

Rising Demand, Trade Prospects, and the Rise of China's Horticultural Industry



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INTRODUCTION

Rising incomes, migration, and changing food-retailing venues are creating dramatic changes in China's food economy – especially in urban areas. During the past decade, there have been sharp rises in the consumption of, among other food items, horticultural commodities. For example, the demand for fruit by urban consumers rose from 40 kilograms (kg) per capita in 1997 to 60 kg per capita in 2004, while the consumption of high-valued vegetables rose from 113 kg per capita in 1997 to 123 kg per capita in 2004 (CNBS).

At the same time, further pressures on the food sector are being exerted by changes in policies governing China's external economy. Beginning in the 1980s, China's leaders have gradually liberalized agricultural trade (Huang and Chen). Nominal rates of protection (NPRs) have fallen steadily over the past two decades – falling for maize and wheat, for example, from more than 80 percent to less than 20 percent (Huang, Rozelle and Chang). Both formal tariffs and nontariff barriers have fallen significantly, driving down the NPRs. Bilateral trade agreements and China's accession to the WTO have likewise provided increased access to the markets of China's trading partners. Simulation analysis demonstrates that with market liberalization, there is downward pressure on the price of grains, edible oils, and other staples, but new export opportunities help strengthen the prices of fruits and vegetables (Rosen, Huang, and Rozelle).

The main question that we examine in this chapter is whether policy-makers, farmers, and traders in China have met and will be able to meet

the growing demand for high-valued fruits and vegetables. Such questions, of course, have great implications for producers of fruits and vegetables in the US and other nations.

To answer these questions, we explore three main issues. First, we briefly describe changes to China's policy approach to managing agriculture. The objective of this inquiry is to understand how the environment within which producers make decisions has changed during the past two decades. Second, we track the changes in agricultural supply in China. In this section we seek to understand how producers have responded over the past ten years to rising demand in both the domestic and external economies. Finally, we examine both enabling factors and constraining elements that will either push China towards or inhibit China from becoming the major supplier of horticultural products domestically and globally.

CHINA'S CHANGING POLICY ENVIRONMENT

Despite launching a series of radical reforms including decollectivization and the removal of restrictions on rural markets, reformers in the 1980s had no intention of forfeiting control over key commodities, such as grain, to market forces (Sicular). Agricultural planners did little, even in the mid-1980s, to encourage grain bureau employees to pursue the potential profits from out-of-plan grain trade (permitted beginning in 1985), and grain system enterprises did not participate in the state-owned enterprise reforms. Managers of grain outlets in many cities could not engage in commercial activities beyond the sales of staple goods. Fixed, low urban ration prices dampened the supply of high quality grain. When out-of-plan prices rose in 1988 and 1989 and shortages of grain threatened, leaders directed grain officials to stabilize supplies. They also pressured producers to sell their surplus through state channels, actively suppressed free market trade, and blockaded shipments to regions of the country, such as Guangdong Province and other southern deficit regions, which had ignored the central government directives to maintain high levels of grain production. Leaders maintained high production levels with a multiplicity of policies such as mandatory delivery quotas, sown area targets, political rewards for high grain output, increased investment in infrastructure, and subsidies to producers.

It was not until after the 1990s that China's leaders were presented with a unique opportunity to deepen market reforms. As food became plentiful, agricultural officials began to liberalize prices and markets to raise the efficiency of China's rural economy, increase rural incomes, and reduce the budget burden at a time when urban consumers were demanding higher quality grain (Rozelle et al.). When market liberalization finally did happen, it happened steadily and affected food markets in both urban and rural areas. In the first stage of the urban reforms, officials eliminated

controls over the physical flow and price of grain. Grain rationing and planned inter-provincial grain transfers were abolished. In addition, signaling one of the most fundamental shifts in urban grain policy, many city officials made retail outlets less reliant on fiscal support and gave outlet managers and other personnel the chance to take advantage of new commercial opportunities in the liberalizing urban food economy. Private and quasi-private trading classes were created who were buying and trading, at least at the margin, on the basis of market prices and sourcing from whomever and wherever they wanted.

At the same time, officials launched an equally ambitious set of reforms in rural areas in the early 1990s. In different parts of China, and at different times, policy-makers reduced mandatory delivery quotas and eliminated the implicit tax on farmers by raising the procurement price to market levels. Between the 1980s and the end of the 1990s, the elimination of the grain quota reduced the implicit tax on China's farmers from more than 30 billion Chinese yuan to zero (Huang, Rozelle, and Wang). While the quota reforms were quite well publicized, the commercialization of the grain system in rural areas proceeded more unobtrusively, much in the same way as it did in urban areas. In the end, China's grain marketing system was completely reformed and now operates with little intervention by the government. Indeed, Huang, Rozelle, and Chang show that after 2000, prices behave very much like those in a market-oriented economy.

Similar policies were being executed for other commodities, although at different paces. State procurement of edible oils, livestock commodities, and other crops, including fruits and vegetables, were mostly discontinued in the 1980s. Cotton and sugar were gradually liberalized in the mid-1990s. By the late 1990s, tobacco was about the only commodity that had not been decontrolled on both the price and procurement side.

Trade Policies

In addition to important changes in the domestic economy, there have been a number of other fundamental reforms to China's international trading system. Lower tariffs and rising imports and exports of agricultural products began to affect domestic terms of trade in the 1980s. In the initial years, most of the fall in protection came from a reduction in the commodities that were controlled by single desk state traders (Huang and Chen). In the case of many products, competition among nonstate, foreign trade corporations began to stimulate imports and exports (Martin). Although some major agricultural commodities were not included in the move to decentralize trade, the moves spurred exports of many agricultural goods. In addition, policy shifts in the 1980s and 1990s also changed the trading behavior of state traders. Leaders allowed the state traders to increase imports in the 1980s and 1990s.

Moves to relax the rights to access import and export markets were matched by actions to reduce the taxes that were being assessed at the border. After the fall of restrictions on imports and exports of many of China's agricultural commodities, a new effort began in the early 1990s to reduce the level of formal protection. The simple average agricultural import tariff fell from 42.2 percent in 1992 to 23.6 percent in 1998 to 21 percent in 2001 (Rosen, Huang, and Rozelle).

Overall, trade distortions in the agricultural sector have declined substantially in the past 20 years (Rosen, Huang, and Rozelle). Much of the falling protection in agriculture has come from decentralizing authority for imports and exports, relaxing licensing procedures for some crops (e.g., moving oil and oilseed imports away from state trading firms), and changing foreign exchange rates. Other trade policies have reduced the scope of nontariff barriers (NTBs), lowered real tariff rates at the border, and expanded import quotas (Huang and Chen). Despite this real, and in some areas, rapid set of reforms, the control of commodities that leaders consider to be of national strategic importance such as rice, wheat, and maize remains with policy-makers to a large extent (Nyberg and Rozelle). Given the changes made prior to the nation's accession to the WTO, it is not surprising that while it was a major event in China (and has had effects on many sectors), in its most basic terms WTO accession was really a continuation of previous policies. Hence, the commitments embodied in China's WTO accession agreement in the agricultural sector – increased market access, less distorting domestic support, and export subsidy reductions – are exactly what China was already doing in the 1990s.

