers of grain reserves to buy rice, wheat and maize aggressively when market prices reach a set minimum and place them in storage. The policy does not authorize the grain managers to give farmers a certain price for any grain sold to them, as pricing policy in the United States once did. With less grain on the market, prices should stabilize.

Unfortunately, it is impossible to know how well this policy works because it has never been tried: since its inception, price pressure has been high. The biggest issue in China's agricultural pricing was how to prevent prices from rising, so it is not clear how the policy will work when prices begin to fall. Those interested in China's price management during the food price volatility of 2007 and 2008 should study Yang *et al.* (forthcoming).

PUBLIC FISCAL REFORMS AND INVESTMENT IN AGRICULTURE/EXPANSION OF RURAL INFRASTRUCTURE AND PUBLIC SERVICES

China has made several reforms to increase fiscal revenue and public investment. The Government has made considerable progress in supporting public finances since the early 1990s. If extra budgetary and social security funds are included, government spending was 25 percent of GDP by 2006, comparable with lower-income Organisation of Economic Co-operation and Development (OECD) countries and higher than most East Asian countries. China has maintained a prudent fiscal policy with low deficits and debt in terms of GDP while higher government spending stimulated the economy.

Government expenditures in most areas of agriculture increased gradually during the reform period, but the ratio of agricultural investment to agricultural GDP steadily declined from the late 1970s to the mid-1990s. In 1978, officials invested 7.6 percent of GDP in the agricultural sector; by 1995 the proportion of GDP committed to such investment had fallen to 3.6 percent (NSBC, 2001). There was significant capital outflow from agriculture to industry and from rural to urban areas during the 1980s and 1990s through the financial system and government agricultural procurement (Huang *et al.*, 2006; Nyberg and Rozelle, 1999). From the mid-1990s, China significantly increased its investment in agriculture and rural development and reduced the agriculture tax; this was eliminated in 2005/06.

Investment at the Local Level

Any visitor to rural China is struck by one thing: agriculture is still being carried out in many places in a manner that can only be described as backward. Apart from a few suburban and coastal regions, infrastructure in rural China is poor: roads, bridges, irrigation, drainage, drinking water, schools and health facilities are decades behind the infrastructure in cities. Yet development economists know that if a country is to modernize its infrastructure must be able to support the production and marketing activities of a complex economy.

But there have been improvements in recent years. Research shows that on average each village in China had one infrastructure project during the late 1990s, far more than most other developing nations in Asia. Investment activity has increased sharply in recent years to almost one project per year (Luo *et al.*, 2007, table 10). Most of these projects are public goods and not activities, such as orchards, in which governments frequently invested during the 1980s. Research also suggests that this investment is being targeted well, with increasing amounts going to poor people, minorities and remote parts of China.

Although the level of per capita investment in public goods has risen from US$40 to US$100 in PPP terms, it is still far below the levels enjoyed by rural residents in Japan during the 1950s and in South Korea during the 1970s (Luo *et al.*, 2007). Quality is rising, but it is still low in many villages (Liu *et al.*, 2007). China is just beginning to narrow the gap between rural and urban infrastructures; an enormous sustained effort will be required to transform the rural economy.

Education and Health Programs

Rural services, particularly education and health, may be the weakest part of the rural economy, despite recognition of their importance by development economists. Rural education is very poor by any standards. China is close to achieving universal compulsory education for nine years, but until recently fees were high, even for elementary schools (see next paragraph for discussion of recent fee exemptions); buildings and equipment are outdated and the quality of teaching is poor. There is evidence that China is not providing enough education for its rural population, even as it accelerates its drive towards industrialization and urbanization and as agriculture becomes more complex and demanding. School fees accounted for an estimated 25 percent of total expenditure for many poor households, which is partly why attendance rates at high school grades 10–12 are less than 15 percent among poor rural people. A national survey found that nearly half of rural residents believe that education has not improved in recent years (Liu *et al.*, 2007).

There has been renewed government interest in improving education and reducing the cost, especially in poor rural areas. In 2005, fees for elementary schools were eliminated in poor areas; in 2006 this was extended to the entire rural economy and by 2007 all compulsory education was free. The income effects of such policies are potentially enormous: Huang *et al.* (2004) show that the elimination of government tuition fees provided a benefit twice as large as the losses resulting from tariff reductions for China's protected crops. China has also launched a massive investment effort to improve the quality of facilities and teachers. There is still a long way to go, but progress is being made in building the foundation of tomorrow's labour force in agriculture and other sectors.

The national and regional governments have also begun to build a rural healthcare system: the New Cooperative Medical System was in high demand in its initial years, when funding was scarce; by 2007, the Government was investing up to CNY40 (US$5.3; US$22 in PPP term) per capita in the system and in 2008 it was announced that investment would rise even further. But the programme covers a small fraction of rural out-of-pocket medical costs, and many rural people report that they do not seek healthcare because it is too expensive. Keeping the population healthy and well nourished has been a fundamental part of China's success, and it remains a significant challenge. Readers interested in this should study Yi *et al.* (2008).

Farm Subsidies and Taxes

The Government launched a major programme of direct subsidies in 2004 and is debating the extent to which these should be increased. The national grain subsidy system, which is designed to increase the production of grain for national food self-sufficiency and to be a rural income-transfer programme, is a combination of four elements: i) subsidies for farmers in areas that grow grain; ii) nation-wide agricultural seed subsidies; iii) input subsidies – payments to help

farmers to cope with the rising costs of fertilizer and other inputs; and iv) a general transfer programme.

Nearly 80 percent of farm households receive subsidies. Participation in the programme is as high in poor areas as it is in wealthier areas (Tan *et al.*, 2006). Payments were relatively small in the first year of the programme, but by the second year many farmers were receiving CNY20–30 (US$3.50, or US$11–17 in PPP terms) per *mu* (15 mu = 1 ha).

The Government has also eliminated almost all taxes and fees in villages. In 2001 and 2002, fees were converted to a single agricultural tax that was not to exceed 8.5 percent of the gross value of agricultural output of a household or village. But no sooner had this been implemented than the tax was eliminated altogether. Surveys show that by 2007 farmers were paying almost no taxes.

A new low-income programme is also being launched across China with a view to developing a social safety net system for people in the rural economy. The current annual payments – CNY200 (US$26.3, or US$111 in PPP terms) – are low, but coverage is broad. A recent survey by the Centre for Chinese Agricultural Policy found that 6 percent of rural households and 10 percent of households in poor rural areas are receiving these transfers. Possible future increases in the annual amounts would help to eliminate much of the remaining absolute poverty and undernutrition in China.

Taken together, the recent policy innovations in rural infrastructure, free tuition in rural schools, agricultural subsidies, tax reductions and health insurance subsidies are substantial: they have contributed significantly to the observed improvements in household incomes in rural areas.

