

Challenges to China's Continued Agricultural Modernization

Over the last three decades, the Chinese Government has largely relinquished its direct role in setting prices, procuring, and marketing agricultural commodities. Yet, many of the institutions that manage and regulate markets in more developed countries are not fully established in China. China's lack of market-supporting institutions, such as extensive property registration and a well-developed legal system to enforce laws and contracts, may impede the ability of the market to bring about efficient, equitable outcomes. Establishing those institutions, however, is not feasible in the short term.

Consequently, China still tends to rely on interventionist policies that use the remaining apparatus of the collective period to address issues that are typically resolved by independent institutions in more developed countries.¹⁵ While markets for inputs and outputs are well established, the Government still plays an influential "behind the scenes" role by controlling key factors of production (land and formal credit), ownership interest in some agribusiness enterprises, and arbitration of disputes. In the absence of private property and open, contestable dispute settlement institutions, Government officials play a key role in managing property rights, resolving disputes, and addressing complex problems related to food safety, environmental protection, and resource allocation.

Understanding the continued direct role of the Government in agricultural policies is important when evaluating the policy responses to the critical issues that continually confront China's leadership. Interventionist policies and practices can be implemented relatively quickly to address problems as they arise, but China's consumers and producers may be missing out on bigger longrun efficiency gains that could be achieved by establishing independent market-supporting institutions and allowing the private sector a greater role in investment and resource allocation. These more difficult reforms potentially could guide China's continued transformation into a modern industrialized economy with a healthy, dynamic agricultural sector.

China faces several challenges as it modernizes its agricultural sector. Resources in China are showing signs of over use, prompting policies to reduce intensive use of chemical inputs and promote land and water conservation. Moreover, as labor leaves agriculture, demand for more flexible land management institutions is rising. China faces several marketing challenges as consumers increasingly purchase products from supermarkets and other modern venues, expecting quality, safety, convenience, and variety similar to consumers in more developed countries. Providing additional income support to farm households as the industrial sector pulls ahead and leaves agriculture behind has become a central concern, as is common in countries at a similar level of development. Lastly, China seeks to catch up with developed countries in agricultural technologies, including biotech and biofuel technologies, which could prove vital for maintaining food and energy needs in the future.

¹⁵ There are also ideological considerations in China's Government, which promotes a "socialist market economy," that affect their policy responses, as well as political considerations regarding the employment of a large Government bureaucracy and over-staffed Government-owned enterprises.

Resource Management Policies

The impressive gains in agricultural and industrial production in China over the last 30 years were achieved, in part, by taxing land and water resources. Government officials and the growing urban middle class want to impose more stringent conservation practices to ensure the long-term health of these vital resources. Resources, including land, however, are owned and managed by Government-run entities, and the agents in charge of these resources do not typically have an incentive to use them conservatively. Reforms to improve land management and incentives to conserve could increase the efficiency by which these resources are used, boost production beyond current levels, and maintain these resources for future generations.

Land

Compared with the enormous changes in China's economy and agricultural market development, land tenure practices have changed little since the adoption of HRS. Agricultural land is still collectively owned in China and village leaders manage land on behalf of the collective owners, resulting in a complex mix of locally defined rights and practices (Lohmar, Somwaru, and Wiebe, 2002). Unclear ownership rights discourage land-saving investments, raise the cost of aggregating land, and inhibit China's capacity to deal with an expanding array of rural problems: rising labor costs, an aging rural population, chaotic supply chains, lack of traceability mechanisms, and soil erosion. China's Government has established laws to clarify and secure farm households' rights to land and allow them to rent land, without giving up collective ownership. In recent years subcontracting and rental of land use rights has become more common, encouraged by the departure of millions of farmers for urban jobs and commercialization of agriculture (see box, "China's Evolving Land Management Practices," page 15), and some farmers and companies have consolidated land into large commercial farms. Still, vague land ownership constrains land rental (Deininger and Jin, 2007), and most of China's farm sector is characterized by small, fragmented plots of land.

Land Allocated in Small Plots

Village leaders allocate the rights to several plots to farm households. Because leaders seek an egalitarian distribution, each household typically receives 4-6 separate plots: one or two plots for grain, one plot close to the village for vegetable production, one plot on the more marginal hillside area, etc.¹⁶ Plots for growing grain are usually allocated contiguously in a large field where dozens

Fields divided and cultivated by different households



Photo by Fred Gale, Economic Research Service.

¹⁶ The 4-6 plots add up to only 1.5 acres on average, so each individual plot averages 0.25-.4 acres in size.

China's Evolving Land Management Practices

China's national laws set a general legal framework, but specific practices for managing collectively owned land vary from village to village. Some villages periodically reallocate land among households, while others have kept the original allocation made in the early 1980s. Some villages impose strict controls on land transfers, while others have devised arrangements to consolidate land and rent or subcontract it. In some villages, members pool their land and distribute shares in a stock-holding cooperative that pays dividends based on land rental payments. Some villages in areas with thriving industries hire migrants from other provinces to cultivate their land.

Many observers expected major changes in land policies to emerge from an October 2008 meeting of the Communist Party that focused on rural issues and marked the 30th anniversary of landmark 1978 rural reforms. Announcements following the meeting gave a vague assurance that farmers' land use rights would be secure for "a long time" and encouraged farmers to pursue various means of trading and transferring land use rights that were already widely practiced. Officials emphasized that farmers cannot sell their land, cannot change its use, and cannot use it as security for a mortgage. Officials have begun allowing farmers to mortgage timber or fruit orchard land in some regions, but it is not clear whether this practice will be extended to cropland.

Policy announcements promised stricter controls on land seizures, but no new policies or legal institutions were created to settle disputes. Anecdotal reports indicate that some local governments are exploring ways to improve land transfer. In one prefecture of Zhejiang, the local government established village land transfer service stations to intermediate land rentals (Jiang and Ke, 2009). The Hunan Provincial government allocated funds to waive farmers' fees for renewing land certificates and contract documents; in one prefecture of Hunan, less than half of land transfers involved a signed document, but this number was up 20 percentage points from previous years (Hou, 2008).

The return of migrants highlighted the benefits and conflicts associated with China's land tenure system. Following the 2008 downturn in the global economy, millions of rural migrants laid off from factories returned to their home villages where they had rights to land tended by family members or rented to others. Small-scale farming generates much less income than factory work, and anecdotal reports indicate that migrants were not inclined to return to farming. Still, land rights guaranteed at least a basic livelihood. Some anecdotal reports, however, noted potential disputes with lessees over land contracts and difficulties returning plots that had been consolidated into large commercial farming operations.

of households have rights to individual sections of the field that, from the roadside, looks like any grain field in the Midwestern United States.