Shifting Priorities

At the same time that the institutional environment was changed by the series of previously discussed reforms, leaders have been gradually changing the fundamental goals of their policy actions. Throughout the Socialist Era (1950 to 1978), China's Grain First policies unambiguously placed national food security, in the guise of self-sufficiency, as the nation's primary agricultural target and this continued throughout the 1980s and early 1990s as agricultural leaders explicitly gave national food security top priority. Policies allowing grain blockades to prevent commodities from flowing from one province to another in the late 1980s and the Governor's Rice Bag policy, both of which encouraged sub-national governments to invest heavily in grain production, are examples of policies that were willing to sacrifice efficiency in order to achieve high levels of domestic grain and other staple production (Rozelle et al.). Local measures that fined farmers for not producing grain, gave input purchase priority for producing government-priority crops, and encouraged community leaders to apply pressures to farmers were all condoned or at least implicitly advocated,

despite clearly documented negative income consequences for producers (Sicular; Rozelle and Boisvert).

In recent years, however, there has been a gradual, but accelerating movement to shift the goal of rural policy from grain first to income first. In the late 1990s, for the first time, local leaders and farmers were encouraged to transform the structure of their farms from ones producing grain and subsistence crops to commercially-oriented enterprises. Loan programs were created to provide investment funding for the production of cash crops and other agricultural activities. The extension system broadened its mandate to promote nontraditional crops, including horticultural crops.

With the recognition that rural incomes were lagging dangerously behind urban ones, the government of Hu Jintao and Wen Jiabao chose to make the transformation of the rural economy and raising of rural incomes one of the key planks of their economic platform. Their efforts included reductions in taxes, expansion of subsidy programs, investment in rural public goods, and most importantly, the evolution of a new ethos that not only allowed, but promoted activities that would lead to higher rural incomes. Both domestic and trade policies have begun to encourage producers to move towards crops and other activities in which China has a comparative advantage and which have higher profit rates. In this regard, the expansion of horticultural crop production area has been encouraged.

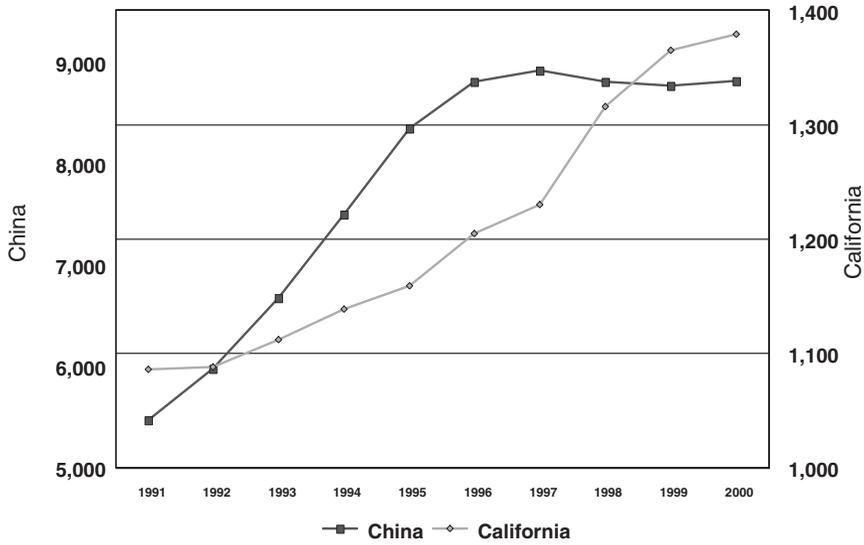
THE NEW HORTICULTURAL ECONOMY

In response to rising demand by consumers and the new policy environment, China's producers have reacted to a degree that would have been difficult to predict. The changes in sown area of vegetables illustrate more than anything the responsiveness of producers to appropriate incentives (figure 4.1, panel A). The sown area under vegetable production more than doubled between 1990 and 2000, increasing by more than eight million hectares (20 million acres). In fact, to put it into perspective, as seen from figure 4.1, Chinese vegetable area increased by the equivalent of a new California about every two years during the 1990s. Moreover, there has been expansion in production of almost every major type of vegetable crop. For example, tomato and garlic area nearly tripled during the 1990s and the rate of change has accelerated since 2000.

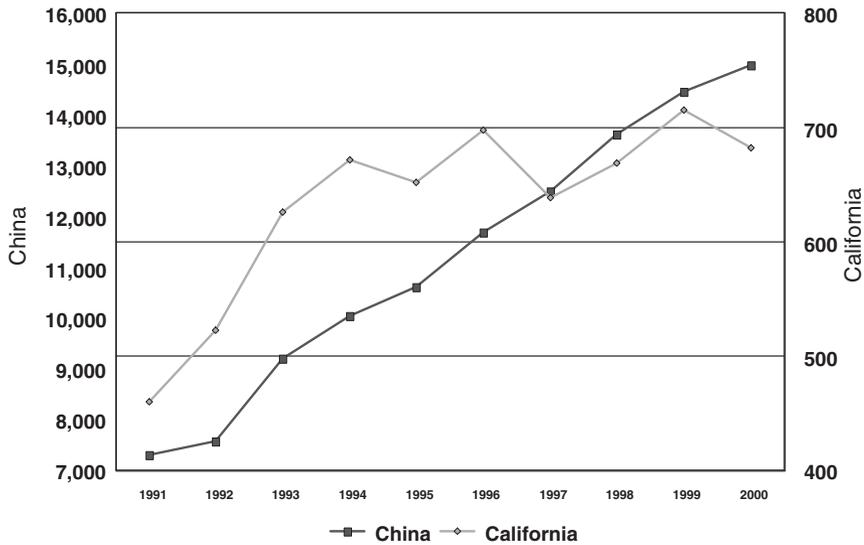
Although most producers still invest relatively low levels of capital into their farms, there is rising investment, especially in greenhouse technologies. Visits to the field show that the range of technologies remains great. While there are many dirt wall backed structures covered with cheap plastic and warmed by coal-burning pot bellied stoves, there

Figure 4.1: Sown area of vegetables and fruit in China and California, 1991 to 2000 (1000 Hectares).

Panel A. Vegetables



Panel B. Orchards



Source: Huang, Dong and Rozelle.

are beginning to be state-of-the-art, integrated, climate-controlled greenhouse facilities.

Similar shifts in production are seen in the case of fruit (figure 4.1, panel B). In the early 1990s, sown area of fruit crops almost doubled from about five million hectares in 1990 to almost ten million hectares in 1995. In the late 1990s, although the growth of sown area slowed, farmers began to invest in upgrading their orchards through grafting, pulling and replanting, and improved agronomic care. Despite China being known as a country that is short of land and that has historically planted grain ahead of all other crops, on a percentage basis, China has more than twice the share of area allocated to fruit production (over five percent) relative to other major producing countries (e.g., two percent in both the US and the EU).

Specialization in China's Villages

Few authors have attempted to quantify the gains from market liberalization in China. Impediments to such an exercise include the short period of available data for analyses and the inability of standard methodologies and indicators of market liberalization to separate efficiency gains of market reform from overall gains in the reforming economy. Nonetheless, there is some evidence that isolates the effect of liberalization reforms on the emergence of markets and productivity of farmers. DeBrauw, Huang, and Rozelle show a positive effect of the increased role of markets on productivity and other authors find a similar result (Lin; Fan). In all three of these papers, the authors conjecture that the gains are due in part to increasing specialization.

In order to try to understand whether or not specialization has occurred since the mid-1990s when markets began to emerge, a national representative survey of 400 communities (in 100 counties and six provinces) was conducted in 2004 (Huang, Rozelle and Chang). The survey of community leaders asked whether farmers in their villages were specializing in any particular crop or livestock commodity. The question concerned the period between 1995 and 2004. If respondents answered affirmatively, they were then asked to identify the commodity in which they were specializing. If farmers in the community were specializing in a cropping activity, the area sown to the specialty commodity was requested.

