March 2006

Vegetables in China:

Final Report to the Western Growers Association

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Final Report to the Western Growers Association

In this report I provide a summary of the work that I have been doing on China's vegetable economy over the past year. This work, in part, was supported financially by the Western Growers Association (WGA). The funds provided by the WGA were mostly used to support a survey of vegetable producers and wholesale procurement traders in rural China. It also went to support the procurement of a data set that could aid in the analysis of the productivity of China's vegetable producers. The work that I summarize here, however, is from far more different sources. I greatly appreciate the support of WGA and look forward to continuing to interact with the management and members in the coming years.

To make the material more accessible, I plan on organizing this report by asking a question and then summarizing the answer. In this way I can cover a lot of ground without getting lost in the details. I am more than willing to try on any given aspect of the final report to expand on the issues.

The organization of the report is as follows:

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I. The Economic Environment of China's Horticulture Economy

In this section we lay out the fact and a few of the relevant statistics that serve as a background for the heart of our analysis in section II. We first look at the changes in consumption.

A. Consumption Forces

1. What is the driving force of the horticulture economy?

There is no doubt about it. China's rising demand for fresh fruits and vegetables is the main driver of the horticulture economy. As will be seen in the rest of this report, the millions of farmers that produce fruits and vegetables are doing so on their own and are mainly responding to the forces of rising demand that are signaling (sometimes not so perfectly) that consumers inside and outside of China want to but and consume more fruits and vegetables. There is a rising demand for quantity. There is a rising demand for quality. There is a rising demand for a diversity of product. Moreover, it is domestic demand that is driving demand; for every 1 dollar of sales into the export market, China's domestic producers probably spend $50 dollars on horticulture products (Figure 1).

2. What is happening to consumption of domestic consumption of fruits and vegetables?

Domestic per capita consumption measured in weight terms of vegetables (Figure 2) and fruit (Figure 3) are rising slightly over time, but the trends differ by urban and rural. The average urban resident increased his/her consumption from 113 kg/capita in 1997 to 123 kg/capita in 2004; fruit rose from 40 kg/capita to nearly 60 kg/capita. The typical rural resident consumed less of both vegetables and fruit and the trend was stagnant.

Quantity statistics, especially for fresh horticultural crops consumed by urban residents cover a lot of growth for two reasons. In fact, quality has grown over time, so expenditure per capita has grown (although prices have also fallen in real terms between 1995 and 2004—Rozelle et al., 2006). In addition, much horticultural consumption is done away from home (in restaurants). As we have seen in the case of meat (Ma et al., 2004), this type of consumption leads to severely undercounting of rising consumption trends.

So, in general, consumption is rising; but the change in quality and variety—at least in urban consumption—is the main trend to consider.

3. What are the forces that are driving the consumption trends? What are the future of these forces?

Income: China's GDP has grown at an astounding 10% annually for more than 20 years in a row, a record that has never before been equaled in the history of our world

by a country (Figure 4). Rising income means higher demand for horticultural crops, especially higher valued ones and higher quality product.

Migration: When people move from rural to urban, over time the former rural resident tends to adopt the urban consumer's consumption pattern. Migration has grown very fast in the past; it is scheduled to continue into the next two to three decades (Figure 5). This means that aside from income there is going to be another very large driver of China's domestic consumption increase.

With project growth of income and migration in the future, we expect that there will be a rapid growth in horticultural consumption into the future. There will be a rise in the demand for absolute quantity. There will be rise in the demand for quality and variety. All of these factors will make it difficult to estimate the exact nature of the demand for a single product; but in general the rise in demand is the real driving force of the entire economy, being pushed by external forces (growth and migration) will almost certainly continue far into the future.

B. Changes in Macro-Marketing/Processing Environment

1. Since China decided to reform its economy, what roles to markets play?

Pre-reform system (see Rozelle et al., 2000):

The administration of prices by the Socialist planning apparatus is one of the most distinguishing characteristics of pre-transition countries. While in some countries leaders allowed subsets of goods to be traded out of the plan, for most high priority commodities—which almost always included food and fiber--planning ministries in most nations allocated goods and services mostly on the basis of quantity-based plans. Prices mostly served accounting functions. This was the case of China, as the rest of the transition world.

In pre-reform era, China used administrative prices to impose a heavy tax on agriculture. Policy makers required farmers to deliver their output at artificially low prices. Although in the 1970s a policy of paying a slightly higher price for marketed output that exceeded the basic quota, most of these prices were purposely held artificially in comparison to inputs, capital equipment purchaes and other consumer goods that were bought from factories and wholesalers in the urban economy. In part of offset the high input prices, subsidized inputs were provided, although only producers could only buy limited quantities.