IMPROVING MOBILITY OF LABOUR OUT OF AGRICULTURE

China began the reform period with most of its workforce in agriculture and, according to Gillis *et al.* (1996) and others China will have to reduce this to a few percent by the time it reaches high-income status if it is to be considered successful in its modernization. In the early years of China's reforms, the 1980s and early 1990s, there were those who resisted this idea: some officials thought that it would be more attractive if China could keep most of its rural labour force on the land and resist the massive urbanization that occurred in other developing countries.

In recent years there has been a clear acceptance of the need to shift most of China's agricultural labour force to the industrial and service sectors and most of the rural population to towns. This consensus can be seen in many recent policies such as those aiming to give migrants legal status in cities, those aiming to increase protection in the labour force and those aiming to facilitate migrants' access to health and education services. These changes are driven largely by a leadership that has accepted the fact that most of the labour force in developed countries is in the industrial and service sectors and most of the populations are in towns.

Can this shift in policy be associated with changes to the rural labour force? The rate of migration out of agriculture is consistent with China's growth and is one of the most rapid ever observed. A study by the Centre for Chinese Agricultural Policy showed that 80 percent of rural labourers have shifted their employment into the off-farm sector (Zhang *et al.*, 2008, table 12). More and more employment opportunities for the migrant labour force are in cities; there are probably 170 million rural migrants in China's cities. The self-employed sector in rural China, which employs 80 million people, is

becoming more profitable and capital-intensive as it shifts to more sophisticated industrial and service sectors.

Have farmers benefited? Migration is without doubt one of the driving forces in the increase in the well-being in the rural economy. Rozelle (1996) showed that obtaining access to off-farm jobs was the most effective way for rural households to raise their incomes. De Brauw and Giles (2008) link migration with rising rural incomes and a falling poverty rate.

At one time in the 1990s there was a downside to the rise in off-farm employment and migration: when some families got off-farm jobs and increased their incomes more than others, inequality in the rural sector increased; Rozelle (1996) demonstrates this linkage clearly for the 1980s and early 1990s. Most households now have at least one person working off-farm. Rozelle *et al.* (2008) report that income inequality in rural areas is now falling because of migration.

Are there still problems? Yes, there are many. Although 60 percent of the rural labour force have off-farm jobs, there are still 200 million people who do not. Many of the jobs are unskilled. Wages are still low.

What are the constraints to making more permanent shifts in labour from rural to urban areas and from the agricultural to the industrial and service sectors? Having enough jobs, as always, is one constraint. Beyond the creation of more jobs, which is not a rural policy issue, there are other barriers. In most rapidly growing economies, poor human capital is frequently seen as the most serious constraint. The usual resistances to out-migration of labour are compounded by a number of China-specific factors: one is the *hukou* residence permit system, which has restricted the movement of labour into towns (Zhao, 1999); another is the land tenure system, where households leaving the agricultural sector are not able to collateralize their land; and despite official policies that state otherwise, there are still some villages in which families migrating to cities are pressured to relinquish their land (Zhao, 1999). Other China-specific resistance comes from institutional barriers that keep rural and urban populations separate: for example, there are still inequities in levels of spending and access with regard to education, health and welfare services.

OTHER POLICIES

In addition to these policies on cultivated land, agricultural technology, promotion of markets, investment in agriculture and the rural economy and labour market initiatives, there are many others that we are unable to address because of space limitations. In the rest of this section we touch on some of the more obvious omissions and suggest other papers that might enhance understanding of them.

The most glaring omission concerns the agricultural trade policy. Trade is important because it provides export opportunities for farmers and is a way to increase access to better and less expensive commodities. It is also a way to allow world markets to send signals to China's policymakers, agricultural producers and others as to the commodities in which China has a comparative advantage and those in which it does not. If such signals are allowed to get through to farmers through liberalized trade policies in addition to the domestic market reforms discussed above, the economy will become more efficient and increase incomes. It is important to note, however, that trade liberalization will hurt some groups in China.

China has been very successful in its efforts to liberalize agricultural trade. Trade barriers have fallen. Rights to import have been extended in the case of most commodities to thousands of private traders and trading enterprises. Non-tariff barriers have been reduced. On the one hand there is evidence

that China has responded to signals from world markets and made adjustments in its production structure to reflect its comparative advantage; on the other, China has tried to minimize the impact on those hurt by trade liberalization. Readers should consult Huang *et al.*, (2004) for more details.

A great deal of work has also been done on water policy. Before economic reform the state focused largely on building dams and canal networks, and China today has one of the most irrigated agriculture's in the world. China's surface water management is advanced, and flood control is being maintained.

After the 1970s there was greater focus on increasing the use of China's vast groundwater resources (Wang *et al.*, 2005), but the country had little experience of managing them. By 2005 China had more tube wells than any country in the world except possibly India. Investment was initially put up by local governments with support from county and provincial water bureaux, but by the 1990s the Government was encouraging the huge shift in ownership that was occurring as pumps, wells and other irrigation equipment went largely into the hands of private farming families (Wang, 2000). At the same time private water markets, in which farmers pumped water from their wells and sold it to other farmers, were also encouraged. After the mid-1990s, the main policy initiative in the surface water sector was management reform with the goal of trying to make water use more efficient.

This investment in groundwater is a tale of good news and bad news. New sources of groundwater are increasing agricultural cultivated area and have been shown to increase farmers' incomes and productivity (Huang *et al.*, 2006), and the privatization movement has made water management more efficient (Wang *et al.*, 2008). But China's groundwater is currently in crisis in many places: groundwater tables are falling and many wells are being pumped dry. There is no immediate danger in these areas of China, but in the longer term these sustainability issues need to be addressed. Interested readers should study Wang *et al.* (2008) for a summary of China's agricultural water management policies, successes and challenges.

Other rural policies, for example those that govern the emergence of village enterprises, privatization and rural governance, almost certainly have a large indirect effect on agriculture. Urban employment policies, residence restrictions, exchange rate management and other policy initiatives also have an impact on agriculture by affecting relative prices in the economy, access to off-farm jobs and the attractiveness of staying on farms. Brandt and Rawski (eds., 2008) is perhaps the best source today on the economic reforms and current and future economic policy issues.

Summary and Lessons

Together, the policies discussed above have had a dramatic effect on China's agricultural sector: they have increased the output of food, driven prices down and improved supplies of non-grain food and raw materials for industry. The mix of policies – pricing, improved property rights, market liberalization, investment and trade – has made producers more efficient and has freed the labour and resources behind the structural transformation of the agricultural economy and the broader rural economy.