The results of the survey show that specialization has been occurring in China's agricultural sector. Between 1995 and 2004, the percentage of villages specializing in an agricultural commodity increased and this was true in every province (table 4.1, columns 1 and 2). On average, 30 percent of China's villages were specializing in 2004, up from 21 percent

Table 4.1: Percentage of villages and sown area with specialization by region.

	Percentage of villages ^a specializing		Percentage of sown area ^b	
	1995	2004	1995	2004
Hebei	18	19	20	24
Henan	22	23	4	9
Shanxi	51	74	11	22
Shaanxi	4	5	23	32
Inner Mongolia	9	17	38	40
Liaoning	15	32	13	29
Average	21	30	14	24

Source: Huang, Rozelle, and Wang.

Notes: ^a Villages are counted as “specializing” if they answered “Yes” to the question: “Are farmers in your village specializing in any particular crop or livestock commodity?”

^b Only includes sown area of villages that are specializing.

in 1995. Although the percent of villages that specialize has risen in all sample provinces, some (e.g., Liaoning, Inner Mongolia, and Shanxi) have risen faster than others (e.g., Hebei, Henan, and Shaanxi). The percent of area sown to specialty crops has also risen across the sample average from 14 percent of total sown area in 1995 to 24 percent in 2004 (columns 3 and 4). Over half of this specialization has been in villages that are specializing in vegetables. Interestingly (and perhaps surprisingly), the propensity to specialize is not correlated with either income levels or the geographical location of the village, implying that poorer farmers may be equally or even more responsible for the rise of specialization, a finding that is consistent with another study by Wang et al.

The Performance of the Export Sector

Although the export segment of the horticultural economy in China remains small, it is important for several reasons. First, because the international horticultural export market tends to be fairly thin, even small shifts from the domestic to the export sector can have dramatic impacts on the international market. In addition, the great gaps between the export market and its demand for high-quality, reliable, and safe products and the relatively simple domestic market mean that there are many things to be learned from those firms that face international

competition. Finally, to the extent that importers are able to source fruit from international markets, it provides a yardstick for measuring the efficiency of the sector and its ability to compete with the quality products that enter from abroad. In sum, the external sector of China's horticultural market represents a potentially lucrative segment of the market to be captured, a source of knowledge, and a source of market discipline (Rozelle, Huang, and Sumner).

Exports Since 1995 fresh vegetable exports have increased steadily. The most rapid rise came in the years after China's accession to the WTO in 2001. The pace of expansion slowed in 2004 and 2005. China is emerging as the world's dominant supplier of garlic, carrots, and onions/shallots. Although fresh vegetable exports have risen rapidly, processed vegetable exports have always been higher (since 1995) and have remained higher (up to 2005). Growth has been rapid in the tomato paste and frozen vegetable product categories. Processed and preserved vegetable categories, although still large, have grown more slowly.

When looking at two of China's largest export products – onions/shallots and garlic – it can be seen that the destinations, although broad, are largely nearby markets. In the case of onions/shallots exports mainly go to Japan, Malaysia, and Russia. In the case of garlic, with the exception of Brazil, most of the large markets are also nearby (e.g., Japan, South Korea, Malaysia, and Southeast and South Asia).

Imports Although China is the fourth largest agricultural export destination for the US (after Canada, Mexico, and Japan) and remains a growing market for US exports. Almost all of the \$5.5 billion in exports from the US are made up of bulk commodities – soybeans (29 percent), vegetable oils (15 percent), cotton and wool (17 percent), hides (12 percent), and grains (five percent). Fruit imports have grown slowly in recent years. Vegetable imports into China fell sharply after the late 1990s and remain at around 20 million metric tons.

Trade Trends: A Shift toward Labor-intensive Export Commodities

When we take all of China's agricultural imports and exports and divide them into two groups – those that are labor-intensive (e.g., fruits, vegetables, and livestock/aquaculture products) and those that land-intensive (e.g., grains, edible oils, fiber products, sugar, and hides), we can see the striking bifurcation of the import and export trends. In the early 1980s, China was a net exporter of both labor-intensive and land-intensive commodities. Since then, however, China has begun to export increasing amounts of labor-intensive commodities and import increasing amounts of land-intensive commodities. Clearly, given China's abundant supply of labor in the rural economy, it has been moving towards commodities in which it has a comparative advantage.

Table 4.2: Cropping patterns and the role of horticultural crops in greater Beijing, 2000 and 2004.

	Concentric Circle Sample Region											
	Greater Beijing (total)		40 km		60 km		80 km		100 km		140 km	
	2000 (%)	2004 (%)	2000 (%)	2004 (%)	2000 (%)	2004 (%)	2000 (%)	2004 (%)	2000 (%)	2004 (%)	2000 (%)	2004 (%)
Grain	68	58	64	52	63	47	68	62	72	64	72	62
Cash crop	10	14	9	12	9	13	9	11	9	14	12	17
Horticultural crops ^a	22	29	27	36	28	39	23	27	18	22	16	21
Vegetables	4	6	4	4	4	9	6	7	2	3	4	6
Fruit	13	16	19	26	13	13	12	16	13	16	10	11
Nuts	5	7	4	6	11	17	5	5	3	3	2	5

Source: Huang and Rozelle.

Note: ^aSown area for horticultural crops includes area sown to vegetables, fruit, and nut orchards.

The Actors in the Horticultural Economy – A View from the Villages

This part of the chapter draws heavily on survey work from a randomly selected set of villages in Greater Beijing (Wang et al.). Caution needs to be exercised for several reasons. First, this is a region that is not at the heart of the export economy and it is in the northern part of the country. Therefore, one needs to be careful about making conjectures about the rest of China from this sample. However, in defense of the sample, it is, to our knowledge, the first fully spatially selected, random sample of horticultural producers in China. It gives the first regionally representative profile. With these data, we describe the actors that make the horticultural economy work in China's rural areas including: 1) producers; 2) traders; and 3) local officials. In further support of the findings of this survey, preliminary analysis of recent field work and data collection in Shandong Province (the horticultural basket of China) confirms the results (Huang and Rozelle).

Producers The rising demand for horticultural products (henceforth, the term used to describe vegetables, fruits, and tree nuts) and the changing production environment are beginning to change production patterns from grain into other crops (table 4.2, columns 1 and 2). The total sown area of grain fell between 2000 and 2004 from 68 to 58 percent. In contrast, cash crops (which include mainly crops such as cotton and peanuts – crops that are not the focus of our study) rose by four percentage points. During the same period, the area sown to horticultural crops rose by seven percentage points (from 22 percent in 2000 to 29 percent in 2004). Vegetable output rose by two percentage points; fruit production – the crop category accounting for by far the largest share of horticultural crops in the Greater Beijing area – rose by three percentage points; and nut production rose by two percentage points.

Table 4.3: Contribution of sampling areas by income category (quartiles) to horticultural production in greater Beijing, 2000 and 2004.

Crops	Very Poor		Poor		Above average		Rich	
	First Quartile (1-25)		Second Quartile (26-50)		Third Quartile (51-75)		Last Quartile (76-100)	
	2000	2004	2000	2004	2000	2004	2000	2004
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Horticultural Crops	15	23	31	32	33	25	20	19
Vegetables	9	12	25	29	53	47	12	12
Fruit	16	25	37	37	34	24	14	14
Nuts	21	30	17	19	8	9	54	42

Source: Huang and Rozelle.