Although early in the reforms China's leaders had no concrete plan to liberalize markets, they did take steps to change the incentives faced by producers that were embodied in the prices that producers received for their marketed surplus. Hence, perhaps one of the least appreciated moves of the early reformers was their bold decision to administratively increase the price of farm goods that were to be received by farmers.

Between 1978 and 1983, in a number of separate actions, planners in China increased the above quota price, the payment farmers received for voluntary sales beyond the mandatory deliveries, by 41 percent for grain and by around 50 percent for cash crops. According to the State Statistical Bureau's data, the relative price of grain to fertilizer rose by more than 60 percent during the first 3 years after reform. During the early reform years, the rise in above-quota price represented a higher output price at the margin to farmers, since until 1984, state-run procurement stations regularly purchased all grain sold by farmers at the above-quota price as long as they had already fulfilled their mandatory marketing delivery quota which was purchased at a state-set quota price, which for the case of rice, for example, was 50 percent below the above-quota price.

The important contribution of China's pricing policy is the timing and breadth of the policy change. The first major price rise occurred in 1979, almost at the same time when reformers were deciding to decollectivize. However, given the leadership's decision to gradually implement the Household Responsibility System (HRS—discussed below), beginning first in the poorest areas of China, the price increases immediately affected all farmers, both those in areas that had been decollectivized and those that had not. By 1981, the time of the second major price increase, less than half of China's farmers had been allowed to dismantle their communes. Hence, as long as there was some, albeit weak, link between the output price and production, the plan-based price rise would have led to increases in China's farm output.

During the entire pre- and post-reform period, input prices – especially that of fertilizer – were still mostly controlled by the state's monopoly agricultural inputs supply corporation in China. Although in short supply, the governments in both countries controlled the price of fertilizer and other inputs (such as pesticides, diesel fuel, and electricity) as well as their distribution. Communes received low-priced fertilizer from the state, but almost all of it was inframarginal. In other words, the government-supplied, subsidized fertilizer was not sufficient to meet the needs of most farmers. Producers in both the pre- and post-reform periods typically purchased additional fertilizer from the state at a higher price. Hence, unlike other transition and developing countries, at the margin, farmers in China were not able to purchase fertilizer prices at highly subsidized rates.

Reforms and Markets

In contrast to the CEE and the CIS countries in which took a Big Bang approach to reform, leaders in China did not dismantle the planned economy in the initial stages of reform in favor of liberalized markets. Observers all discuss how China's leadership had little intention of letting the market play anything but a minor supplemental guidance role in the early reforms period in the early 1980s. In fact, the major changes to agricultural commerce in the early 1980s almost exclusively centered on increasing the purchase prices of crops. The decision to raise prices, however, should *not* be considered as a move to liberalize markets since planners in the Ministry of Commerce made the changes administratively and the price changes mostly were executed by the national network of grain procurement stations acting under direction of the State Grain Bureau.

An examination of policies and the extent of marketing activity in the early 1980s illustrate the limited extent of changes in the marketing environment of China's food economy before 1985. It is true that reformers did allow farmers increased discretion to produce and market crops in 10 planning categories, such as vegetables, fruits, and coarse grains. Moreover, by 1984, the state only claimed control over 12 commodities, including rice, wheat, maize, soybeans, peanuts, rapeseed, and several other cash crops. However, while this may seem to represent a significant move towards liberalization, — the crops that remained almost entirely under the planning authority of the government still accounted for more than 95 percent of sown area in 1984. Hence, by state policy and practice, the output and marketing of almost all sown area was still directly influenced by China's planners.

Reforms proceeded with equal caution when reducing restrictions on free market trade. The decision to permit the reestablishment of free markets came in 1979, but only initially allowed farmers to trade vegetables and a limited number of other crops and livestock products within the boundaries of their own county. Reformers did gradually reduce restrictions on the distance over which trade could occur from 1980 to 1984, but some scholars point out, the predominant marketing venue during the early 1980s was mainly local rural periodic markets. Farmers also did begin to sell their produce in urban settings, but free markets in the cities only began to appear in 1982 and 1983. In addition to being small and infrequent, traders could not engage in the marketing of China's monopolized commodities that were still under strict control of the state procurement stations.