The atomistic production structure that results from China's land tenure system raises the cost of production and of aggregating land for more commercial agriculture. Multiple trips to work on multiple small parcels add to the cost of production. Aggregating land through rental activity to obtain more commercially efficient land sizes is costly, particularly when the size of each plot is small and available plots typically are not contiguous to those controlled by the farmer interested in expanding.¹⁷ Rental markets in most parts of China may be very thin, but are growing (Deininger and Jin, 2005; Zhu et al., 2007). Village leaders may seek to coordinate some type of "unified production" on portions of village land, but most households prefer to purchase their own inputs and make their own production decisions. Direct linkages with modern supply chains are expensive to develop because of the small plot sizes, and the Government has been slow to allow farmers to organize their own producer associations to coordinate linkages.¹⁸

Taking Village Land

As the designated managers of collectively owned land, village leaders can take land away from households and allocate use rights to other households or convert it to nonfarm uses. Originally, village leaders had explicit rights to reallocate land to maintain an egalitarian distribution after births, deaths, and marriages, but village leaders no longer have explicit rights to reallocate land. Instead, households are entitled to 30-year written leases on the land allocated to them.¹⁹ Leaders still have some room to maneuver and take back land for other uses, but also do it illegally. In a 2005 survey of 1,962 farm households in 17 provinces, fewer than 1 in 5 farmers (19 percent) believed there would be no more reallocations over the 30-year period (Zhu et al., 2007). The survey question only included village reallocations of agricultural land; land reallocation for nonagricultural use was not addressed.

While policies have sought to end periodic land reallocations within agriculture, village leaders still have the right to take land from households for nonagricultural uses. Legally, village leaders must get farmers' approval and authorization from the township to convert agricultural land and must pay compensation to households according to the discounted value of that land in agricultural production over a 30-year horizon. The various means to calculate this value provide ample opportunity to dispute the final figure and, even if assessed correctly, it may be well below the value of the land in nonagricultural uses. Moreover, affected households may not be included in the deliberations to take land for nonagricultural use, and there is widespread belief that households sometimes receive only a fraction of their entitled amount. These land reallocations and perceived corruption or inadequate compensation are behind many incidents of rural unrest in China.

Land Improvement and Conservation

To boost domestic food production, as well as employ its large rural population, China has stressed land resources by farming steep hillsides and areas that other more land-abundant countries do not farm, creating soil erosion problems. Land has also been degraded by intensive chemical applications and by rarely leaving land out of production to "rest." As the agents of collective owners, village leaders have an obligation to maintain the long-

¹⁷ Rental activity may also be discouraged by reallocation policies in some villages where renting out land serves as a signal to village leaders that the land can be reallocated to another household.

¹⁸ In a 2003 survey of villages in 216 townships in 6 provinces in China, researchers found that approximately 2 percent of farm households belonged to a functional producer association (Shen et al., 2006). The Government has begun encouraging farmers to join cooperatives and producer associations since a 2007 law clarified the legal status of such organizations, but associations are small, localized, and often led by village officials.

¹⁹ According to the 2002 Rural Land Contracting Law and previous directives and laws.

term productivity of the land. As the direct beneficiaries of the use rights to the land, farm households have an incentive to maintain and improve the productivity of the land. Uncertainty over their long-term rights to the land, however, dulls farmer's incentives to make long-term productivity improving investments and rely more heavily on short-term productivity measures such as chemical fertilizers and pesticides.²⁰ While village leaders manage the land under collective ownership, they are only appointed for a fixed period. Increasing agricultural and nonagricultural production under their leadership benefits their performance evaluation, so they too do not have strong incentives to tradeoff short-term production for long-term productivity nor to prevent farm land from conversion into nonagricultural uses.

Evolving tenure security and mechanisms to pool land into more commercially viable plots will affect China's competitiveness on world markets and ensure land productivity for future generations. Lowering the cost of aggregating plots will facilitate adjustments as labor becomes more expensive and the current cohort of farmers ages. Larger commercial plots will raise farmers' incentives to carefully select and verify the quality of inputs from China's fragmented input providers to maximize profits and implement practices to ensure quality and safety.

Collective ownership is also linked with social welfare issues. Land provides social security for the elderly and acts as a safety net for rural workers who have trouble finding employment outside of agriculture. Many farmers support collective ownership and favor land reallocations that maintain an egalitarian distribution of land (Kung, 1995).²¹ While using land as an income security institution has served China well thus far, it distracts from establishing institutions to use land more efficiently in agricultural production. Establishing separate, viable institutions to provide income security will help China establish more effective land tenure policies. In Cixi prefecture, the land rental system is paired with a social security system; elderly villagers can receive land rental and social insurance payments of 400-500 yuan per month, enough to cover basic needs (Jiang and Ke, 2009). More importantly, institutions to register and enforce farmers' land rights are still underdeveloped but will be critical to further reform. Recent reforms to increase farmers' rights to land, such as the 2002 Rural Land Contracting Law, are undermined by an inability to independently register land rights and settle disputes according to the law.

Water

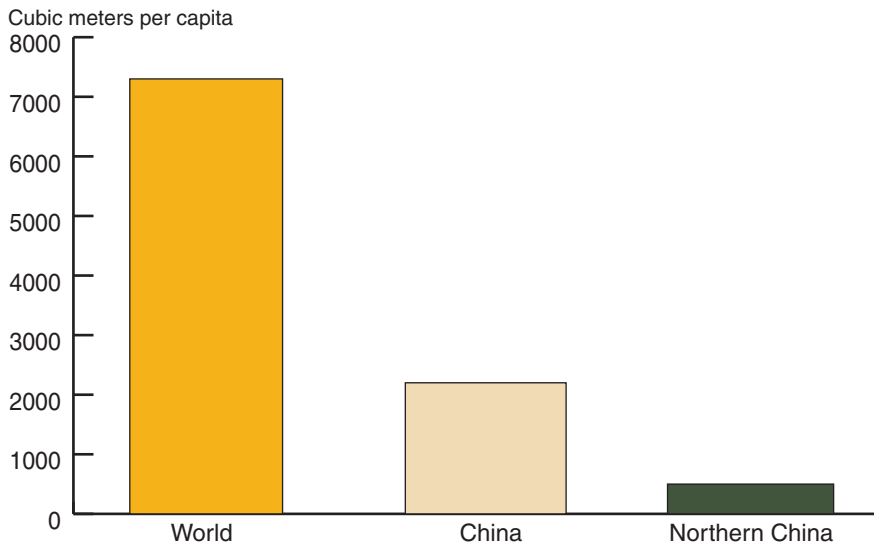
Like the United States, China's water endowment is unevenly distributed. Water is relatively abundant in the south, but it is scarce in the north (figs. 8-9). Extensive irrigation is key to China's capacity to maintain agricultural production. Important crops in water-scarce areas that rely on irrigation include wheat, corn, and cotton, as well as China's increasing production of horticultural crops.²² But in the reform period, rapid demand for water in the industrial and urban areas generated intense competition for limited water resources. Rising water demand is causing rivers to run dry and groundwater tables to fall.

²⁰ Several studies found that farmers decrease their investments when tenure is less secure in China (Jacoby, Li, and Rozelle, 2002; Deininger and Jin, 2007; Zhu et al., 2007)

²¹ Taking land for nonagricultural use has been much more contentious, but conflicts appear to focus more on the closed-door nature of the process and farmers' share of the proceeds than with the transfer of the land out of agriculture itself.