While production trends for the entire Greater Beijing area fairly closely match the rise in horticultural demand in China's urban areas, in this chapter we are most interested in the types of farmers who are participating in supplying the horticultural crops. In fact, as table 4.2 shows, when information on the typical farmer engaged in farming inside each of the concentric circles is compared (i.e., farmers close to Beijing compared to those far from Beijing), it can be seen that farmers in all areas are adjusting their production structures (table 4.2, columns 3 to 12). In particular, while the average farmer in all areas reduced his/her share of area sown to grain by ten percentage points (68 to 58 percent, row 1), as might be expected (Fafchamps and Shilpi), farmers in the first two circles – 40 and 60 kilometer (km) circles – reduced the share of area sown to grain by 12 to 16 percent, exceeding farmers in the other three circles that are farther away from Beijing who made reductions of six to ten percent. In other words, although the production of horticultural crops rose everywhere, the largest rise in the share of a village's land allocated to horticultural crops was in the 40 and 60 km circles. Interestingly, while the increase in the share of horticultural crops in the 40 km circle mainly came from fruit (19 to 26 percent), the rise in the 60 km circle came from vegetables and nuts (four to nine percent for vegetables and 11 to 17 percent for nuts).

While the relatively smaller rise in horticultural area share for remote areas is what one may expect, the most significant finding, based on our data, is that poor farmers are increasing their share of the production of horticultural crops (table 4.3). To show this, we divided villages into four quartiles, according to each village's reported income per capita. Between 2000 and 2004, we found that farmers in the very poor and poor categories (those farmers living in villages with incomes below the median income level) increased their share of total sown area of horticultural crops (top row). In fact, by 2004, farmers in very poor and poor villages produced more than one-half (55 percent) of the horticultural crops in the Greater Beijing area. Even more significantly, farmers in the very poor villages increased their share of vegetables, fruits, and nuts between 2000 and 2004 (rows 2 to 4, columns 1 and 2).

A similar picture emerges when examining different types of horticultural crops (table 4.3, row 2, columns 5 and 6). In the case of fruit, production was dominated by farmers in the very poor and poor villages. In contrast, farmers in average income villages produced most of the vegetables. One of the most interesting findings in table 4.3 is that the richest farmers were not the driving force (or beneficiary) of increased production of vegetables, fruits, and nuts.

Hence, we have strong evidence that the rise of horticultural production in the Greater Beijing area has not followed the trends that have been observed in other developing countries (e.g., Farina and Machado). Our data show that farmers in very poor and poor villages have not been left out. In fact, especially in the case of the very poor, they have been the driving force behind the rise in the supply of fruit and nuts. Moreover, there is no evidence – even for vegetable crops – that richer farmers have dominated production. Indeed, farmers living in the richer villages (above average and rich) have lost their share in all categories of horticultural crops (e.g., 65 to 59 percent for vegetables, 48 to 38 percent for fruits, and 62 to 51 percent for nuts). In 2004, the richest 25 percent of farmers only cultivated 19 percent of the region's horticultural area.

A profile of the typical horticultural producer in China shows that the emerging competitor in the world's horticultural industry is actually a small, poor, and uneducated farmer who is labor-rich, faces low wages, and is highly commercialized. Rough calculations suggest that there are probably more than 40 million households engaged in commercial production of fruit, nuts, and vegetables in China.

The average household involved in horticultural production consists of four people, only three (at most) of which are typically of working age. Each family generally has one person working off the farm in a wage-earning job or running a small, non-farm business. The head of the household (typically the husband) is, on average, 42 years old with one year of post-elementary education. In total, a typical vegetable producer's total farm assets are worth only \$700 (at nominal exchange rates). The house in which the producer lives is his/her most valuable asset making up about 75 percent of the household's total assets and is worth less than \$8000 (Huang and Rozelle).

Although no individual in China owns his/her own land (land belongs to the village and is contracted to households for a period of 30 years for no rent), all farm households have access to what amounts to their own land. The typical vegetable producer (and the same is true for fruit producers) only has one acre (six mu). This acre of land is typically divided into five different plots. Vegetables are typically planted on three of the five plots

while the farmer usually plants wheat, corn, or rice on the remaining plots to use for his household's annual grain consumption (although it is possible to buy grain on local markets). Only four percent of land that is planted to vegetable crops is rented.

When asked who decides what to plant, the average farmer answered that he/she decides him/herself in nearly 95 percent of the cases. In the remaining five percent of the cases, the local village had invested in a greenhouse in the late 1980s or early 1990s and was renting the land with the greenhouse out to the farmer. In other words, no one is telling farmers what to plant and there are almost no subsidies given by the government to farmers.

Because of the small size of land and access to family labor, the typical farmer and his family spend about 312 man-days working in vegetable production each year. After subtracting costs, an average vegetable farmer earns about two dollars per day. In addition to family labor, during harvest or other particularly busy times, the typical horticultural farmer hires laborers for 42 man-days per year. The laborers are paid the equivalent of \$3.2 per man-day for working ten hours per day (about 32 cents per hour).

From these figures it is easy to see why the typical producer in China has such low costs. Additionally, the average horticultural producer has been farming all of his/her life and is a commercial producer, selling about 97 percent of production.

Traders and Marketers The surprises on the supply side are matched by surprises on the procurement side (table 4.4). Although there has been much discussion about the potential implications of the rise of modern supply chains in developing countries and the effect of their procurement agents on welfare in rural areas (Reardon et al.), according to our data, supermarkets have been completely absent as buyers in China. Indeed, not one of the 201 village leaders that we interviewed reported the presence of supermarkets in the procurement of any vegetable products (table 4.4, panel A, column 1). Likewise, village leaders reported that only two percent of procurement from vegetable farmers was from specialized suppliers and only two percent was from processing firms (columns 2 and 3). Hence, in the Greater Beijing area in 2004, only four percent of all vegetable sales were procured by those operating in firms that could be described as part of a modern supply chain.

Even when we look at data on the second buyer in the supply chain, the modern supply chain played a fairly minor role (table 4.4, panel C, columns

Table 4.4: Supply and marketing channels of horticultural markets in greater Beijing area, 2004.

	Modern supply chains				Traditional supply chains			Other supply chains	
	Super markets	Specialized suppliers	Processing firms	Small traders	Farmers sell in local periodic markets	Cooperatives	Consumers direct purchase from farmers	Others ^a	Others ^b
Horticultural Crops	0	2	2	79	8	0	7	2	
Vegetables	0	3	5	82	5	0	1	3	
Fruit	0	1	1	75	11	0	9	3	
Nuts	0	6	0	88	3	0	3	0	
Panel B: Location of first transaction (percent)									
	Farmer's fields	Village center	Roadside	Periodic market	Wholesale markets	Urban wetmarkets	Others ^b		
Horticultural Crops	65	9	3	6	11	4	2		
Vegetables	64	0	3	6	18	9	0		
Fruit	60	12	3	9	12	3	2		
Nuts	86	11	0	0	0	0	4		
Panel C: Second-time buyers (percent)									
	Modern supply chains			Traditional supply chains			Other supply chains		
	Super markets	Specialized suppliers	Processing firms	Small traders	Traders sell to consumers in periodic markets	Cooperatives	Others		
Horticultural Crops	3	3	10	49	13	0	22		
Vegetables	6	0	6	57	11	0	20		
Fruit	1	2	9	46	16	0	26		
Nuts	3	10	19	50	6	0	12		

Source: Wang et al.