The record of the expansion of rural and urban markets confirms the hypothesis that market liberalization had not yet begun by the early 1980s. Although agricultural commodity markets were allowed to emerge during the 1980s, their number and size made them a small player in China's food economy. In 1984, the state procurement network still purchased more than 95 percent of marketed grain and more than 99 percent of the marketed cotton. In all of China's urban areas, there were only 2000 markets in 1980, a number that rose only to 6000 by 1984. In Beijing in the early 1980s, there were only about 50 markets transacting around 1 million yuan of commerce per market per year. Each market site would have had to serve, on average, about 200,000 Beijing residents, each transacting only 5 yuan of business for the entire year. In other words, it would have been impossible for such a weak marketing infrastructure at that time to even come close to meeting the food needs of urban consumers.

After 1985, however, market liberalization began in earnest. Changes to the procurement system, further reductions in restrictions to trading of commodities, moves to commercialize the state grain trading system, and calls for the expansion of market construction in rural and urban areas led to a surge in market-oriented activities. For example, in 1980, there were only 241,000 private and semi-private trading enterprises registered with the State Markets Bureau; by 1990, there were more than 5.2 million. Between 1980 and 1990, the per capita volume of transactions of commerce in Beijing urban food markets rose almost 200 times. Private traders handled more than 30 percent

of China's grain by 1990, and more than half of the rest was bought and sold by commercialized state grain trading companies, many of which had begun to behave as private traders. The recent record on the expansion of rural markets is shown in Figure 6, Panel A.

China moved equally slow in its liberalization of input markets. During the prereform era, the state distributed all key inputs such as chemical fertilizer through the government-controlled network of agricultural input supply stations. During a time when many inputs in many regions were scarce, local officials were issued coupons that gave communes that right to purchase at least part of the inputs they needed. In the initial years of reform when decollectivization was occurring, leaders did virtually nothing to limit the role of the state in input allocation. Indeed, private sales of nitrogen fertilizer were restricted and the state continued to completely control all chemical fertilizer distribution. Even after the start of liberalization in both output and input markets in 1985, the process was still partial and executed in a start and stop manner.

However, it is only after 20 years of market liberalization that the state had largely abdicated its responsibilities for grain and inputs trade. By the mid-1990s, about 50 percent of fertilizer was sold by private traders. In 2000, according to a survey of 1200 households in six provinces, fertilizer was almost exclusively handled by the private sector. All pesticides, tractors, diesel fuel, plastic sheeting and nearly all other inputs are now all 100% private.

2. How have markets changed in urban areas?

As in the case of rural markets, urban markets in recent years have also have changed dramatically. The biggest and most significant change has come in the area of the emergence of supermarkets. The rise of supermarkets has been nothing less than spectacular (Figure 6, Panel B). Although there has been participation in the supermarketization movement into China by foreign firms (such as Carrefour and Walmart), they are not the largest players; domestic chains from China are the largest.

I believe that the rise of supermarkets is so important that I wrote a paper with my colleagues describing the phenomenon. This is attached as Supplemental Paper 1.

3. What has happened to the processing sector?

Through the 1980s the processing sector in China was quite underdeveloped (Figure 7). Almost completely state-owned through the mid-1980s, only a small percentage of the nation’s total value of agricultural output went through the processing sector. After the 1990s, agro-product processing (APP) exploded. Most of the growth has come in the private sector. Today the value of the APP is greater than the total value of agricultural output.

It should be noted that while there are many international state of the art firms, by far more processing capacity is fairly rudimentary (Figure 8)

In summary, then, changes in income and migration led to rapid changes in consumption and demand for quality and variety (and convenience). In response, to make the connection to get the product from farm to consumer, a radical shift has occurred in the procurement, wholesale, retail and processing industry.

C. Changes in Macro-Production Trends

1. What have been the Changes to Sown Area for Vegetables?

In response to rising demand by consumers and the new requirements of processors and retailers, the producer sector's response likewise has been nothing less than fantastic. The changes in sown area of vegetables can illustrate more than anything the responsiveness of producers (Figure 9). Between 1990 and 2000 sown area increased by more than 8 million hectares (or 20 million acres). The area under vegetable production more than doubled during this time. In fact, to put it in perspective, as seen from the figure, the area in China increased so fast that vegetable area increased the equivalent of a new California about every two years.

It does not matter what crops that one looks at, there has been a rise of almost every major type of vegetable crop. For example, tomato and garlic area have expanded very fast during the 1990s (Figure 10).