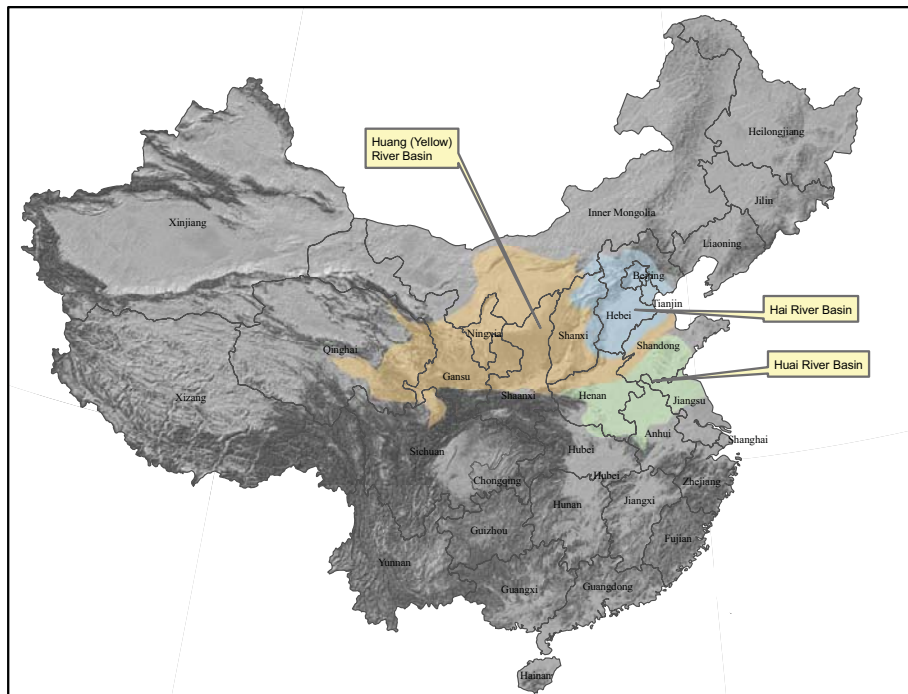
²² Although rice is heavily reliant on irrigation, most of it is produced in the water-abundant southern part of China. Much of northern China receives sufficient rainfall for agriculture in an average year, but 70 percent of the rainfall comes in the summer months (July-September), the primary growing season for corn and cotton. Winter wheat production in northern China occurs from October to June and relies heavily on irrigation during this period.

Figure 8
China's per capita water resources are below the world average, northern China even lower



Note: Northern China refers to the Hai, Huang (Yellow), and Huai River Basins, areas where water scarcity is most serious (see map below).
 Source: China's Ministry of Water Resources.

Figure 9
Areas of water scarcity in China, by region



Note: Highlighted areas represent regions of greatest water scarcity.
 Source: Economic Research Service analysis based on ESRI, Inc. data.

Water Policies

All water in China is owned by the State, and, in northern China, roughly 50 percent comes from surface sources and the remainder from ground water.²³ Surface water is managed by the Ministry of Water Resources and its local water resource offices that oversee a network of large and small irrigation districts (Lohmar et al., 2003). Efforts to promote more efficient use of surface water include management reforms that typically involve providing water managers with incentives to use less water and improve delivery services (Huang et al., 2007).²⁴ Surface water prices, however, are set by the Government and, despite price increases over the last decade, water prices remain too low for most districts to recover operating costs, much less additional revenue for investments in infrastructure improvements.²⁵

Many farmers have turned to ground water for irrigation in water-scarce northern China, but groundwater management policies are neither clearly defined nor vigorously enforced. China had the means to control ground water withdrawals during the collective period because wells were dug by Government-owned enterprises and owned by Government-run local collectives. Recently, there has been a proliferation of privately owned wells that serve irrigators and collect payments from farmers based partly on the costs of pumping and delivering the water (Wang et al., 2006). The private wells are difficult to regulate and the State, which nominally owns the water, does not receive payment for the water extracted. Since pumping costs rise as the water table falls, volumetric prices increase as ground water becomes more limited, providing some incentives to use water more efficiently.

Incentives To Conserve

China's water management policies do not provide strong incentives to conserve water.²⁶ For surface water and nearly all ground water, farmers are charged a fraction of what the water is worth in agriculture, which is a fraction of its value in other sectors.²⁷ For most ground water, the price is still low enough that farmers have little incentive to invest in improvements or adopt technology to improve irrigation efficiency (Blanke et al., 2007). For surface water, farmers typically do not pay for water by volume, but instead pay a fixed amount based on the area they irrigate. With Government-determined prices, irrigation districts earn income from the amount of water they sell, so they are not encouraged to conserve or to invest in conveyance. Some local water managers have an incentive to use surface water efficiently, but the incentive is typically to invest in and manage conveyance to the field more carefully so that more farmers receive irrigation. This increases fee remission from farm households, from which the manager may get a percentage, but does not necessarily reduce overall water use in agriculture and can reduce the return flow of water to streams or water tables, thereby reducing water availability to downstream users.

Rising water prices for farmers are a hotly debated topic in China. While raising water prices would induce farmers to conserve water, current policies are focused on reducing water costs to farmers to raise their incomes (see, rural income discussion on page 25). Moreover, water conservation conflicts with another Government priority—maintaining near (95 percent) self-sufficiency in grain (see box, “China’s Agricultural Policy Dilemma,” page 20). Higher water prices may lead to lower grain yields as farmers reduce water use. Some farmers abandoned grain production when ground water pumping

²³ In southern China, far more comes from surface water than in northern China.

²⁴ Reforms include contracting canal management out to an individual to manage or setting up a Water User Association (WUA) that identifies a manager to take over selected tasks. Some, but not all, of these managers have a direct incentive to reduce water use and improve fee remission.

²⁵ For all State-owned assets, national offices of the Price Bureau still determine price guidelines and ranges, and local Price Bureau offices set prices in accordance with these guidelines.

²⁶ China is not unique in this regard.

²⁷ The exception is when the ground water table falls deep enough that charges rise to levels where farmers choose to either conserve or switch crop patterns.

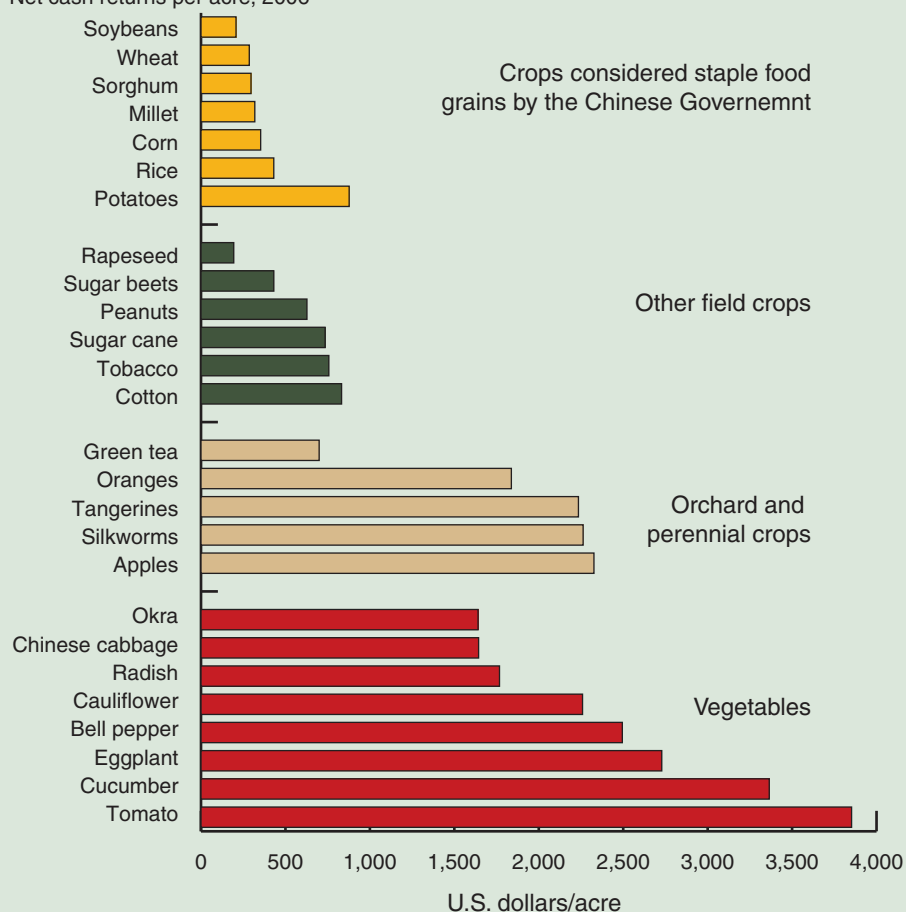
China's Agricultural Policy Dilemma

China's agricultural policies are intended to achieve multiple objectives that often conflict. While the balancing of strategic, consumer, and producer welfare objectives present tradeoffs for policymakers in all countries, the conflict between these goals has become especially clear in China.