One of the most convincing indications that agriculture is beginning to have an effect in China's development is that the importance of grain is declining in the crop sector, the importance of cereal crops is declining in the agricultural sector and the share of agriculture is shrinking in the national economy. But food prices remain low, the calories available for the population are more than sufficient, and rural productivity and incomes are increasing.

Many of the improvements in welfare, however, are being generated by the 200 million individuals who have been able to move from grain into high-value crops, from crop production into livestock and fisheries and, most important, from agriculture and the rural economy into jobs in cities.

THE MAIN CHALLENGES TO CHINA'S DEVELOPMENT

Despite these successes, many challenges remain. There are challenges of equity and income distribution affecting people who have not been able to participate in China's overall economic growth. And although overall success on the economic front is clear, the impact of development on the environment and natural resources is yet to be determined. Finally, there are food security concerns in terms of the impact of the new policies on long-term nutrition and access to food.

Equity and Income Distribution.

Despite the notable progress in agriculture, there are many lessons and challenges ahead. The transition to a market-oriented rural economy is largely complete, but China's main challenge has shifted to broader development issues: in the coming years the development process will have to be fundamentally different from earlier efforts, whose goals were meeting the nation's food needs, poverty reduction and economic growth.

China's rapid economic growth and the increase in the nation's wealth have been accompanied by increasing income inequality. Regional income disparity has been enlarging since 1980s (Cai *et al.*, 2002; World Bank, 2002), with eastern China growing faster than central and western China. After the one-time impact of the rural institutional reforms, income growth in towns has been consistently higher than in rural areas: by 2004 per capita income in towns was 3.21 times greater than in the rural areas (NSBC, 2005). Rising income disparity in rural areas has also emerged: Gini coefficients in rural areas, for example, increased from 0.24 in 1980 to 0.37 in 2003 (NSBC Rural Survey Department, 2004).

In the coming years these concerns have to be faced. The policies of investment in agriculture and infrastructure, the increase in labour mobility and the development of a set of public services will have a part to play.

Natural Resources and the Environment.

Innovations in technology will help China to increase its agricultural productivity, but it must address water scarcity. Water shortages and increasing competition from industry and domestic use offer little hope for large increases in the areas under irrigation and related increased output (Lohmar *et al.*, 2003). This is particularly important in the North China Plain, where most of China's wheat and some of its maize are produced. Although China's land policy helped to increase agricultural productivity in the early reform period and contributed significantly to the reduction of rural poverty, land holdings are so small that farming alone cannot continue to raise the incomes of most rural households. The challenge is to establish linkages between rural and urban areas and encourage a large shift of labour out of agriculture. There is also a danger that poor under-educated small farmers may not have the means or the incentive to make farming decisions that contribute to long-term sustainable development.

Trends in environmental degradation suggest that there is considerable stress on the agricultural land base. Judicious use of modern technologies is essential for the efficient production of food, but inappropriate use of technologies such as excessive application of fertilizers and pesticides or imbalances in the combination of inputs can result in serious environmental problems and food safety concerns. China is now the world's largest consumer of chemical fertilizer and pesticide – but intensive use of these products can have adverse effects. There is growing concern about contamination of farm produce and damage to the agro-ecosystem and human health. Environmental stresses are evident in terms of soil erosion, salination, loss of cultivated land and declining land quality (Huang and Rozelle, 1995). Deng *et al.* (2006) show that although China did not record a decline in total cultivated land from the late 1980s to the late 1990s, average potential productivity of cultivated land – or bioproductivity – declined by 2.2 percent over the same period. And a large decline in cultivated land was recorded after the late 1990s as a result of industrial development and urban expansion.

These amount to concerns about future food security in that the pressures on the environment will undermine past progress in food production. Policies must therefore be evaluated in terms of the balance between current and future food production.

PROSPECTS FOR CHINA'S AGRICULTURE IN THE FUTURE AND LESSONS FOR OTHER NATIONS

Nearly three decades of economic reform in China have achieved remarkable economic growth and structural changes. During the 1980s, 1990s and early 2000s China became one of the fastest growing economies in the world, with GDP growing by 10 percent annually. Over the course of the reform period, rural and urban incomes increased noticeably. Rising income was also associated with a substantial reduction of poverty and significant improvements in food security.

China's rapid growth would not have been possible without its economic transformation and its "open-door" policy. Growth in the agricultural sector facilitated the transition from a rural, agriculture-based economy to one based on urban industry and services. The growth in agricultural productivity enabled China to convert its large pool of rural labour into cheap labour for industrialization. Increasing international

trade and foreign direct investment was the other engine of economic growth and structural shifts to more competitive sectors.

Food security is a central aim of China's agricultural policy. Since the early 1980s reforms to increase agricultural growth and farm incomes have covered most aspects of the economy: these started with land reform and gradually moved to input and output markets and from agriculture-specific policies to macroeconomic policy. The reforms had significant impacts on the economy: China was able to feed its growing population from limited natural resources and developed itself as an exporter of food and agricultural products. Per capita availability of food, for which increased domestic production is almost solely responsible, household food security and nutrition have all improved significantly.

China's experience demonstrates the importance of technological development, institutional change, market liberalization, public investment and policies to improve agricultural productivity, farmers' incomes and food security in a nation with limited land and natural resources. Technology has been the engine of growth in China's agricultural economy. Institutional arrangements and government policies also play an important part in making food available for the whole Chinese population.

Challenges related to the agricultural sector remain, but we are optimistic with regard to China's future growth. China has established land policies, R&D policies and marketing policies and has invested in infrastructure, but future policies will need to balance growth, efficiency and equity and address the need for sustainable food security for China and the rest of the world.

This study also suggests significant policy implications for other developing countries, which can learn a great deal from the set of policies underlying China's progress. There are also possible gains from interaction: countries with agricultural economic structures complementary to China's may benefit from China's increasing imports of land-intensive agricultural products and exports of labour-intensive agricultural products. But countries with similar agricultural export structures, and therefore in competition with China, will have to work to reduce the costs of production and marketing.

Challenges in policy-making include deciding not only which policies to adopt but the order in which they should be adopted. Study of China's reforms reveals a clear order in the reform and development policies behind its growth during the past 30 years. China led with a set of reforms that provided incentives for farmers to increase their output and that gave them the benefits of their work. Land was not privatized, but use and income rights were. Farmers saw and exploited the opportunities to improve their lives. During and after the early reform period in the 1980s, the Government invested in agricultural technology and made sure it was available to all farmers, large and small, rich and poor. The second stage of reform saw improvements in markets and domestic prices. There were few markets in the 1980s, but throughout the 1990s markets were encouraged by removing regulation for entry, building transport and communication infrastructures and eliminating state activities in domestic trade. Labour markets were liberalized, and farmers were encouraged to search for off-farm employment outside villages and for self-employment. As domestic markets developed it became clear that better incentives and clearer price signals would be produced if China's external sector were liberalized. During this second period, state investments were mainly in regional projects for roads and communications. As

markets began to mature and the economy – which now had good incentives and sent out efficient price signals – China decided in the 2000s that its enormous rural/agricultural sector needed further encouragement. It therefore initiated local investment in poor communities in roads, irrigation, drinking water, public education and health services, and direct subsidy programmes.