As production has begun to rise, although most producers still invest very little in their farms, there is rising investment, especially in greenhouse technologies. The range of technologies in terms of sophistication is great. On the one hand, there are many dirt wall backed structures that are covered with cheap plastic and warmed by coal-burning pot bellied stoves. On the other hand, there are beginning to be state-of-art, integrated, climate controlled green house facilities.

2. What have been the Changes to Orchard Area for Fruit?

Similar shifts are seen in the case of fruit (Figure 11). In the early 1990s, fruit sown area almost doubled from about 5 million hectares to almost 10 million hectares. In the last 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 had a mentality to plant grain ahead of all other crops, on a percentage basis, China has more than double the area allocated to fruit than other major countries (Figure 12)..

3. How has the Nature of Production Changed in Terms of Specialization?

At the village-level:

Few authors have attempted to quantify the gains from market liberalization. Part of the problem may be the short period of analyses, the inability of standard methodologies and measures or indicators of market liberalization to separate efficiency gains of market reform from overall gains in the reforming economy. According to our reading of the literature, in only three papers have there been an attempt to isolate empirically the effect of reforms that facilitate the emergence of markets. In deBrauw et al. (2004) it is shown that there is a positive effect of increasing marketization on productivity. Other authors find a similar result. In all three of these papers, the authors conjecture (without an empirical basis) 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 and integrate, in 2004 we conducted a national representative survey of 400 communities. In the survey of community leaders we asked the following question: Are farmers in your village specializing in any particular crop or livestock commodity? The question was asked about 1995 and 2004. If the respondent answered affirmatively, we asked for the commodity in which they were specializing. If the farmers in the community were specializing in a cropping activity, we asked for the area sown to the speciality commodity.

The results of our survey show that indeed specialization has been occurring in China's agricultural sector. Between 1995, the percentage of villages that are specializing in an agricultural commodity has increased and has done so in every province (Table 1, columns 1 and 2). On average, throughout our sample from across China, 30 percent of China's villages are specializing, up from 21 percent in 1995. Although the percent of villages that specialize has risen in all of our sample provinces, some (e.g., Liaoning, Inner Mongolia and Shanxi) have risen faster than others (Hebei, Henan and Shaanxi). The percent of area sown to the speciality crops has also risen, rising across our sample average from 14 percent of total sown area in 1995 to 24 percent in 2004 (columns 3 and 4). Over half of the 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 .

At the regional-level:

One of the most important sets of data that we have collected is from a data collection effort that we sent to Shandong Province, China's vegetable basket province (and the source of over ½ of China's exports). The location of Shandong is shown in Figure 13. It is a province of about 90 million people with an area smaller than California.

When we went to Shandong our team visited every prefecture and collected by county data on 10 major vegetables crops. We then mapped them on a by-county map of Shandong Province. What we found is that there has been the beginning of a real concentration of production of the major vegetable crops in China. For example, bean production has concentrated in Weifang prefecture, one of the highest production areas in Shandong province, located halfway between the Jiaodong Penisula and Jinan, the capital city (Figure 14). In contrast, large areas of cucumbers are grown around Qingdao (Figure 15). Other crops, such as garlic and leeks, are concentrating in the southern parts of the province (Figure 21). This regional concentration is one of the consequences of the market reforms. It also could mean that as China gears up to increase exports the rising concentration will allow for more efficient investment into transport, communication, storage and other logistic services.

II. The Actors—From a Micro-level

This part of the report draws heavily on the survey work that was funded by the project. In short, the information in this part of the report is mostly from a randomly selected set of villages in Greater Beijing. Caution needs to be exercised for several reasons. First, this is an area that is not at the heart of the export economy. It also is in the north part of the country. Therefore, one needs to be careful about making conjectures about the rest of China from this sample. However, in the defense of the sample, this also is, to our knowledge, the first fully spatially selected random sample of horticulture producers in China. It will give the first fully regionally representative profile. We will be repeating this work in the summer of 2006 in Shandong province.

In this section, I will try to keep the answers short. In it I look at the actors that make the horticulture economy work on the ground in China's rural areas: a.) the producers; b.) the traders; and c.) local officials. As part of my preliminary report, I sent in a paper on China's horticulture economy, which was also based on this data set. The interested reader can read the entire paper which is included as a Supplemental Paper 2.