Notes: ^a“Others” (first time buyers) includes purchases by agents of hotels or restaurants, gifts to other farmers, or procurement by organized groups (such as enterprises for distribution to their workers).

^b“Others” (second time buyers) includes sales to other villages and sales to market sites that supply processing and other food firms.

1 to 3). When asked to whom the first buyer sells, supermarkets were involved in just three percent of the volume. Specialized supply firms also accounted for only three percent. Processing firms were the second buyer for ten percent of the volume of vegetable crops. Hence, in total, even by the second link of the marketing chain, modern supply chains have played a relatively minor role, accounting for only 16 percent of the volume. Therefore, in summary, it is safe to say that in the Greater Beijing sample villages, despite the rise of demand for high-valued vegetable products, and despite the rapid emergence of supermarkets in urban areas, modern supply chains were almost nonexistent in 2004 at the producer end of the marketing chain.

So, the main story of vegetable marketing in China in 2004 is the domination of traditional supply channels by small traders. According to our data, fully 79 percent of the first-time buyers of vegetables were small traders (table 4.4, panel A, row 1, column 4). These small traders, who during the harvest season can be seen throughout areas that are producing vegetables, entered the village itself and bought directly from farmers. Almost all sales are spot market transactions, in which the commodity was exchanged for cash. In another eight percent of cases, farmers took their crops, as they have done for hundreds of years, to local markets to sell to local consumers and traders (column 5 and for a related point see Rozelle and Huang). In Shandong Province, recent fieldwork suggests that more farmers take their horticultural crops to local wholesale markets. Though similar to the case of transactions in the village, trade occurs between the farmer and a small trader who happens to have a stall in the market rather than traveling from village to village looking for sellers.

The supply chain penetrates far into the villages of the Greater Beijing area (table 4.4, panel B). While some of the traders bought from farmers in local markets (about six percent), most of them went directly to the farmer. In fact, when aggregating procurement by traders in farmers' own fields (65 percent), at the village center (nine percent) or at the side of the road near the village (three percent), more than 75 percent of all procurement took place inside or immediately next to the boundary of the village (row 1 in panel B). Only 15 percent of first time sales took place in formal wholesale markets (11 percent) or urban wet markets (four percent).

Finally, small traders not only make up the first link in the marketing chain, but 49 percent of second buyers also are small traders (table 4.4, panel C, column 4). In other words, in nearly half of the cases, small traders bought from farmers and sold their vegetables to a second small trader. In addition, 13 percent of small traders took their vegetables to a nearby retail market and to sell their goods to consumers (column 5).

Using data from a 2000 Rural China Household Survey data set collected by the Center for Chinese Agricultural Policy and the University of California, Davis (Huang and Rozelle), we present a profile of the typical horticultural trader in China. Among other sections of the national representative rural household survey, one part focused on family-run businesses and carefully enumerated the income and expenses, assets and liabilities, and working hours of more than 350 small micro-enterprises, including more than 50 small trading firms. In this section, we assume that horticultural traders are similar to traders who are operating in other industries.

According to the dataset and other supplemental interviews, most small traders in the Greater Beijing area were from three poor provinces, Hebei, Henan, and Anhui (Wang et al.). On average, small traders worked in small groups or trading firms of three to four people. On average, small traders had only seven years of education with an average age of over 30 years old, which is older and less well-educated than the average migrant to China's largest cities. In almost all cases, the employees/partners working in the same small trading firm were either relatives or fellow villagers – people that could be relied upon to work hard and trusted to work for the good of the firm. Moreover, despite the long hours of work per day for about eight months of the year, the average annual income of traders was only about 3200 yuan per person. If this was their only source of income and if we assume each small trader had to support, on average, a single dependent, this placed them at the high international poverty line (about two dollars per day in purchasing power parity terms). Hence, these small traders can be thought of as poor themselves and willing to engage in labor-intensive economic activities, including traveling long distances to procure fruit and vegetable crops from farmers.

Based on the data, an average six-man trading firm typically had three people in the rural areas going from village to village locating sources of supply. When a deal was struck, the traders would find an independent trucker. Traders typically possessed a cell phone list with hundreds of trucker names and numbers. The hired truck was loaded with produce owned by the trading firm and sent to a nearby wholesale market. At the wholesale market the trucker would be met by the “urban” side of the trading team. This person would unload the truck into a stall that had been rented in the market and begin selling the product. There were typically two or three other such employees in the firm, working individually in each market of a city.

Local Government and the Role of Policy Despite the heavy intervention that occurred during the 1980s and early 1990s in the agricultural production sector, in today's horticultural economy there is

almost no active government involvement. There is little intervention or regulation of the production sector, the procurement/trading sector, and the transportation sector. Some processing plants, which are almost 100 percent in the private sector, have received some assistance from the government such as access to cheap land or preferential access to loans, although mostly at market-set interest rates. In addition, it is our perception (although this needs more research) that access to government land and loans helps make some investors profitable but does not help others. There is little effort to rescue failing firms. There is little intervention or regulation of the retail sector for fresh fruits and vegetables. Such observations are consistent with others who have spent a lot of time in the field researching the horticultural economy (Crook 2005).

While the unregulated nature of China's economy may allow producers to make decisions on cropping and investment without having to deal with bureaucratic regulation, the government also is absent in the more productive roles. For example, in our survey of vegetable producers, we found that only one-half of vegetable farmers had ever seen an extension agent with regards to vegetable production or marketing matters. In a typical year, only one in eight farmers ever saw an extension agent (Huang and Rozelle).

Historically, the government has not supported farmer cooperatives (Shen et al.), but during the past five years there has been a new effort to allow cooperatives to develop and they have begun to grow. Between 2000 and 2003 the number of cooperatives, which mostly support production and marketing of vegetables and fruit, more than doubled. However, when looked at in another way, this growth is fast in part because it is starting from such a small base. Even after the fast growth experienced since 2000, by 2003, only eight percent of villages had any cooperative organization. In villages with cooperatives, less than one-third of the farm households had joined. Hence, over the 200 million farm households in China, fewer than two percent were members of cooperatives. When compared to the US, Japan, and South Korea, where most farm households belonged to cooperatives during their developmental years, China lags far behind.

In short, although China's horticultural producers are endowed with cheap labor, they get little government support. Most of their villages are very poor, have inferior infrastructure (transport and communications), and have almost no extension support. Few belong to cooperatives, so they are facing China's very competitive markets on their own – with very few subsidies from the government.

Table 4.5: Summary statistics for sample households and villages, 2004.

Variable	Unit	Concentric circle sample region					
		Total	40 km	60 km	80 km	100 km	140 km
No. of sample households	households	494	143	60	111	90	90
Cultivated land per capita ^a	ha	0.14	0.09	0.07	0.16	0.13	0.17
Share of households that belong to a cooperative	%	1.05	2.68	0	3.58	0.59	0
Share of laborers that have off-farm job ^b	%	35	42	53	24	43	31
Average days of per laborer of those that have off-farm job	day	96	111	125	67	122	82
Share of off-farm income in net income ^c	%	40	44	61	25	50	34
Household size	persons	3.98	4.06	4.19	3.70	4.46	3.77
Size of household labor force	persons	2.82	2.75	2.89	2.72	3.09	2.72
Income per capita	yuan	2913	3881	2974	2299	3085	2752
No. of sample villages	number	201	40	40	41	40	40
Average distance from village to the nearest county road	km	4.95	2.46	3.51	6.09	6.30	4.65
Share of villages that are within 5 kilometers of a paved road	%	79	86	76	77	80	78
Share of households that have cell phone	%	48	66	53	42	50	43

Source: Wang et al.