The order in which development policies are implemented is subject to country-specific factors that cannot be discussed here. Swinnen and Rozelle (2006), however, examine the development record of 20 nations in transition between the early 1980s and the 2000s: they consider why some were successful and others were not and try to identify the various political and economic factors involved. Their argument is that at least four groups of factors determine the order and pace of development policy implementation: i) the nature of a nation's agricultural technology; ii) the extent to which the state commands fiscal resources; iii) the politics of the country and the extent of political support for reform and development; and iv) cultural and other factors such as the nature of ties with developed regions. Policymaking is more of an art than a science, and good governance is a necessary condition for launching a successful development or transition process.

References

Balat, J. & G. Porto. 2006. The WTO Doha Round, Cotton Sector Dynamics, and Poverty Trends in Zambia. *In* Hertel, T. and L.A. Winters (eds.) *Poverty and the WTO: Impacts of the Doha Development Agenda*. Basingstoke, UK, and Washington DC, Palgrave Macmillan and the World Bank.

Brandt, L. & Rawski, T.G. (eds). 2008. *China's Great Economic Transformation*. Cambridge University Press, Cambridge, UK.

Brandt, L., Huang, J., Li, G. & Rozelle, S. 2002. Land Rights in China: Fact, Fiction, and Issues. *China Journal,* 47(1):67–97.

Brandt, L., Rawski, T.G. & Lin, G. 2005. *China's Economy: Retrospect and Prospect* (edited). Asian Program Special Report no. 129. Woodrow Wilson International Center for Scholars, Washington DC.

Branstetter, L. & Lardy, N. 2005. China's Embrace of Globalization. In: *China's Economy: Retrospect and Prospect* (edited). Asian Program Special Report no. 129. Woodrow Wilson International Center for Scholars, Washington DC.

Cai, F., Wang, D. & Du, Y. 2002. Regional Disparity and Economic Growth in China: the Impact of Labour Market Distortions. *China Economic Review*, 13(2–3):197–212.

Chen , C. 2004. *Ten Years: Tracks of China Nutrition Situation in 1990–2000*. Beijing, People's Health Press.

de Brauw, A. & Giles, J. 2008. *Migrant Labour Markets and the Welfare of Rural Households in the Developing World: Evidence from China*. Policy Research Working Paper Series 4585. Washington DC, World Bank.

de Brauw, A., Huang, J. & Rozelle, S. 2004. The Sequencing of Reform Policies in China's Agricultural Transition. *The Economics of Transition* 12(3):427–465.

de Brauw, A., Huang, J., Rozelle, S., Zhang, L. & Zhang, Y. 2002. China's Rural Labour Markets. *The China Business Review* (3–4):2–8.

Deng, X., Huang, J., Rozelle, S. & Uchida, E. 2006. Cultivated Land Conversion and Potential Agricultural Productivity in China. *Land Use Policy* 23:372–384.

Fan, S. 1991. Effects of Technological Change and Institutional Reform on Production Growth in Chinese Agriculture. *American Journal of Agricultural Economics* 73:266–275.

Fan, S. 1997. Production and Productivity Growth in Chinese Agriculture: New Measurement and Evidence. *Food Policy* 22 (3):213–228.

Fan, S. & Pardey, P. 1997. Research Productivity and Output Growth in Chinese Agriculture. *Journal of Development Economics* 53(6):115–137.

FAO. 2002. *The State of Food Insecurity in the World 2001*. Rome.

Giles, J. 2000. *Risk and Rural Responses in China*. Working paper. Michigan State University, East Lansing, MI, USA.

Gillis, M., Perkins, D., Roemer, M. & Snodgrass, D. 1996. *Economics of Development*. New York, W.W. Norton, 4th edition.

Hu, R., Shi, K., Cui, Y. & Huang, J. 2007. China's Agricultural Research Investment and International Comparison**.** *China's Soft-Science* 2:53–65.

Huang, J. & Bouis, H. 1996. *Structural Changes in Demand for Food in Asia*. Food, agriculture and the environment discussion paper. Washington DC, International Food Policy Research Institute.

Huang, J. & Chen, C. 1999. *Effects of Trade Liberalization on Agriculture in China: Institutional and Structural Aspects*. Bogor, Indonesia, United Nations Economic and Social Committee for Asia and the Pacific Regional Coordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific.

Huang, J., Hu, R. & Rozelle, S. 2003. *Agricultural Research Investment in China: Challenges and Prospects*. China Finance and Economy Press, Beijing.

Huang, J. & Li, N. 2003. China's Agricultural Policy Analysis and Simulation Model – CAPSiM**.** *Journal of Nanjing Agricultural University* 3(2):30–41.

Huang, J., Qiao, F., Zhang, L. & Rozelle, S. 2000. *Farm Pesticides, Rice Production and the Environment*. EEPSEA research report, 2001–RR3. Singapore, International Development Research Centre.

Huang, J. & Rozelle, S. 1995. Environmental Stress and Grain Yields in China**.** *American Journal of Agricultural Economics* 77:853–864.

Huang, J. & Rozelle, S. 1996. Technological Change: Rediscovery of the Engine of Productivity Growth in China's Rural Economy. *Journal of Development Economics* 49(2):337–369.

Huang, J. & Rozelle, S. 1998. Market Development and Food Consumption in Rural China. *China Economic Review* 9:25–45.

Huang, J. & Rozelle, S. 2003. Trade Reform, WTO and China's Food Economy in the 21st Century. *Pacific Economic Review* 8(2):143–156.

Huang, J. & Rozelle, S. 2006. The Emergence of Agricultural Commodity Markets in China. *China Economic Review* 17:266–280.

Huang, J., Rozelle, S. & Chang, M. 2004. Tracking Distortions in Agriculture: China and its Accession to the World Trade Organization. *World Bank Economic Review* 18(1):59–84.

Huang, J., Rozelle, S. & Pray, C. 2002. Enhancing the Crops to Feed the Poor. *Nature* 418(8):678–684.

Huang, J., Hu, R., Rozelle, S. & Pray, C. 2005. Insect-Resistant GM Rice in Farmer Fields: Assessing Productivity and Health Effects in China. *Science* 308:688–690.

Huang, J., Rozelle, S., Pray, C. & Wang, Q. 2002. Plant Biotechnology in China. *Science* 295:674–677.