A. The Producers

1. Where are vegetables being produced?

The rise of demand for horticultural crops (henceforth the term used to describe "vegetables, fruits and nuts grown in orchards") that have been observed in the demand statistics is beginning to change production patterns of farmers from grain into other crops in the greater Beijing area after 2000 (Table 2, columns 1 and 2). The total sown area of grain between 2000 and 2004 fell from 68 percent 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 4 percentage points. During the same period, the area sown to horticultural crops also rose by 7 percentage points (from 22 percent in 2000 to 29 percent in 2004). Vegetables rose by 2 percentage points; fruit—by far the crop category

accounting for the largest share of horticultural crops—rose by 3 percentage points; and nuts rose by 2 percentage points.

While the production trends for the entire greater Beijing area match fairly closely the rise in horticulture demand in China's urban areas, in this paper we are most interested the types of farmers that are participating in the supplying the horticulture crops. In fact, when information on the typical farmer that is engaged in farming inside each of the concentric circles is compared (that is information on those farmers close to Beijing are compared to those far from Beijing), it can be seen that farmers in all areas are adjusting their production structure (Table 2, columns 3 to 12). In particular, while average farmers in all areas reduced the share of their area sown to grain by 10 percent (from 68 to 58 percent, row 1), as might be expected (Fafchamps and Shilpi. 2003) farmers in the first two circles (40 km and 60 km circles) reduced the share of area sown to grain (12 to 16 percent) more than farmers in the other 3 circles (6 to 10 percent) that are far away from Beijing. In other words, although the production of horticultural crops rises everywhere, the largest rise in terms of the share that a village's land that is allocated to horticulture crops is in the 40 and 60 kilometer circles. Interestingly, while the share of horticultural crops in 40 kilometer circles rise mainly came from fruit (19 to 26 percent), the rise in 60km circle came from vegetables and nuts (vegetables, 4 to 9 percent; nuts, 11 to 17 percent).

2. Who is producing China's vegetables?

While the relative smaller rise of horticultural area share in remote area is what one may expect according to the theories of von Thunen (1826), the most significant finding, based on our data, is that poor farmers are increasing their share of the production of horticulture crops (Table 3). To show this, we divide villages into four quartiles, according to each village's reported income per capita. Between 2000 and 2004 we find that farmers in the very poor and poor categories (those farmers living in villages with incomes below the median income level) have increased their share of total sown area of horticultural crops, in general (top row). In fact, by 2004 farmers in very poor and poor villages produced more than half (55 percent) of horticultural crops in Greater Beijing. 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 3, row 2, columns 5 and 6). For example, in the case of fruit, production is dominated by the farmers in the very poor and poor farmer village. In contrast, farmers in average income villages produce most of the vegetables. Of course, one of the most interesting findings of Table 3 is that the richest farmers are not the driving force (or beneficiary) of vegetables, fruits or nuts.

Hence, according to our data, we have strong evidence the rise of horticultural production in the greater Beijing area is not following the trends that have been observed in other developing countries (e.g., Farina and Machado 1999). Clearly, our data show

that farmers in very poor and poor villages are not being left out. In fact, especially in the case of the very poor, they are 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 are dominating production. Indeed, farmers that live in the richer villages (above average and rich) have lost their share in all categories of horticultural crops (eg, 65 to 59 percent for vegetable, 48 to 38 percent for fruits and 62 to 51 percent for nut). In 2004 the richest 25 percent of farmers only cultivated 19 percent of the region's horticultural area.

3. To whom are vegetable producers selling?

The surprises on the supply side, if anything, are matched by surprises on the procurement side (Table 4). Although there has been a lot of discussion about the potential implications of the rise modern supply chains and the effect of their procurement agents on welfare in rural areas, according to our data, supermarkets are completely absent. Indeed, not one of the 201 village leaders that we interviewed reported the presence supermarkets for the procurement of any vegetable products (Table 4, Panel A, column 1). Likewise, village leaders reported that only 2 percent of procurement from vegetable farmers was from specialized suppliers and only 2 percent was from processing firms (columns 2 and 3). Hence, in the greater Beijing area in 2004, only 4 percent of all vegetable sales were procured by those operating in firms that could be described as part of the modern supply chain.

Even when we look at data on the second buyer in the supply chain, the modern supply chain plays a fairly minor role (Table 4, Panel C, columns 1 to 3). When asked to whom the first buyer sells, supermarkets only are involved in 3 percent of the volume. Specialized supply firms also account for only 3 percent. Processing firms are the second buyer for 10 percent of the volume of the vegetable crops. Hence, in total, even by the second link of the marketing chain, modern supply chains are playing 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 in 2004 were almost non-existent at the producer end of the marketing chain.