For decades, achieving self-sufficiency in food production has been a primary strategic goal for China's agricultural policymakers. The leadership mobilized resources to increase production of grain, cotton, and other strategic crops during the collective period and this carried over into the reform period, most visibly during a campaign to boost grain output in the mid-1990s. As China further integrated into the world economy, self-sufficiency goals were relaxed for most products, but leaders still maintained near-self-sufficiency goals (95 percent) for rice, wheat, and corn.

China's farmers receive relatively low returns from grain

Net cash returns per acre, 2006



Source: Economic Research Service calculations based on China's National Development and Reform Commission data.

Since the late 1990s, policymakers have sought to simultaneously increase grain production and farm incomes. These two objectives conflict since producing grain is less profitable than other types of farming. Net cash returns earned by Chinese farmers from vegetables and fruits are several times higher than returns from rice, wheat, and corn (see figure at left).

Recent events show that rural income objectives can also conflict with urban consumer welfare objectives. International prices for most commodities rose sharply between 2007 and 2008, but Chinese officials sought to limit domestic price increases by shutting down exports of grains, cutting soybean tariffs, and importing vegetable oil. Domestic prices for some types of Chinese grain were almost 50 percent lower than international prices. Limiting the rise in prices protected consumers, but denied Chinese farmers a potential windfall.

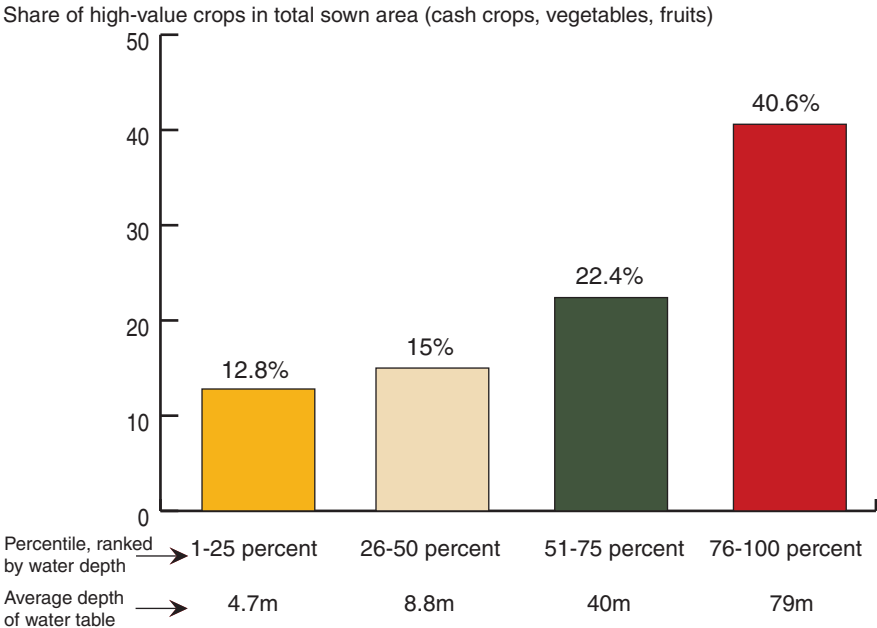
costs rose. Establishing viable water trading regimes might allow farmers to benefit by selling their water rights to higher valuing users, but this too may cause farmers to forego grain production. Experiments in water trading regimes find that they are difficult to establish because farmers are wary of losing their water rights altogether if they begin selling it to more powerful nonagricultural interests (Zhang, 2006). Thus, as with land, establishing more efficient water allocation regimes is hamstrung, in part, by under-developed property rights enforcement institutions.

The lack of regulation for ground water withdrawals also affects the severity of water scarcity. In the Hai River Basin and other parts of northern China, ground water tables are not only falling rapidly, but there is scant policy enforcement to curb the expansion of private wells. The falling water table increases the price of water beyond its economic value in wheat or other field crop production, inducing farmers to either use water more efficiently or switch to crops that bring higher returns to water. Alternatives include relatively water-intensive fruit and vegetable crops, which are both more profitable and more suited to efficient irrigation delivery technology, such as drip or micro-sprinkler irrigation (fig. 10).²⁸

While many observers see water shortages as a threat to China’s agricultural production capacity, there is little evidence that systemic water scarcity has adversely affected production to date, and China could avert future effects by improving water conservation. Conservation is occurring, albeit slowly, in surface water systems. It is also occurring somewhat inadvertently in ground water systems as the water tables are drawn down to the point that farmers switch out of grain and into crops that bring a higher return to water. If these trends continue, water shortages will likely not bring about a surge in

²⁸ Horticultural crops that bring a higher value to water may also be riskier than grain crops and require some initial investment that discourages farmers from producing them when water is less costly.

Figure 10
Farmers move into cash crops as pumping costs rise



Source: Survey by the Center for Chinese Agricultural Policy, Chinese Academy of Sciences, of 400 villages in Hebei and Henan Provinces.

demand for grain imports. Because China's water shortages occur primarily in northern China, and China is a large country, a regional shift out of grain and cotton production would cause prices for these commodities to rise, consumers to consume less, and producers in other parts of China to produce more, dampening the demand for imports (Lohmar and Hansen, 2007).²⁹

Agricultural Marketing Challenges

China's traditional agricultural marketing system is extremely efficient, flexible, and low cost, but these efficiencies come at the expense of providing strong incentives for producers or marketing agents to achieve quality or safety. However, quality and safety characteristics are increasingly demanded by the growing food processing sector, modern retailers, middle class consumers, and export markets. The atomistic nature of production and marketing, the lack of effective contract enforcement mechanisms, and the scarcity of farmer organizations make it difficult and costly for traders, packers, and suppliers to ensure food safety and consistent quality. Investments in higher quality storage, transportation, and cold chain infrastructure would reduce waste through spoilage, allow for more regional specialization, and facilitate the distribution of imported products throughout the country.

Improving food safety has become the central challenge in China's marketing reform efforts. The Government has taken a leading role in addressing food safety issues in China, in part, because the institutional framework for markets to provide safety assurances is not yet developed. Benefits to farmers providing food safety assurances are limited because their products are typically aggregated with products from other producers in the marketing chain, often at the point of sale. Companies that institute costly measures to ensure food safety cannot recoup these costs because counterfeiting and other mislabeling are so widespread that consumers lack the confidence in private assurances to pay a high premium for them. Companies producing unsafe products have little risk of being caught and, if they are caught, they are typically not fined or liable for damages, but instead shut down and may even reopen somewhere else.³⁰ In this environment, the market will lag in providing the safety assurances that consumers demand, creating a role for Government intervention. Resolving obstacles to more market-oriented solutions, however, could provide more sustainable solutions and allow farmers to receive more of the price premiums for producing safe and high-quality products.