Huang, J, Rozelle, S. & Rosegrant, M. 1999. China's Food Economy to the 21st Century: Supply, Demand and Trade. *Economic Development and Cultural Change* 47:737–766.

Huang, J., Rozelle, S. & Wang, H. 2006. Fostering or Stripping Rural China: Modernizing Agriculture and Rural to Urban Capital Flows. *The Developing Economies* XLIV–1:1–26.

Huang, Q., Lohmar, B., Rozelle, S., Huang, J. & Wang, J. 2006. Irrigation, Agricultural Performance and Poverty Reduction in China. *Food Policy* 31:32–52.

Jin, S., Huang, J., Hu, R. & Rozelle, S. 2002. The Creation and Spread of Technology and Total Factor Productivity in China's Agriculture. *American Journal of Agricultural Economics* 84(4):916–939.

Jin, S., Ma, H., Huang, J., Hu, R. & Rozelle, S. 2007. *Productivity, Efficiency and Technical Change: Measuring the Performance of China's Transforming Agriculture*. Paper for conference: Trends and Forces in International Agricultural Productivity Growth, Washington DC.

Lardy, N.R. 2001. *Integrating China into the Global Economy*. Washington DC, Brookings Institution.

Lardy, N.R. 1995. The Role of Foreign Trade and Investment in China's Economic Transition. *China Quarterly* 144:1065–1082.

Lin, J.Y. 1992. Rural Reforms and Agricultural Growth in China**.** *American Economic Review* 82:34–51.

Liu, C., Zhang, L., Huang, J. & Rozelle, S. 2007. *Quality and Quantity Trade-Offs in the Public Goods Investments in Rural China*. Working paper, Centre for Chinese Agricultural Policy. Beijing, Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences.

Lohmar, B., Wang, J., Rozelle, S., Huang, J. & Dawe, D. 2003. *China's Agricultural Water Policy Reforms: Increasing Investment, Resolving Conflicts and Revising Incentives*. Agriculture Information Bulletin no. 782. Washington DC, United States Department of Agriculture Economic Research Service.

Luo, R., Liu, C., Zhang, L. & Rozelle, S. 2007. *Investing in Rural China: a Report on a Survey of Public Infrastructure Investment*. Working paper. Beijing, Centre for Chinese Agricultural Policy, Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences.

Ma, H., Rae, A., Huang, J. & Rozelle, S. 2006. *Enhancing Productivity on Suburban Dairy Farms in China*. Working paper. Palo Alto, CA, USA, Stanford University Freeman Spogli Institute for International Studies.

McMillan, J., Walley, J. & Zhu, L. 1989. The Impact of China's Economic Reforms on Agricultural Productivity Growth. *Journal of Political Economy* 97:781–807.

Ministry of Agriculture. *China Agricultural Development Report, 2000 and 2002*. Beijing, China Agricultural Press.

Ministry of Foreign Affairs and United Nations. 2008. *China's Progress towards the Millennium Development Goals*. Beijing.

Ministry of Foreign Trade and Economic Cooperation. 2002. *Foreign Trade and Economic Yearbook of China*. Beijing, China Statistical Press.

National Statistical Bureau of China. 1985–2008. *China Statistical Yearbook*. Various issues. Beijing, China Statistical Press.

National Statistical Bureau of China Rural Survey Department. 1982–2008. *China Rural Household Survey Yearbook*. Various issues. Beijing, China Statistical Press.

Nyberg, A. & Rozelle, S. 1999. *Accelerating China's Rural Transformation*. Washington DC, World Bank.

Park, A., Jin, H., Rozelle, S. & Huang, J. 2002. Market Emergence and Transition: Arbitrage, Transition Costs and Autarky in China's Grain Market. *American Journal of Agricultural Economics* 84(1):67–82.

Pray C., Rozelle, S. & Huang, J. 1997. *Can China's Agricultural Research System Feed China?* Working paper. New Brunswick, NJ, USA, Rutgers University Department of Agricultural Economics.

Rae, A.N., Ma, H., Huang, J. & Rozelle, S. 2006. Livestock in China: Commodity-Specific Total Factor Productivity Decomposition Using New Panel Data. *American Journal of Agricultural Economics* 88(3):680–695.

Rosen, D., Huang, J. & Rozelle, S. 2004. *Roots of Competitiveness: China's Evolving Agriculture Interests*. Policy Analysis in International Economics, vol. 72. Washington DC, Institute for International Economics.

Rozelle, S. 1996. Stagnation Without Equity: Patterns of Growth and Inequality in China's Rural Economy. *China Journal* 35(1):63–96.
Rozelle, S., Huang, J. & Otsuka, K. 2008. Agriculture in China's Development: Past Disappointments, Recent Successes and Future Challenges. *In* Brandt, L. & Rawski, T. (eds) *China's Great Economic Transformation*. Cambridge, UK, Cambridge University Press.

Rozelle, S. & Huang, J. 2003. *China's Maize Economy: Supply, Demand and Trade*. Report for the United States Grains Council. Beijing.
Rozelle, S. & Huang, J. 2004. *China's Soybean Economy: Supply, Demand and Trade*. Report for the American Soybean Association. Beijing. Sicular, T. 1995. Redefining State, Plan and Market: China's Reforms in Agricultural Commerce. *The China Quarterly* 144:1020–46.

Sonntag, B.H., Huang, J., Rozelle, S. & Skerritt, J.H. 2005. *China's Agricultural and Rural Development in the Early 21st Century*. Canberra, Australian Centre for International Agricultural Research.

Swinnen, J. & Rozelle, S. 2006. *From Marx and Mao to the Market: the Economics and Politics of Agrarian Transition*. Oxford, UK, Oxford University Press.

Tan, X., Luo, R. & Rozelle, S. 2006. *The Effects of Direct Farm Subsidies on the Income of Farmers in China*. Working paper, Center for Chinese Agricultural Policy. Beijing, Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences.

Turgis, C. 2008. *Food Security in China*. Working paper, United Nations World Food Programme. Beijing.

United Nations. 2005. *World Population Prospects*. New York.

United Nations Development Programme. 2008. *China Human Development Report 2007/08: Basic Public Services for 1.3 Billion People*. Beijing.

Wang, J. 2000. *Property Right Innovation, Technical Efficiency and Groundwater Management: Case Study of Groundwater Irrigation System in Hebei, China*. Ph.D. thesis. Beijing, Chinese Academy of Agricultural Sciences.

Wang, J., Huang, J., Huang, Q. & Rozelle, S. 2006. Privatization of Tubewells in North China: Determinants and Impacts on Irrigated Area, Productivity and the Water Table. *Hydrogeology Journal* 14(3):275–285.

Wang, J., Huang, J., Rozelle, S., Huang, Q. & Zhang, L. 2008. *Understanding the Water Crisis in Northern China: What are the Government and Farmers Doing?* Working paper, Centre for Chinese Agricultural Policy. Beijing, Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences.