4. What does a profile of the typical vegetable producer look like?

The picture of the typical vegetable producer in China shows that the competition of California horticultural economy is small, poor and uneducated. But, it is labor rich, faces low wages and highly commercialized. There are also probably more than 40 million households that are engaged in producing fruit, nuts and vegetables for sale into China's domestic horticultural economy.

To summarize, see Table 5. The average household consists of four people, only three (at most) of which typically are of working age. Of this, about each family 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 42 years old and after graduating

from elementary school only attended one year of junior high school before dropping out. In total, the vegetable producers total farm assets are only $700US (at nominal exchange rates). The house in which the producer lives is his most valuable asset; it makes up about 75% of the household's total assets and is worth less than $8000US.

Since no individual in China owns their 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 their own land. However, the typical vegetable producer only has 1 acre (or 6 mu). This 1 acre of land is typically divided into 5 different physical plots. Vegetables are typically planted on 3 of the 5 plots; the farmer usually will plant wheat or corn or rice on the other plot to use for his household's annual grain consumption (though it is possible to buy grain on local markets). Only 4% of the land that is planted to vegetable crops is rented.

When asked who it was the "decided what to plant," the farmer answered that he had decided himself in nearly 95% of the cases. In the other cases, the 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. Farmers are deciding to plant based on their own decisions. There were almost no subsidies given by the government to farmers.

Because of the small size of land and access to a lot of family labor, on average, the typically vegetable farmer and his family spent about 312 mandays working in vegetable production each year. After subtracting all of his cost, on average vegetable farmers earned about $2/day. In addition to family labor, during harvest or other particularly busy times, the typical horticulture farmer hired laborers for 42 mandays a year. The laborers were paid the equivalent of $3.2/manday for working a 10 hours day (or about 32 cents per hour).

From these figures it is easy to see why the vegetable producers in China can produce for such low cost. But it is also a mistake to think of them as "dumb peasants." Most have been farming all of their lives. And, when they focus on vegetables they are commercial producers. The typical vegetable farmer in China sells about 97% of what he/she produces.

B. Traders and marketers

1. Where are China's vegetables being purchased?

Instead, the main story of vegetable marketing in China in 2004 is the domination of traditional supply channels, mostly by small traders. According to our data, fully 79 of the first-time buyers of vegetables were small traders (Table 4, Panel A, row 1, column 4). These small traders, which during harvest season can be seen veritably everywhere in areas that are producing vegetables, enter the village itself and buy directly from farmers. Almost all transactions are spot market transactions, exchanging the commodity for cash. In addition, in another 8 percent of the cases farmers take their crop, as they have done

for hundreds of years, to local period markets to sell to local consumers and traders (column 5—Rozelle and Huang, 2001).

Almost certain in part due to the domination of traditional small traders, it can be seen from our data that the supply chain penetrates far into the village (Table 4, Panel B). While some of the traders bought from farmers in local periodic markets (about 6 percent), most of them came to the farmer. In fact, when aggregating procurement by traders in the farmer's own fields (65 percent), at some spot in the village's center (9 percent) or at the side of the road near the village (3 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 take place in formal wholesale markets (11 percent) or urban wet markets (4 percent).

Finally, small traders not only make up the first link in the marketing chain. In fact, 49 percent of second buyers also were small traders (Table 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 sold their goods to consumers (column 5).

2. What does a profile of the typical vegetable producer look like?

We thank Jian Zhang, a Ph.D. student of Dr. Rozelle in the department of agricultural and resource economics, University of California, Davis for these statistics. The data are from a 2000 Rural China Household Survey data set collected by the Center for Chinese Agricultural Policy and the University of California, Davis. Among other sections of the survey, one part focused in 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. For more about the nature of China's small micro-enterprises (there are more than 70 million of them in China), we have included Supplemental Paper 3.

While a comprehensive study of vegetable traders is still needed, given their primary role in the rural segment of the marketing chain in the vegetable economy, from interviews and from another data set collected by the authors in 2000, we can sketch a simple profile of small traders. By far, from discussions with village leaders and farmers, most small traders in the greater Beijing area are from three poor provinces, Hebei, Henan and Anhui. On average, small traders worked in small groups (henceforth, trading firms) of 3 to 4 people. On average they received only 7 years of education and their average age was over 30 years old (older and less well-educated than the average migrant to China's largest cities). In almost all cases, those 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 firm. Moreover, despite the long hours of work (on average, for 8 months of the year), the average 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 has to support, on average, a single dependent, this would put them right at the high international poverty line (about $2 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 going far distances to procure vegetable crops from farmers.