Notes: ^aCultivated land includes all farmer-managed land, including contracted land and land rented in, but excluding land rented out.

^bLabor includes all able bodied persons 16 to 65 years old and excludes persons within this age bracket that are at school.

^c“Net income” includes cropping net income, off-farm net income and other sources of net income.

Why Is China's Horticultural Production and Procurement Dominated by Small Farmers and Small Traders?

As noted above, although horticultural production grew along with domestic demand for fruits and vegetables and the emergence of supermarkets in urban areas, there has been almost no penetration by modern wholesalers or retailers into rural communities. Fewer than six percent of first-time buyers and fewer than 16 percent of second buyers can be identified as members of modern supply chains, in the form of supermarkets, professional suppliers, or processing firms. Instead, China's horticultural economy is dominated by traders who are themselves poor and small, typically operating in firms of four to six people who earn low wages. Moreover, unlike the evidence found in other countries, it appears that in China, far from being hurt by the rise of supermarkets and the horticultural boom that has come with it, the poor, small farmers in our sample appear to have gained. The richest farmers, in contrast, played a smaller role in 2004 than in 2000. Clearly, it appears that this is a special case of "Producing Horticultural Crops with Chinese Characteristics."

So what makes China special? While a full analysis and more definitive conclusions would require more research, it is our opinion that there are seven characteristics of China's horticultural economy that produce these surprising results. First, China's land holdings and those in our sample (table 4.5, row 2) are relatively equal. In our sample, the average farm size of the largest 20 percent of farmers was only 0.36 hectares (ha) per capita.

Second, there are almost no farmer cooperatives to allow farmers to act in concert with one another. In our sample, only 11.4 percent of villages reported that they had a horticultural or general farm cooperative and only 1.05 percent of farmers said that they belonged to a cooperative (table 4.5, row 3, column 1). These numbers, as it turns out, are remarkably similar to figures for all of China reported by Shen et al. using data from a national representative sample of more than 2000 villages. Because of characteristics one and two, it is easy to see why it could be so difficult for supermarkets and other modern supply firms to deal with farmers given their atomistic size and the absence of organization. Clearly, the transaction costs of contracting or direct procurement would be high.

The third characteristic relevant to explaining the role of small, poor farmers in the rise of China's horticultural economy is that although land is relatively equally allocated across all communities in China, there are still differences. In the case of horticultural producers, farm households in poorer more remote areas had relatively more land (0.17 ha/capita) than those in areas nearer to the richer urban center (0.09 ha/capita – row 2, columns 2 and 6).

Fourth, there are differences in the access that these households have to labor. Although horticultural farmers in our sample had the same family size as those not engaged in horticultural farming, the main difference was due to differential access to off-farm jobs (rows 4 to 7). Farm households located nearest to Beijing had a higher percentage of their labor force involved in off-farm employment (42 percent for those nearest versus 31 percent for those furthest away) and they worked a larger number of days per year (111 for those nearest versus 82 for those furthest away). The same was true when dividing the sample between better off households and poorer households. Poorer households had more land and labor available for use in producing horticultural crops. Hence, when considering the third and fourth characteristics together, it is easy to see why poor farmers have increased their share of area devoted to production of many of the horticultural crops – they are relatively land and labor rich, the two key factors in the production of horticultural crops.

The fifth characteristic contributing to the propensity for poorer farmers to increase their participation in the horticultural economy is the fact that this activity is almost completely unregulated within China. The sixth characteristic is that China's road and communication networks have improved remarkably over the past ten years (table 4.5, rows 11 to 13). These two characteristics mean that small traders working with a limited amount of capital, using extremely large amounts of low-cost labor, and utilizing the relatively efficient road and communication infrastructure appear to be out-competing all other would-be procurement agents. According to our interviews with the small traders and producers, the competition among small traders is fierce and profit margins are almost always razor thin. There is little above normal profits available to attract new, more innovative entrants. Interestingly, in this type of small trader-dominated system, there is little or no effort being made to impose or monitor quality or safety standards directly on producers.

Finally, the seventh characteristic is that China remains a relatively poor nation and its consumers so far have not placed a high premium on either food safety or obtaining a standard product. Although there is a rising middle class, most urban consumers still live in households earning an annual disposable income of around \$1000 per capita. Many consumers are becoming increasingly stressed with rising payments in other expenditure categories such as housing, automobile ownership, education, and health care.

The combination of extremely competitive wholesale markets, the low price premium for quality, and the high transaction costs that would have to be borne should a supermarket want to maintain tight control over its horticultural supply means that China still relies on traditional wholesale channels for the procurement of horticultural products.

As a result, standardization and safety in China's food system suffer. However, this may be good news for small poor farmers because they are adept at supplying the traditional wholesale markets. Although one must remember how fast China is changing in so many areas; if any of these seven characteristics changed, China's horticultural economy may change as well. Such a change, like so many other things in China, could be very fast.

COMPETITIVENESS TODAY; CONSTRAINTS TOMORROW?

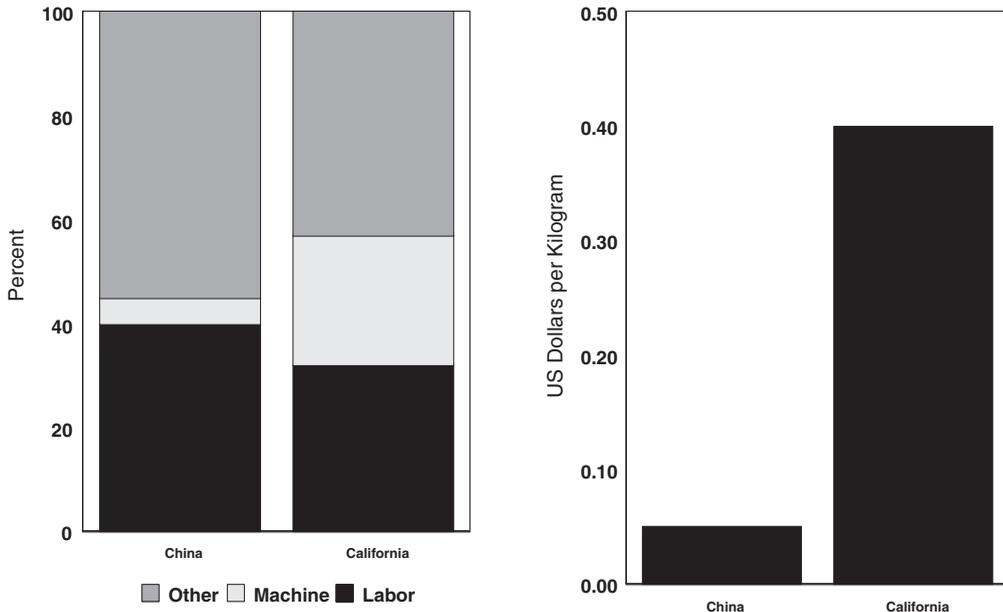
This section looks at the strengths and potential weaknesses of China's horticultural economy. First, past productivity performances are analyzed in order to identify the source of China's advantages. Then, a number of possible constraints are considered. By understanding the factors that can enable or constrain the growth of China's horticultural economy, we can better project what may happen in the future.