Wang, H., Dong, X., Huang, J., Reardon, T. & Rozelle, S. 2007. *Small Traders and Small Farmers: the Evolution of China's Horticulture Economy*. Working paper, Centre for Chinese Agricultural Policy. Beijing, Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences.

World Bank. 2002. *World Development Indicators 2002*. Washington DC.

World Bank. 2008a. *World Development Report 2008*. Washington DC.

World Bank. 2008b. *China Quarterly Update (1 December 2008)*. Washington DC.

Yang, J., Huanguang, Q., Huang, J. & Rozelle, S. 2008. Fighting Global Food Price Rises in the Developing World: the Response of China and its Effect on Domestic and World Markets. *Agricultural Economics*. Forthcoming.

Yi, H., Zhang, L., Rozelle, S. & Atlas, S. 2008. *China's New Cooperative Medical System: Trends, Successes and Challenges*. Working paper, Centre for Chinese Agricultural Policy. Beijing, Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences.

Zhang, L., Li, X., Rozelle, S. & Huang, J. 2008. *Rural Labour and Educational Challenges in Rural China*. Working paper, Centre for Chinese Agricultural Policy. Beijing, Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences.

Zhao, Y. 1999. Leaving the Countryside: Rural-to-Urban Migration Decisions in China. *American Economic Review* 89(2):281–286.

Tables

Table 1. Annual Growth Rates of China's Economy, 1970–2007 (%)

	Pre-reform	Reform period				
	1970-1978	1979-1984	1985-1995	1996-2000	2001-2005	2006-2007
GDP	4.9	8.8	9.7	8.2	9.9	11.8
Agriculture	2.7	7.1	4.0	3.4	4.3	4.4
Industry	6.8	8.2	12.8	9.6	11.4	13.2
Service	Na	11.6	9.7	8.3	10.1	12.4
Foreign trade	20.5	14.3	15.2	9.8	25.3	19.4
Import	--	12.7	13.4	9.5	24.9	16.2
Export	--	15.9	17.2	10.1	25.7	22.1
Population	1.80	1.40	1.37	0.91	0.63	0.5
Per capita GDP	3.1	7.4	8.3	7.2	9.0	11.3

Note: Figure for GDP in real terms in 1970–1978 is the growth rate of national income in real terms. Growth rates are computed using the regression method; trade growth is based on current value in US$.
Source: NSBC, Statistical Yearbook of China.

Table 2. Changes in the Structure of China's Economy, 1970–2007 (%)

	1970	1980	1985	1990	1995	2000	2005	2007
Share in GDP								
Agriculture	40	30	28	27	20	15	12	11
Industry	46	49	43	41	47	46	48	49
Services	13	21	29	32	33	39	40	40
Share in employment								
Agriculture	81	69	62	60	52	50	45	41
Industry	10	18	21	21	23	22	24	27
Services	9	13	17	19	25	28	31	32
Trade to GDP ratio	Na	12	23	30	40	44	64	67
Export/GDP	Na	6	9	16	21	23	34	37
Import/GDP	Na	6	14	14	19	21	30	29
Share of rural population	83	81	76	74	71	64	57	55

Source:National Statistical Bureau, China Statistical Yearbook, various issues; and China Rural Statistical Yearbook, various issues.

Table 3. Annual Growth Rates of China's Agricultural Economy, 1970–2005 (%)

	Pre-reform	Reform period			
	1970-1978	1979-1984	1985-1995	1996-2000	2001-2005
Agricultural GDP	2.7	7.1	4.0	3.4	4.3
Rice:					
Production	2.5	4.5	0.6	0.4	-0.8
Area	0.7	-0.6	-0.6	-0.5	-0.8
Yield	1.8	5.1	1.2	0.8	0.0
Wheat:					
Production	7.0	8.3	1.9	-0.6	-0.4
Area	1.7	-0.0	0.1	-1.6	-3.1
Yield	5.2	8.3	1.8	1.0	2.7
Maize:					
Production	7.4	3.7	4.7	-1.3	5.6
Area	3.1	-1.6	1.7	0.8	2.7
Yield	4.2	5.4	2.9	-0.9	2.9
Other production					
Cotton	-0.4	19.3	-0.3	-1.9	5.3
Soybean	-2.3	5.2	2.8	2.6	1.4
Oil crops	2.1	14.9	4.4	5.6	0.8
Fruits	6.6	7.2	12.7	10.2	21.0
Meats (pork/beef/poultry)	4.4	9.1	8.8	6.5	4.9
Fishery	5.0	7.9	13.7	10.2	3.6
Planted area:					
Vegetables	2.4	5.4	6.8	9.8	3.1
Orchards (fruits)	8.1	4.5	10.4	2.0	2.4

Note: Growth rates of individual and groups of commodities are based on production data.

Sources: NSBC, 1985–2006 and Ministry of Agriculture, 1985–2006.

Table 4. Output Value Shares in China's Agricultural Economy, 1970–2007 (%)

	1970	1980	1985	1990	1995	2000	2005	2007
Crop	82	76	69	65	58	56	51	52
Livestock	14	18	22	26	30	30	35	34
Fishery	2	2	3	5	8	11	10	10
Forestry	2	4	5	4	3	4	4	4

Source:National Statistical Bureau, China Statistical Yearbook, various issues; and China Rural Statistical Yearbook, various issues.

Table 5. Shares of Crop Sown Areas, 1970–2007 (%)

	1970	1980	1985	1990	1995	2000	2005	2007
Rice	22.1	23.1	21.9	22.3	20.5	19.2	18.6	18.8
Wheat	17.4	19.7	20.0	20.7	19.3	17.1	14.7	15.5
Maize	10.8	13.7	12.1	14.4	15.2	14.8	17.0	19.2
Soybean	5.5	4.9	5.3	5.1	5.4	6.0	6.2	5.7
Sweet potato	5.9	5.1	4.2	4.2	4.1	3.7	3.0	2.4
Cotton	3.4	3.4	3.5	3.8	3.6	2.6	3.3	3.9
Rapeseed	1.0	1.9	3.1	3.7	4.6	4.8	4.7	3.7
Peanut	1.2	1.6	2.3	2.0	2.5	3.1	3.0	2.6
Sugar crops	0.4	0.6	1.0	1.2	1.3	1.0	1.0	1.2
Tobacco	0.2	0.3	0.9	0.9	1.0	0.9	0.9	0.8
Vegetable	2.0	2.2	3.2	4.3	6.3	9.8	11.4	11.3
Others	30.1	23.5	22.5	17.4	16.3	17.2	16.2	14.9
Total	100	100	100	100	100	100	100	100

Source: NSBC, China's Statistical Yearbook, various issues; China Rural Statistical Yearbook, various issues.