Based on our interviews during the horticulture procurement survey and from the 2000 Rural China Household Survey, we constructed the profile of a typical 6-man trading firm. There typically are three people in the rural areas going from village to village finding sources of supply. When a deal is struck, the traders find an independent trucker (they typically have a cell phone list with hundreds of trucker names). The truck is loaded and then sent to a nearby wholesale market. At the wholesale market the trucker is met by the "urban" side of the trading team. This person (there are sometimes two or three, one in each of a different market) then takes the produce and unloads the truck into a stall that has been rented in the market and begins to sell the product.

Finally, in summary, the wholesale marketing channels of most vegetables in China are simple and dominated by small traders. Figure 25 has a stylized set of marketing chains. The interesting thing about such chains is that modern supermarkets and specialized buyers are almost non-existent. We offer an explanation in part D below.

C. The Local Government and Role of Policy

Unregulated …

This is one of the easiest parts of the reports to write. As we summarize in Table 6, there is almost no active government involvement in most parts of China's horticulture economy. There is little intervention or regulation of the producer sector. There is little intervention or regulation in the procurement/trading sector. There is little intervention or regulation in the transport sector. While in the case of some plants, owners (who are almost 100% in the private sector) did get access to some help from the government (e.g., access to cheap land or preferential access to loans, though mostly at market-set interest rates), most plants did not. In addition, it is our perception (although this needs more research) that access to government land and loans helps make some investors profitable and does not help others. There is little effort to rescue failing firms. There is little intervention or regulation of the retailing sector in fresh fruits and vegetables.

To show that this perception of China's horticultural economy is not just my own, I also cite in Table 7 a set of comments made by a former USDA economist who has been studying China for more than 30 years. He agrees. China's horticulture economy is dominated by laize fare economics.

… But also Unsupported

While the unregulated nature of China's economy may help producers in allowing them to make decisions on cropping and investment without having to deal with a lot of bureaucratic regulation, the government also is absent in the more productive ways that they are able to help in production and marketing as they do in other countries. For

example, in our survey of vegetable producers (which were reported in Table 5), we found that only 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 or so farmers ever saw an extension agent.

The government also has historically not supported farmer cooperatives. During the past 5 years there has been a new effort to allow cooperatives to develop and they have begun to grow (Figure 26). Between 2000 and 2003 the number of cooperatives, which were mostly supporting production and marketing of vegetables and fruit more than doubled.

However, when looked at in another way, in fact, this growth is fast in part because it is starting from such a small base. Even after the fast growth after 2000, by 2003, only 8% of villages had any cooperative organization (Figure 27). In villages with cooperatives, less than 1/3rd of the farm household joined. Hence, over all 200 million farm households in China, less than 2% are members of cooperatives. When compared to the US, Japan and South Korea, where most farm household were in cooperatives during their development years, China lags far behind and this will certainly hurt efforts to modernize the horticulture economy given such a large number of small, undereducated, poor fragmented farms (Figure 28). I have also written a paper describing China's cooperative movement in more detail and have included it as Supplemental Paper 4.

In short, although China's vegetable producers are endowed with cheap labor, they get little support. Their villages are very poor and have inferior infrastructure (transport and communications—although these are improving). They 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.

D. What makes China's vegetable procurement so small-trader dominated?

Interestingly, although we showed the rise of horticultural crops was paralleled by a surge in the emergence of supermarkets in urban areas, there has been almost no penetration of modern wholesalers or retailers into rural communities. Less than 6 percent of first-time buyers and less than 16 percent of second buyers could be identified as being from modern supply chains—either supermarkets, professional suppliers or processing firms. Instead, China's horticultural economy is dominated by small traders who are themselves poor and small, operating in firms of 4 people or so and are themselves earning low wages. Moreover, unlike the evidence found in other countries, it appears as if in China, far from being hurt by the rise of supermarkets and the horticulture boom that has come with it, poor, small farmers in our sample appear to have gained. The richest farmers, in contrast, were playing a smaller role in 2004 than in 2000. Clearly it appears as if 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 require more research, it is our opinion that there are 7 characteristics about China's horticultural economy that produces these surprising results. First, China's land holdings (and those in our sample—see Table 8, row 2) are relatively equal (characteristic 1). In essence, there are no large farmers in China; indeed in our sample, the average farm size of the largest 20 percent of the farmer is only 0.36 ha per capita.