Productivity Increases

We begin the analysis by examining detailed cost of production data for seven vegetable crops in China's major production areas (Huang and Rozelle). The data are from a survey executed in all of China's main horticultural producing provinces by the National Price Bureau. On average, data from ten to 15 provinces is available for each crop. The survey began in 1990 and we gained access to data through 2003. The family's own labor in the cost data was accounted for at the equivalent of about two dollars per day (although this changes over time). Yields are reported in kilograms per mu, where a mu is equal to one-sixth of an acre (one-fifteenth of a hectare). Huang and Rozelle present data for eggplant, capsicum (green/bell peppers), field-cultivated tomatoes, greenhouse-cultivated tomatoes, field-cultivated cucumbers, greenhouse-cultivated cucumbers, and potatoes.

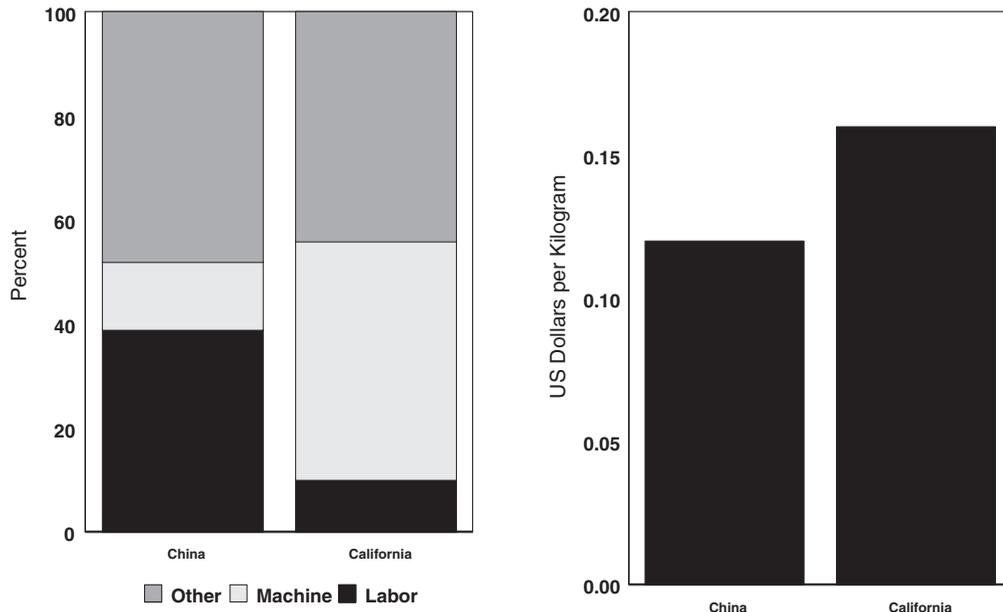
Although there are differences across crops and years, there are some important patterns and trends in the productivity of China's horticultural sector. The survey data dealt with both vegetable and fruit production and they showed a similar pattern. Between the early 1990s and early 2000s, yields (kg/mu) rose. In addition, output per person-day of labor rose steadily over the study period. Importantly, after initially rising in the early 1990s, total production cost per ton of output tended to fall (or at least stay constant) since the late 1990s, and the share of labor in the total cost of production rose over time. Two factors accounted for the rise in the cost share of labor: 1) as demand for vegetables rose, farmers placed more intense effort into their commercial production of vegetables; and 2) the wage applied to family labor rose. In addition, the shares of material (non-labor) cost accounted for by fertilizer and pesticides rose. Finally,

Figure 4.2: Cost of production of bell peppers in China and California.



Source: Huang, Dong, and Rozelle.

Figure 4.3: Cost of production of Japonica rice in China and California.



Source: Huang, Dong, and Rozelle.

although seed costs were relatively high; farmers bought most of their seed from the market and there were no regulations on seed prices.

When all of these facts are put together, it is clear that horticultural production in China has become more efficient. The amount of labor employed is enormous, but it is being used more effectively in producing vegetables. In other work done by the Center for Chinese Agricultural Policy (Wang et al.), it has been shown that when a farm moves into vegetable production, its cropping income rises substantially, although this implies increases in use of family labor and may divert labor from other activities.

Cost Comparisons with California Two figures (figures 2 and 3) provide a comparison of the costs of production between crops grown in California and China. The data for China were collected by a research team under our direction and put into cost categories that were designed to be similar to cost of production categories collected by the University of California's cost of production extension surveys (Huang and Rozelle). The left panel in figure 4.2 shows that a high percentage of the cost of vegetable production in China and California comes from labor. When this is so, the right side of the panel shows that China's producers have a large absolute cost advantage in production at the farm gate (that is, not counting marketing and processing costs). In figure 4.3, costs for rice are compared (short and medium grain rice that is produced in both northern China and northern California). In the case of rice, the share of costs in California that are made up of labor is lower than for vegetables (left-hand panel of figure 4.3). As a result, when comparing the farm gate cost of production, the costs in China and California are almost the same (right-hand panel). This clearly shows that in crops that are labor-intensive, China has an enormous cost advantage.

The cost advantages also show up in consumer food prices (table 4.6). While the prices of rice and poultry are about one-half of what they are in the United States, the retail food prices of tomatoes and apples are only about one-eighth as high. Quality differences certainly exist, but these are also disappearing.

Potential Constraints

China's producers also face many constraints. While it is beyond the scope of this chapter to analyze these in depth, it is an important area of research to see what factors are likely to hold back China's growth as a horticultural producer. In this section, we examine three possible constraints.

Table 4.6: Comparison of food prices between China and the US.

	China	US
Average food spending per person per year, 2003	\$262	\$5,050
Average retail price, 2005	\$ per pound	
Rice	.33	.58
Poultry	.58	1.07
Pork	.89	3.05
Tomatoes	.22	1.55
Apples	.12	.99

Sources: ERS estimates based on China National Bureau of Statistics, China National Development and Reform Commission, and US Bureau of Labor Statistics data.

Water scarcity is one of the key problems that affects northern China, an area that covers 40 percent of the nation's cultivated area and houses almost half of the population (Crook 2000). Water scarcity in China has risen both because of limited water supply and increasing water demand. Water availability per capita in northern China is only around 300 cubic meters per capita, which is less than one-seventh of the national average and far lower than the world average (Ministry of Water Resources). Past water projects have tapped almost all of the region's surface water resources. At the same time that irrigated cultivated area has expanded, the rapidly growing industrial sector and an increasingly wealthy urban population have demanded rising volumes of water (Crook 2000). As a result, surface supplies are becoming increasingly stressed and groundwater resources are diminishing in large areas of northern China (Wang, Huang, and Rozelle). For example, between 1958 and 1998 groundwater levels in the Hai River Basin fell by up to 50 meters in some shallow aquifers and by more than 95 meters in some deep aquifers (Ministry of Water Resources).

Since many horticultural crops use water relatively intensely, it seems plausible that as water becomes increasingly scarce, horticultural crop production could be hurt. In a study by officials on the use of water pricing policies to dampen the demand for water (Huang et al.), it was found that in order to substantially curb demand, the price of water would need to be raised substantially. They found that if water prices rose substantially a large amount of the sown area would come out of production. If water pricing policies were used aggressively and the area of horticultural crops declined, future horticultural supply could have trouble keeping up with demand.

Other findings from the Huang et al. study suggest that as water becomes scarcer, producers may choose to idle lower-valued wheat land when

setting aside sown area. In its place, farmers could shift into horticultural land. Although horticultural crops are water-using, they are relatively more labor-using. If the price of water rose, farmers may shift into those crops that use the relatively inexpensive factor (i.e., horticultural crops). In fact, cross sectional data ranked by the price farmers pay for water shows that as the price of water rises, farmers produce more horticultural crops. Hence, in this indirect way, as water becomes scarcer, horticultural supply may actually rise.