A weak marketing system constrains the supply of products with special attributes. Because the marketing system is not conducive to segregating higher-quality products, it prevents the farmer from producing high-quality products and selling them at a premium. Unlike food safety, high-quality fruit and vegetable products can be determined largely by consumers at the point of purchase, so there is some incentive for marketing agents and suppliers to specialize in higher quality products. In more modern economies, suppliers and processors often contract with producers or producer groups to provide products based on set guidelines to obtain specific quality and safety characteristics. In China, however, contracting for production is limited and not particularly effective because few contract enforcement institutions exist. The large number of farm households needed to produce commercially viable

²⁹ The extent to which production falls in one region and causes prices to rise depends critically on import policies.

³⁰ The majority of food processing businesses are small, often family owned, enterprises operating out of households or rented facilities with very little capital investment and are relatively mobile (Thompson and Hu, 2007).

quantities of product also raises the cost of contracting directly with farmers. The limited contracts that do exist are typically with village leaders or producer associations that coordinate production among members or village farmers. Producer associations, in particular, could facilitate adoption of technologies and good agricultural practices to produce safe and high-quality products, but the establishment of truly independent producers' associations in China has been limited to date.

Marketing issues also extend beyond horticultural products.³¹ In the past decade, China has established a program to increase wheat quality because the competitive food processing industry seeks wheat with specific quality characteristics that domestic producers have little incentive to produce. The effectiveness of this program, however, is also reduced by the atomistic nature of wheat marketing and the few incentives to segregate wheat by quality characteristics. Milk marketing and quality assurance issues stemming from the large number of small producers came to the fore in 2008 (see box below, “*Food Safety Setback: Infant Milk Production*”).

Food Safety

Improving food safety is a major issue among both China's domestic consumers and food export industries, but poses many challenges (Calvin et al., 2006; Ellis and Turner, 2008). An atomistic farm sector, coupled with

³¹ Grain marketing in China is influenced more by State-owned or State-affiliated companies than horticultural marketing, reflecting remnants of the former State-owned marketing monopolies in grains and strategic crops.

Food Safety Setback: Infant Milk Production

In 2008, a number of infants in China died and thousands were sickened after consuming powdered infant formula tainted with melamine, an industrial chemical that can cause renal failure. The milk powder incident highlighted the lack of institutional mechanisms to monitor and enforce standards in an atomistic supply and processing sector. The milk found to be adulterated came from large companies with internationally recognized food safety certifications selling well-known brands, but they procured much of their raw milk from small farmers who brought their milk to local purchasing stations operated by independent contractors. Melamine was allegedly introduced by merchants and handlers to boost the apparent protein content after the milk was watered down. In 2007, a representative from one of China's two biggest dairy companies presented the company's detailed food safety management system, which appeared to build in adequate safeguards (Zhang, W., 2007), yet its products were among those found to be adulterated in 2008. The incident also revealed apparent complicity between a company and local officials to cover up the problem and pay off victims to forestall legal action.

Following the milk powder incident, some companies began sourcing more of their milk from large company-owned farms, while others required small farmers to bring their cows to be milked at central locations. Companies also began posting their own employees at milk stations to monitor transactions. Government subsidies funded increased testing of raw milk at the point of purchase and at processing plants.

high agricultural chemical use on crops and in livestock production, increases the risks and the costs of monitoring. China's marketing and food processing sectors are also fragmented. Some estimates report that approximately 1 million food processing companies—70 percent of which have fewer than 10 employees—and probably millions more traders and merchants handle food and agricultural products. The agricultural chemical industry in China is also fragmented and without effective regulation. Counterfeiting and mislabeling products is not uncommon. Farmers' knowledge of these products, and how to use them to reduce residue at the point of consumption, is also limited.

To combat these problems, China has established a complex set of standards (central and provincial government standards; industry and private safety standards) and assigned food safety responsibilities to a number of agencies. Keeping track of the various standards is confusing to producers and consumers alike. Many Chinese standards were adapted from international models, often with modifications, and they can vary from province to province. Food safety enforcement and monitoring responsibilities are divided among several Government agencies. The Ministry of Agriculture (MOA) supports programs for improving the safety of produce and meat and testing fresh products in wholesale markets. Provincial-level offices of the General Administration of Quality Supervision, Inspection, and Quarantine (AQSIQ) oversee domestic food processors, and the national AQSIQ office oversees safety of exported (and imported) products. The Ministry of Health inspects food service establishments. Testing of agricultural produce occurs after the fact and, with no viable traceability system in place, its effectiveness is uncertain. Monitoring hundreds of thousands of small, often family-owned food processing businesses falls on local officials who lack the incentive and training necessary to enforce laws and standards.

Many food companies wanting strict safety assurances maintain their own safety assurance programs instead of relying on Government safety standards, programs, and labels. Assuring safety, however, is relatively costly compared with China's efficient but unregulated domestic marketing. Instructing the thousands of households that produce for a given processor/supplier, monitoring their actions over the growing season, and monitoring the integrity of the marketing chain is costly. Companies with a high stake in safety assurances often resort to a vertically integrated model. This model may include leasing land from village collectives to produce products with hired labor and technical managers. This can be a tiresome process that involves negotiating with village officials, who act as agents for farm households to aggregate land into fields to form a viable production base. For products consumed fresh and prone to safety issues, such as leafy vegetables, these bases may be fenced off to reduce animal or other contaminations and monitored by around-the-clock hired workers. The produce is typically harvested by hired workers and shipped directly to company facilities to be processed.³²

While the vertically integrated production and marketing model is much more expensive than relying on the traditional marketing system, produce from China under this system is still competitively priced in export markets such as Korea and Japan. For companies producing for the domestic market, such practices are still too expensive. Acquiring production bases and producing products with hired workers entails premium prices to cover the

³² Hired workers may come from the very households renting their land to the company; often this is part of the rental arrangement.

costs of added safety assurances that exceed what most domestic consumers are willing to pay.³³

Chinese officials have adopted a version of the vertically integrated model to promote as a safety system for domestic production. This version links a processing or packing company with a “production base” of small farm contractors. Many of the links are established by Government agencies who select the processing or packing company according to certain criteria, including the capacity to provide agricultural technology and training to farmers, and these companies get preferential treatment from local governments (i.e., loans and access to land) in establishing production bases. The companies provide or specify seed varieties, livestock breeds, chemical inputs and application practices, and veterinary drugs to the production bases, and production from the bases is delivered to the company. This “company + production base + standard” model may be easier to monitor and allow traceability compared with traditional supply chains. It is also less expensive than the model used by many exporters, in which land is rented and farmed by hired workers. China’s AQSIQ requires that exported products vulnerable to safety hazards be produced in the vertically integrated model, inspecting and certifying export companies and their production bases, although most exporters have already adopted such practices.³⁴ Authorities are also cracking down on production of substandard agricultural chemicals and feeds, banning production of some foods in areas that fail environmental testing, promoting farm record-keeping, and establishing product traceability systems.

The policy whereby the Government selects firms for loans and assistance in developing production bases means the Government rather than market competition is choosing which firms will be successful. As such, it will not be as efficient as market outcomes, but it does provide coordination in an environment where coordination comes at a high premium.