Table 6. China's Food, Feed, Fibre and Non-Agriculture Trade, 1985–2005 (US$ million)

	SITC	1985	1990	1995	2000	2005
Exports						
Food and feed		3183	7515	10900	12804	23420
Live animals and meat	00-01	429	1221	1822	1619	2234
Dairy products	02	34	79	75	104	180
Fish	03	154	1370	2875	3661	7527
Grains	04	917	614	281	1812	1836
Fruit and vegetable	05	433	1760	3401	3362	7431
Sugar	06	65	318	321	257	502
Coffee and tea	07	312	534	512	545	1061
Animal feeds	08	225	758	351	303	497
Other foods	09	62	82	286	608	1182
Oilseeds and vegetable oils	22, 04	552	780	975	533	971
Fibre	26	892	1096	753	1085	1186
Non-agriculture		21557	53481	137126	235314	737347
Imports						
Food and feed		1437	4460	8825	8648	20747
Live animals and meat	00-01	24	68	115	667	691
Dairy products	02	29	81	63	217	461
Fish	03	41	102	609	1217	2904
Grains	04	829	2353	3631	662	1640
Fruit and vegetable	05	16	83	185	516	1349
Sugar	06	262	389	935	177	451
Coffee and tea	07	18	30	73	94	222
Animal feeds	08	79	305	423	909	1307
Other foods	09	21	46	88	283	354
Oilseeds and vegetable oils	22, 04	118	1003	2702	3906	11368
Fibre	26	1023	1975	4108	2846	6854
Non-agriculture		37335	46911	119150	213599	632352
Net export						
Food and feed		1746	3055	2075	4156	2673
Live animals and meat	00-01	405	1153	1707	952	1543
Dairy products	02	5	-2	12	-113	-281
Fish	03	113	1268	2266	2444	4623
Grains	04	88	-1739	-3350	1150	196
Fruit and vegetable	05	417	1677	3216	2846	6082
Sugar	06	-197	-71	-614	80	51
Coffee and tea	07	294	504	439	451	839
Animal feeds	08	146	453	-72	-606	-810
Other foods	09	41	36	198	325	828
Oilseeds and vegetable oils	22, 04	434	-223	-1727	-3373	-10397
Fibre	26	-131	-879	-3355	-1761	-5668
Non-agriculture		-15778	6570	17976	21714	104996

Source: UNCOMTRADE.

Table 7. Real Per Capita Net Income of Rural Households in China, by Province, 2000– 2005 (CNY 2005)

Province	2000	2005	Growth (%) in 2005 over 2000	Annual growth rate (%)
Beijing	4790	7346	53.36	8.93
Tianjin	3830	5580	45.68	7.82
Hebei	2711	3482	28.41	5.13
Shanxi	2127	2891	35.90	6.33
Inner Mongolia	2318	2989	28.97	5.22
Liaoning	2671	3690	38.18	6.68
Jilin	2215	3264	47.37	8.06
Heilongjiang	2339	3221	37.75	6.61
Shanghai	5809	8248	41.97	7.26
Jiangsu	3960	5276	33.25	5.91
Zhejiang	4603	6660	44.70	7.67
Anhui	2095	2641	26.08	4.74
Fujian	3467	4450	28.36	5.12
Jiangxi	2255	3129	38.77	6.77
Shangdong	2960	3931	32.80	5.84
Henan	2195	2871	30.80	5.52
Hubei	2526	3099	22.68	4.17
Hunan	2452	3118	27.17	4.92
Guangdong	3838	4690	22.22	4.10
Guangxi	1991	2495	25.32	4.62
Hainan	2346	3004	28.06	5.07
Chongqing	2015	2809	39.39	6.87
Sichuan	2109	2803	32.90	5.85
Guizhou	1513	1877	24.02	4.40
Yunnan	1615	2042	26.40	4.80
Tibet	1414	2078	46.99	8.01
Shanxi	1620	2053	26.68	4.84
Gansu	1656	1980	19.53	3.63
Qinghai	1729	2151	24.40	4.46
Ningxia	1891	2509	32.64	5.81
Xinjiang	1796	2482	38.24	6.69
National Average	2462	3255	32.21	5.74

Note: values are in real CNY 2005 using rural consumer price index by province.

The exchange rates were: CNY8.19 = US$1 in 2005; CNY1.8 = US$1 in PPP in 2003.

Data source: NBSC, Statistical Yearbook of China, 2001–2006.

Table 8. Annual Growth Rate of Yield and Total Cost of Main Grain Crop in China, 1985–2004 (%)

Crop	1985-1994		1995-2004	
	Output	Input	Output	Input
Early Indica	0.05	1.72	0.08	-2.31
Late Indica	1.37	2.12	0.80	-1.16
Japonica	1.79	3.99	0.17	-1.99
Wheat	2.84	2.58	1.38	-0.22
Maize	3.66	1.87	1.04	-0.63
Soybean	0.71	2.24	1.06	-1.36

Data source: Jin *et al.*, 2007.

Table 9. Annual Growth Rate of Main Grain Crops' TFP and Decomposition into TE[1] and TC[2] in China, 1985–2004

	1985-1994			1995-2004		
	TFP	TE	TC	TFP	TE	TC
Early Indica	1.84	-0.03	1.88	2.82	0	2.82
Late Indica	1.85	0.26	1.59	2.92	0.21	2.71
Japonica	-0.12	-0.37	0.26	2.52	0.15	2.37
Wheat	0.25	1.08	-0.83	2.16	1.06	1.10
Maize	1.03	0.61	0.42	1.70	-0.23	1.94
Soybean	0.11	0.19	-0.09	2.27	-0.08	2.35

1 Technical efficiency.

2 Technical change.

Data source: Jin *et al.*, 2007.

Table 10. Percentage of Market Pairs in Rural China that Test Positive for Integration on the Basis of the Dickey-Fuller Test, 1988–2000

Commodity	1989–1995	2000–2003
Maize	28	98
Soybeans	28	100

Note: Results are for two periods from same data set. For results for 1989–1995 for maize, see Park *et al.*, 2002. Results for soybeans for 1989–1995 and all results for 2000–2003 are from the authors (see Huang and Rozelle, 2006).