The size of China's farms also may be a potential binding constraint. There are now tens of millions of producers of horticultural crops in China. China's farm sizes are small and getting smaller. The very nature of China's production, trading, and trucking sectors means that ensuring food safety, quality, and reliability will be difficult, when we recognize that the costs of monitoring and providing assurance for food safety rise as the number of farms rise and their size falls. As the demand for food safety rises, the current level of quality assurance may become unacceptable. If this happens, and farm sizes are not able to adjust and other mechanisms are not found to certify and provide traceability for high quality, safe food, China may have trouble meeting both domestic and export demand.

Of course, China's most important advantage is its low labor costs. Rural wages have remained remarkably low over the past 20 years, in large part because China restricted the off-farm work of rural residents. As China develops, rural wages must rise. Indeed, our personal observations in the field suggest that the real hourly/daily wage rose between 2004 and 2005. China's comparative advantage in labor-using horticultural commodities will remain for some time. But if China's wages continue to grow at five to seven percent per year for two or three decades, China will lose some of its low-cost advantage.

SUMMARY

Policy changes and economic factors have played a remarkable role in triggering China's move into the horticultural market. As demand has risen, a more market-oriented policy has allowed China's farmers to respond and supply massive quantities of fruits, vegetables, and nuts. Small farms and poor farmers who sell to poor traders have supplied most of the production. Tens of millions of individuals are involved in the sector. The shift into horticultural crops has had many consequences, most of them positive. Incomes have risen, farm output has diversified, the quantity and quality of fruits and vegetables have risen, and China's production for its domestic market has expanded into the international arena. In fact, China's horticultural sector has grown far faster than anyone might have expected just ten years ago.

While many of the enabling conditions will persist, China's horticultural economy still faces large challenges. The availability and cost of water, land, and labor could all in some way undermine the sector's competitiveness. This will not happen soon, but it is possible, indeed probable, that in the long-run, China will not remain competitive in the production of many agricultural commodities. Until that time, however, there will be a race between China's ability to supply what consumers want and the increasing pace of domestic demand. If the supply side wins, China's producers will enjoy the fruits of both supplying the large domestic market and exporting. If the demand side pulls ahead, there will be opportunities for international horticultural producers to sell to China's market.

References

- China National Bureau of Statistics (CNBS). 2005. *Statistical Yearbook of China*. China Statistical Press: Beijing, China.
- Crook, F. 2000. "Water Pressure in China: Growth Strains Resources." *Agricultural Outlook*. Washington, DC: Economic Research Services, United States Department of Agriculture.
- Crook, F. 2005. "Horticulture in China." Working Paper, China Strategy, Salt Lake City, UT.
- DeBrauw, A., J. Huang, S. Rozelle. 2004. "The Sequencing of Reforms in China's Agricultural Transition." *Economics of Transition* 12(3): 427-466.
- Fafchamps, M. and F. Shilpi. 2003. "The Spatial Division of Labor in Nepal," *The Journal of Development Studies* 39(6):23-66.
- Fan S. 1997. "Production and Productivity Growth in Chinese Agriculture: New Measurement and Evidence." *Food Policy* 22 (3 June):213-228.
- Farina, E. and E. Machado. 1999. "Government Regulation and Business Strategies in the Brazilian Fresh Fruit and Vegetable Market." Paper presented at the International Food and Agribusiness Management Association (IAMA) Congress, Florence, Italy.
- Huang, J. and C. Chen. 1999. *Effects of Trade Liberalization on Agriculture in China: Commodity and Local Agricultural Studies*. United Nations, ESCAP CGPRT Centre, Bogor, Indonesia.
- Huang, J., X. Dong, and S. Rozelle. 2005. "China's Emerging Horticultural Economy: Supply, Demand and Trade." Working Paper, Center for Chinese Agricultural Policy, Institute for Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences, Beijing, China.
- Huang, J. and S. Rozelle. 2007. "The Rise of China's Horticultural Economy: Impact on Poor, Small Farmers." Working Paper, Center for Chinese Agricultural Policy, Chinese Academy of Sciences, Beijing, China.
- Huang, J., S. Rozelle, and M. Chang. 2004. "The Nature of Distortions to Agricultural Incentives in China and Implications of WTO Accession." *World Bank Economic Review* 18(1): 59-84.
- Huang, Q., S. Rozelle, R. Howitt, J. Wang, and J. Huang. 2006. "Irrigation Water Pricing Policy in China." Working Paper, Center for Chinese Agricultural Policy, Institute for Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences.

- Huang, J., S. Rozelle, and H. Wang. 2006. "Fostering or Stripping Rural China: Modernizing Agriculture and Rural to Urban Capital Flows." *Developing Economics* 44(1): 1-26.
- Lin, J.Y. 1992. "Rural Reforms and Agricultural Growth in China." *American Economic Review* 82(1):34-51.
- Martin, W. 2001. "Implications of Reform and WTO Accession for China's Agricultural Policies." *Economics of Transition* 9(3):717-42
- Ministry of Water Resources of the People's Republic of China. 2002. "China Water Resources Bulletin."
- Nyberg, A. and S. Rozelle. 1999. *Accelerating China's Rural Transformation*. Washington DC: The World Bank.
- Reardon, T., C. Timmer, C. Barrett, and J. Berdegue. 2003. "The Rise of Supermarkets in Africa, Asia and Latin America." *American Journal of Agricultural Economics* 85(5):1140-1146.
- Rosen, D., J. Huang, and S. Rozelle. 2004. *Roots of Competitiveness: China's Evolving Agriculture Interests*. Washington, DC: Institute for International Economics, June.
- Rozelle, S. and R. Boisvert. 1995. "Control in a Dynamic Village Economy: The Reforms and Unbalanced Development in China's Rural Economy." *Journal of Development Economics* 46(2):233-252.
- Rozelle, S. and J. Huang. 2002. "Continuity and Change in China's Rural Periodic Markets." *China Journal* 49: 89-115.
- Rozelle, S., J. Huang, and D. Sumner. 2006. "Supply, Demand and Trade for Horticultural Commodities in China." Working Paper, Department of Agricultural and Resource Economics, University of California, Davis.
- Rozelle, S., A. Park, J. Huang, and H. Jin., 2000. "Bureaucrat to Entrepreneur: The Changing Role of the State in China's Transitional Commodity Economy." *Economic Development and Cultural Change* 48(2):227-252.
- Sicular, T. 1995. "Redefining State, Plan, and Market: China's Reforms in Agricultural Commerce." *China Quarterly* 144:1020-1046.
- Shen, M., S. Rozelle, L. Zhang, and J. Huang. 2005. "Farmer's Professional Associations in Rural China: State Dominated or New State-Society Partnerships?" Working Paper, Center for Chinese Agricultural Policy, Chinese Academy of Sciences, Beijing, China.
- Wang, H., X. Dong, J. Huang, T. Reardon, and S. Rozelle. 2006. "Producing and Procuring Horticultural Crops with Chinese Characteristics: A Case Study in the Greater Beijing Area." Working Paper, Center for Chinese Agricultural Policy, Institute of Geographical Sciences and Natural Resource Research, Chinese Academy of Sciences, Beijing, China.
- Wang, J., J. Huang, and S. Rozelle. 2005. "Evolution of Tubewell Ownership and Production in the North China Plain." *Australian Journal of Agricultural and Resource Economics* 49:177-195.