China’s ability to control food safety hazards and increase confidence in its products—for both domestic and export markets—has implications for producers and consumers in the United States. When products from China suffer food safety-related setbacks in other countries, U.S. producers of those products may have an opportunity to supply those markets.³⁵ Alternatively, successfully reassuring consumers of the safety of products from China will help China compete with U.S. producers in both third-country markets and in the United States.³⁶ As China increases the stringency of its food safety enforcement, however, the costs of producing and marketing its agricultural products will rise, eroding China’s cost advantage in international markets. It will also take time to establish confidence and integrity in China’s marketing and safety system, which gives U.S. producers a niche by promoting their products as safe and high quality.

Rural Income and Development Policies

Rapid economic development invariably brings about changes in agriculture, and China is no exception to this rule.³⁷ While rural China was first to benefit from economic reforms due to the take-off of agriculture and rural enterprises, the locus of growth shifted to urban areas in the late 1980s. By the mid-1990s, urban incomes were roughly three times higher than rural

³³ Again, the price companies can charge for safety assurances is limited by consumers’ confidence in these assurances in China, where counterfeiting and mislabeling are not uncommon.

³⁴ Many of the foreign-owned companies or joint ventures with foreign companies have much more stringent standards than China’s own certification requirements.

³⁵ Sometimes food safety-related setbacks, however, reduce overall demand for those products in the affected countries and adversely affect all imports regardless of origin.

³⁶ U.S. imports from China would also compete with U.S. producers, but benefit U.S. consumers as well.

³⁷ Economically, agriculture suffers from declining relative prices as a country develops and industrializes because additional income is spent on nonagricultural products over agricultural products. In addition, agriculture must compete for resources from the faster growing sectors.

incomes (fig. 11).³⁸ Policymakers responded with a series of programs to narrow the income gap. Each year between 2004 and 2009, China's State Council issued a series of documents offering an array of policy measures and plans to improve incomes and living standards in the countryside. Rural income growth accelerated during this period but urban incomes grew even faster, and the policies were not able to narrow the urban-rural income gap.

Eliminating Taxes

In the first two decades after reforms, China taxed farmers through price policies as well as explicit taxes and fees. Prices paid for grain quota deliveries to State marketing bureaus were well below market prices, implicitly taxing farmers.³⁹ In the late 1990s, China reversed this policy by paying above-market prices for quota deliveries—an implicit subsidy for farmers. Ultimately, by the early 2000s, China eliminated the grain quota system altogether.

China also established local taxes and fees after HRS to help fund village government, infrastructure, schools, and health care facilities.⁴⁰ As with most rural policies in China, the level and means of assessing taxes and fees varied widely from village to village. Fiscal changes in the 1990s eliminated many intergovernmental transfers, and a slowdown in the rural economy in the late 1990s and early 2000s left many rural governments with a thin tax base. Many villages began assessing various fees and taxes on farmers to fund local services (fig. 12). The rising tax burden on farmers became a major policy issue. After several years of experimentation, China began a nationwide push to phase out agricultural taxes in 2004, and taxes on farmers were eliminated by 2006 (fig. 12).⁴¹

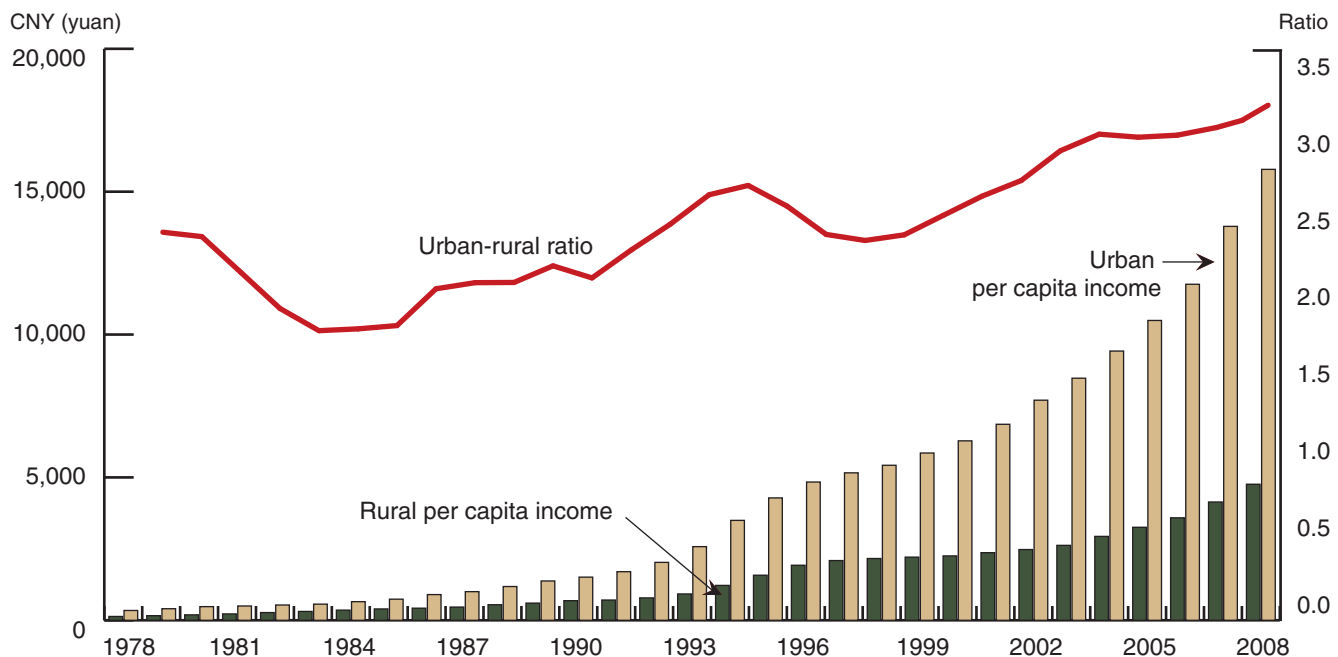
³⁸ Rural residents must pay fees for education and health care services that are of inferior quality compared with subsidized services provided to many urban residents.

³⁹ China also provided some inputs, however, such as fertilizers, at subsidized prices over some of the period.

⁴⁰ Farm households in China have a long history of paying local taxes and fees based on land area and other factors and activities.

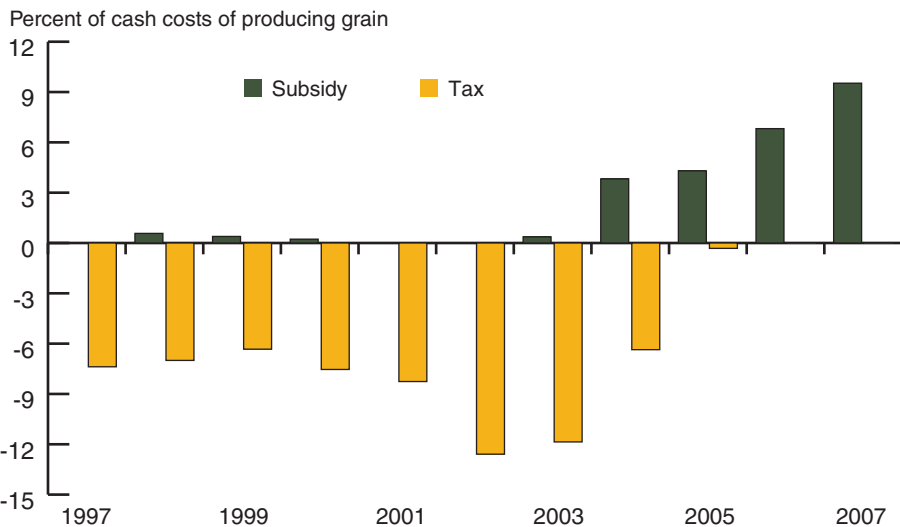
⁴¹ There is some evidence that the elimination of taxes accelerated land reallocation for nonagricultural development as a means for local government to generate revenue to replace the lost tax revenues.