Table 11. Number and Size of Public Goods Projects, Weighted by Regional Population, 1998–2003

Project	Number of projects	Average size (CNY1,000)	Average size* In US$ PPP (US$1,000)	Accumulated distribution of projects
Roads and bridges	1266	112	62	21.2
Grain for Green	892	67	37	36.1
School construction	850	99	55	50.3
Irrigation and drainage	819	65	36	64.1
Drinking water	636	75	42	74.7
Loudspeaker for village committee	379	60	33	81.0
Recreation centre	262	50	28	85.4
Build clinic	163	25	14	88.2
Beautify environment	157	24	13	90.8
Watershed management	151	298	166	93.3
Forest closure	140	34	19	95.6
Land levelling	124	136	76	97.7
Eco-forest	55	34	19	98.6
Land improvement	52	110	61	99.5
Build pasture	19	134	74	99.8
Other public project	10	244	136	100.0
N / mean	5,975	108		--

* The following conversion rate is used: CNY1.80 =US$1 in PPP terms.

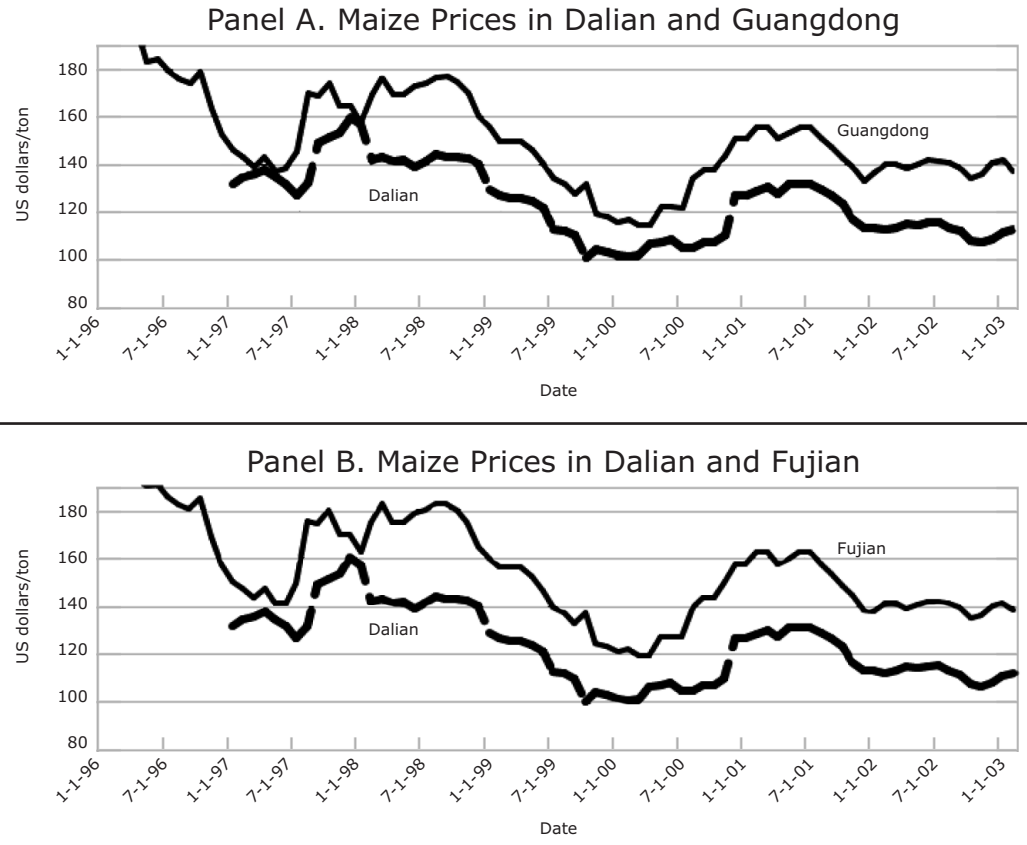
Data source: Luo *et al.*, 2007.

Table 12. Off-Farm Employment Participation by Members of Rural Labour Force, by Age Cohorts, 1990–2007

Age cohorts	Percentage with off-farm work in		
	1990 (from de Brauw *et al., 2002)*	2004 (from Zhang *et al., 2008)*	*2007 (from Zhang et al*., 2008)
16-20	23.7	78.6	93.1
21-25	33.6	82.8	87.5
26-30	28.8	71.0	76.4
31-35	26.9	65.1	67.2
36-40	20.5	54.0	65.7
41-50	20.8	44.0	54.1

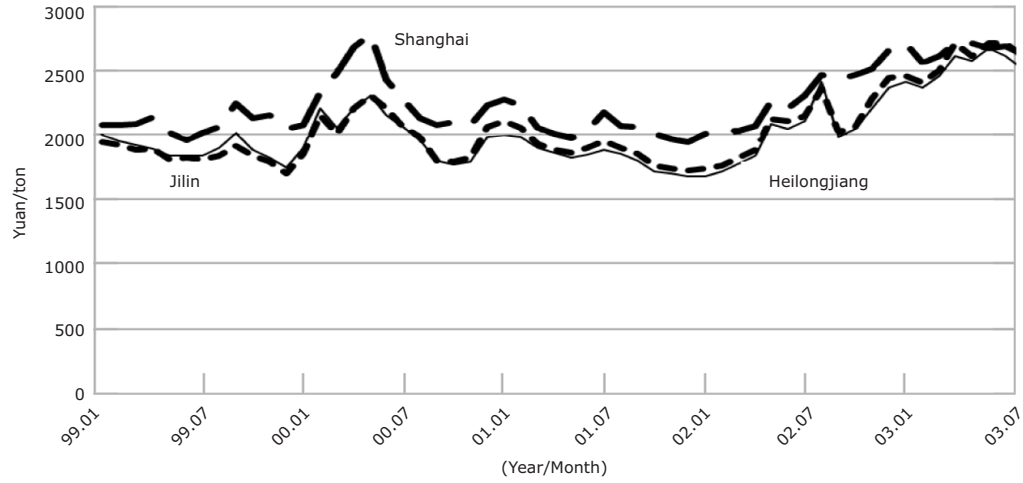
Graphs

Graph 1. Maize Prices in Guangdong, Fujian and Dalian, January 1996–February 2003



Data source: Huang and Rozelle, 2003.

Graph 2. Soybean Prices in Major Markets, 2001 and 2003



Data source: Huang and Rozelle, 2004.

Acronyms used in the document

FAO	**Food and Agriculture Organization of the United Nations**
GDP	**gross domestic product**
HRS	**household responsibility system**
IFAD	**International Fund for Agricultural Development**
MDG	**Millennium Development Goal**
OECD	**Organisation of Economic Co-operation and Development**
RLCL	**Rural Land Contract Law**
SAR	**Special Autonomous Region**
TFP	**total factor productivity**
UNDP	**United Nations Development Programme**
WFP	**World Food Programme**
WHO	**World Health Organization**

Printed: November 2009 - Layout images: from left to right, Imagebank; WFP/Tom Haskell

World Food Programme
China Office
UN Building
2 Liangmahe Nanlu
Beijing 100600
P.R. China

wfp.org.cn

WFP
wfp.org

World Food Programme