Figure 11
Urban incomes exceed rural incomes in China



Source: Economic Research Service calculations based on China's National Bureau of Statistics (NBS) data.

Figure 12
China's grain taxes have given way to subsidies in recent years



Note: Ratio of tax and subsidy to cash production cost for producers of rice, wheat, and corn.
 Source: Economic Research Service calculations based on National Development and Reform Commission data.

Subsidies, Investments, and Price Supports

In recent years, China initiated a wide range of programs and subsidies aimed at rural areas (Gale, Lohmar, and Tuan, 2005). In 2004, China began to pay direct subsidies to farmers and expenditures have grown rapidly (table 2). Subsidies now include payments to grain producers, subsidies for improved dairy breeds, hog breeding farms, and large poultry farms, insurance for breeding sows, quality seeds, and machinery purchases. A subsidy to compensate farmers for rising fertilizer and fuel prices was initiated in 2007. More general rural development programs include construction of rural roads, irrigation projects, support for rural schools, a new rural cooperative health care system, worker training, support for elderly and low-income households, and subsidies for the purchase of household appliances and electronic items. The central Government reported spending nearly \$87 billion on rural programs in 2008, a 37 percent increase from 2007.

An increase in grain production coincided with the establishment of a subsidy program. Since prices also rose over much of this period, it is unclear what the net effect of subsidies was on farmers' crop choices and yields. Moreover, oilseed production dropped over the last few years, in part, because oilseed acreage was drawn into grain production. This contributed to a surge in soybean and vegetable oil imports.

In addition to direct subsidies, China introduced price supports for wheat and rice in key grain-producing provinces in 2004.⁴² If the market price falls below a minimum price set by authorities, designated grain enterprises (mostly State-owned) will purchase grain from farmers at the minimum price. Loans from the China Agricultural Development Bank to finance these purchases exceeded \$9 billion (U.S. dollars) for 2006. The grain is stored and later offered for auction at provincial grain exchanges. Wheat

⁴² The minimum procurement price was first implemented for rice in 2004 and extended to wheat in 2005.

Table 2

China's national Government increases agricultural subsidies

Year	Direct grain subsidies	Quality seed subsidies	Agricultural machinery subsidies	Input subsidies	Total
<i>billion dollars</i>					
2004	1.4	0.3	0.01	-	1.8
2005	1.6	0.5	0.04	-	2.1
2006	1.8	0.5	0.08	1.5	3.9
2007	2.0	0.7	0.26	3.6	6.6
2008	2.2	1.5	0.58	9.2	13.9
2009*	2.2	1.8	1.46	10.4	17.5

Notes: Values converted to U.S. dollars at average exchange rate for each year.

Subsidies for inputs other than seeds and machinery did not begin until 2006.

*Announced February 2, 2009.

Source: Economic Research Service calculations based on Ministry of Agriculture data.

accounted for most of the purchases under this program until the Government announced large purchases of corn, soybeans, cotton, rice, sugar, and rubber to support prices in late 2008.

Rural Credit

Rural financial institutions are riddled with bad loans that were extended to rural businesses, governments, and grain bureaus, but most farmers in China do not participate in formal credit programs (Gale and Collender, 2006).⁴³ In recent years, the Government has made reform of the rural financial system a priority. One goal of the reforms is to restore financial health to nearly insolvent rural institutions. The over-arching goal of rural financial reform is to push more capital to farmers through a massive increase in rural loans to farmers, agribusinesses, and rural development projects (Gale, 2009).

Since 2003, a complex program was put in place to reorganize, rename, and consolidate 40,000 tiny rural credit cooperatives into credit unions, cooperative banks, and commercial banks. Thousands of officials have been mobilized to conduct village-wide credit checks and organize borrowing groups to ensure that small, short-term loans of roughly 5,000 yuan (\$715 U.S. dollars) each are repaid. A postal savings bank that opened in 2007 was expected to engage largely in rural micro-lending. Pilot programs are formalizing heretofore illegal underground lenders, who account for most rural lending, and allowing city commercial banks and foreign banks to open small “village banks” and loan companies. Statistics show large increases in rural lending, yet farmers seem to have little access to formal financial markets.

Many rural investments have the potential to increase agricultural productivity, particularly livestock production. However, household-level investment is hampered by the absence of markets for land and housing. Since land cannot be bought and sold, it cannot function as collateral for loans.⁴⁴ Consequently, most farmers have few assets to secure loans, and rural lenders resort to elaborate credit guarantee schemes for short-term loans of a few

⁴³ It is not clear whether this is because they have difficulty obtaining formal credit or whether they prefer other means to support investments.

⁴⁴ Houses can technically be sold, and the lease to the collectively owned land they occupy can be transferred to the new owner, but houses are explicitly not allowed as collateral in rural China. New initiatives allow forest rights, orchard land, and agricultural marketing contracts to be used as loan collateral.

hundred dollars. Small farmers and entrepreneurs typically rely on their own savings, underground lenders, and relatives for small short-term loans.

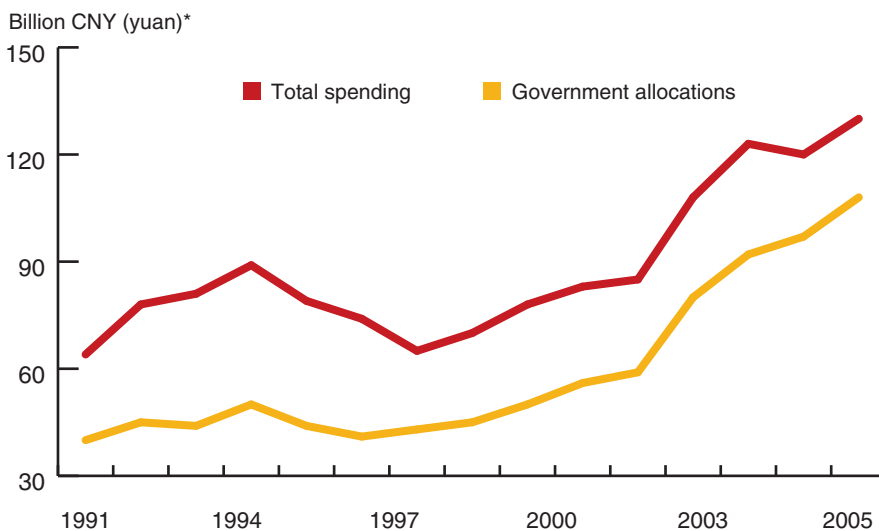
Technology Development and Promotion

Investments in agricultural research and technology contributed to China’s agricultural production gains. Since employment of land and labor in agricultural production has been stagnant or negative over the last 30 years, a large portion of China’s agricultural growth has come from productivity growth due to new technologies or specialization that uses resources more efficiently.⁴⁵ Studies show that research and new technologies released by the national agricultural research system were important components of productivity growth (fig. 13), particularly since specialization has only just begun in China (Fan and Pardey, 1997; Colby, Diao, and Somwaru, 2000; Jin et al., 2007).

While agricultural research spending has taken off in recent years, a number of factors may constrain further development and adoption of new varieties, breeds, and techniques. China’s large agricultural research expenditure is almost entirely publicly funded; private research has been slow to develop. This cautious approach since 2002 has delayed approval of a number of seed varieties developed using biotech techniques. Only *Bt* cotton and a few varieties of tomatoes and flowers have been approved for commercial use. China’s agricultural extension service is weak, and extension stations that are expected to be self-supporting pursue a mix of commercial and educational objectives that sometimes conflict. China has a portfolio of biofuel technology research, but grain-based biofuel development has been capped due to food security concerns, and most nongrain biofuel projects are still in experimental stages. Biofuels are heavily subsidized and licenses to sell it have been tightly controlled; private companies have mostly been excluded.

⁴⁵ In addition to increased applications of fertilizer and other inputs, which in many cases go hand-in-hand with the use of high-yielding seed varieties.

Figure 13
Agricultural research expenditures are rising in China



*Constant 2005 Chinese yuan (CNY) – total spending does not include private enterprises, but includes funds raised by universities and Government research institutes outside of direct Government outlays.

Source: Hu et al., 2007.

Agricultural Research

China's agricultural research system is dominated by public funding. During the 1990s, only about 1 percent of all research funding came from private sources. That percentage has likely increased since then, but is still small. While China has as many as 10,000 seed companies, less than 100 have enough resources to carry out their own research. Counterfeiting and inadequate property rights protection diminish incentives for private companies to develop new seeds. These concerns also discourage multinational seed companies from entering China's large market. Government efforts in livestock breeding are part of the country's overall investment in agricultural research, but fall far behind that of plant technology development (fig. 13). China has been active in importing foreign genetic stock for cross-breeding with domestic animals. Increased use of manufactured feed provided by foreign-invested and other private enterprises has contributed to significant feeding efficiency of China's livestock production in recent years.

Biotechnology

China benefits from investments in biotechnology and recently established a program to boost development of biotech varieties. In the late 1990s, farmers began to adopt *Bt* cotton, and today nearly two-thirds of China's cotton is a *Bt* variety. Because *Bt* cotton is resistant to bollworm and requires only about half the pesticide applications of nonbiotech varieties, adoption of *Bt* cotton lowers pesticide and labor costs and provides clear health benefits to farmers from lower exposure to pesticides (Huang et al., 2002). China has also commercialized biotech varieties of several horticultural crops, but the area sown to these crops is very small.⁴⁶

Despite having invested funds into the development of biotech varieties, which resulted in promising varieties, China is still hesitant to release biotech seeds for basic food crops due to concerns about their reception in export markets and potential effects on human health.⁴⁷ Recent surveys, however, indicate that less than 40 percent of China's urban consumers had any understanding of what biotechnology was, but 50-65 percent (depending on the food product) supported using such technology (Lin et al., 2006). Food security concerns may push the Government to approve more biotech crops.

Agricultural Extension Services

After reforms, China established a vast network of agricultural extension offices at the county and township levels that continued to expand and specialize. By the mid-1990s, the system employed over a million agents. Most counties have crop, livestock, agricultural machinery, aquaculture, and economic management stations, or centers, and many have established specialized substations for plant protection, horticulture, and soil and fertilizer technology. But China's agricultural extension network suffers from efficiency problems. Programs established in the late 1980s to make the extension stations partially self-supporting have caused many agents to spend time on administrative and commercial activities not related to extension, such as work on family planning, budget management, fire protection, village elections, and legal matters (Hu et al., 2008).

⁴⁶ Including varieties of tomatoes, sweet peppers, chili peppers, and petunias.

⁴⁷ Including corn, which is a food crop for some people in China.

Agricultural land is limited in China, so the development and extension of agricultural technologies will be critical for China to continue productivity gains. China has an extensive research system that has contributed to productivity growth both inside and outside its borders.⁴⁸ Further development of new varieties, including biotech varieties, will help China continue production gains. Improving the link between the technologies developed in the research institutes with the needs of farm households through reforms in the extension system will benefit overall system performance. Strengthening intellectual property rights would likely spur private investment for developing new varieties in China and operationalize the technologies developed in Government institutes.

Biofuel

China initiated its biofuel program in the early 2000s to use up surplus grain held in Government reserves, but the program is now viewed as a source of alternative fuels and clean energy. China does not want to miss out on technologies that could provide renewable fuel supplies. China is now the world's fourth-largest producer of fuel ethanol with production from four Government-designated plants, using predominantly corn, but also some rice and wheat, as feedstocks. A fifth ethanol plant using cassava was opened in 2008, and multiple small biodiesel plants are in operation using waste cooking oil.

Because of the conflict with grain self-sufficiency goals, China has scaled back on the ambitious biofuel production goals set out in the 11th Five-Year Plan (2006-2011) and may produce only 2-3 mmt of ethanol annually by the end of that period. China is investing in research to develop cellulosic ethanol production technology that utilizes nonfood materials (i.e., urban waste) or coproducts of food production (i.e., corn stover or straw). Until cellulosic technology is economically viable, China is emphasizing production of ethanol and biodiesel from crops, such as cassava, sweet sorghum, sweet potatoes, and jatropha, that can be grown on marginal land unsuitable for grain production. A number of demonstration projects using these feedstocks are in operation and many others are planned.

Biofuel Policy

China manages domestic fuel ethanol supply by controlling access to the State-owned petroleum industry through a quota system coordinated by China's National Development and Reform Commission (NDRC). These quotas are mandated for selected ethanol production facilities to deliver a fixed amount of fuel ethanol to the two State-owned petroleum companies (Sinopec and PetroChina) in return for a Government subsidy. All new production facilities will use nongrain feedstocks, and the current facilities using grain are expected to convert to nongrain feedstocks.⁴⁹ Some ethanol production is exported out of this State-authorized system (both fuel grade and hydrous ethanol that is sometimes dehydrated in the receiving country or a third country).⁵⁰ The demand for ethanol is managed by programs in selected cities and provinces to use blended E10 (gasoline blended with 10 percent ethanol) within their jurisdictions. In 2008, E10 was used province-wide in 6 provinces and in 27 selected cities of 4 other provinces.

⁴⁸ Many of the traits found in the high-yield dwarf rice varieties that led to the "Green Revolution" in rice throughout Asia were initially isolated and developed in China.

⁴⁹ One plant reported switching to cassava in 2008, but then reduced production due to high cassava prices.

⁵⁰ In 2006, China exported 268.9 million gallons of ethanol (roughly 0.8 mmt), about 60 percent of the authorized amount sold to the domestic petroleum industry. Exports fell sharply in subsequent years after export tax rebates for ethanol were rescinded.

The Government controls the development of biofuels. Commercial production of biofuels is only profitable when it receives a subsidy. State-owned petroleum companies constitute the only market for biofuel, and the Government has so far issued licenses to sell biofuels only to other State-owned companies. China is increasingly concerned about the competition between biofuel feedstock and food production and has scaled back plans to develop noncellulosic biofuels. Future changes will depend on China's estimation of the effect of biofuel production on grain availability and prices.

A plant that distills alcohol from cassava in Guangxi Province



Photo by William Coyle, Economic Research Service.