Second, there also are almost no farmer cooperatives that can allow farmers to act in concert with one another (characteristic 2). In our sample, only 11.4 percent of the villages reported that they had a horticultural or general farm cooperative. Only 1.05 percent of farmers said that they belonged to a cooperative (row 3, column 1). These numbers, as it turns out, are remarkably similar to figures for all of China reported by Shen et al. (2004) using data from a national representative sample of more than 2000 villages. Because of characteristic 1 and 2, 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 that may be 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, here are still differences (characteristic 3). And in the case of horticultural producers, farm households in more poorer, more remote areas have relatively more land (0.17 ha per capita) than those in areas nearer to the richer, urban center (0.09 ha per capita—row 2, columns 2 and 6).

In addition, there are also differences in the access that these households have to labor for working on the farm (characteristic 4). Although horticultural farmers have the same family size as those not engaged in horticultural farming, the main differences are due to differential access to off farm jobs (rows 4 to 7). Farm households that are nearest to Beijing have a higher percentage of their labor force in off farm employment (42 for those nearest; 31 for those furthest) and they work a larger number of days per year (111 for those nearest; 82 for those furthest). The same is true when dividing the sample between better off households and poorer households. Poorer households have more land and labor available for use in producing horticultural crops (Appendix 2, rows 2 to 5). Hence, when considering characteristics 3 and 4 together, it is easy to see why poor farmers have increased their share of area in many of the horticultural crops—they are relatively land and labor rich, the two factors that are keys factors in the production of horticulture crops.

Two additional characteristics help reinforce the propensity for poorer farmers to be increasing their participation in the horticultural economy, while the supermarkets are almost completely absent from the production areas. Since China's horticultural economy is almost completely unregulated (characteristic 5) and since China's road and communication networks have improved remarkably over the past 10 years (characteristic 6—Table 8, row 11 to 13), small traders working with a limited amount of capital and using extremely large amounts of low cost labor (while utilizing the relatively

efficient road and communication infrastructure) appear to be out-competing all other types of would-be procurement agents. According to our interviews with the small traders and producers, the competition among small traders is fierce and profit margins on traders 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, one of the main characteristics of China's economy that produces the status quo is that China is still a relatively poor nation and its consumer, so far, may not be placing a very high premium on food safety or obtaining a standard product (characteristic 7). Although there is a rising middle class, most urban consumers still live in households making around 1000 US dollars per capita annual disposable income. Many of them are becoming increasingly stressed with rising payments in other expenditure categories—housing, automobile ownership, education and health care (among other expenditure categories). Combined with the absence of an active pro-consumer lobby (which may be limiting the information consumers have on the quality of their food), it is almost certain that the premium willing to be paid by the average urban consumer is still relatively small. When this low premium is combined with the high transaction costs that would have to be born should the supermarket want to maintain tight control over its horticultural supply, along with the thriving, deep, extremely competitive wholesale markets, it may be (although further research is required to definitively say so) that, at least now and in the immediate future, China will still be relying mostly on traditional wholesale channels.

If this is true, food safety in China's food system may suffer. However, it is good news for small poor farmers. Although, it should be recalled how fast China is changing in so many areas; if any one (or perhaps any several) of these characteristics changed, we should expect to see China's horticultural economy—from both the supply and procurement side change. The change, like so many other things in China, could be very fast.

III. Competitiveness

In this section, we look at detailed cost of production of seven vegetable crops in China's major production areas. To study changes in cost of production and the changes in efficiency we were able to purchase with funds from the project data from the Cost of Production data office of the National Price Bureau (which is now under the National Development and Reform Commission). The data from a survey of producers that are executed in all of China's main producing provinces. On average from 10 to 15 provinces are available for each crop. The survey was begun in 1990 and we got access to data through 2003. The family's own labor in the cost data are accounted for at the equivalent of about $2/day—although this changes over time. Yields are reported in kilograms / mu, where a mu is equal to 1/6th of an acre (or 1/15th of the hectare).

The crops that we have provided data for include:

Eggplant (Table 9)
Capsicum (or Green/Bell Peppers—Table 10)
Field-cultivated Tomato (Table 11)
Greenhouse-cultivated Tomato (Table 12)
Field-cultivated Cucumber (Table 13)
Greenhouse-cultivated Cucumber (Table 14)
Potato (Table 15)

Although there are differences in trends among crops and among years in the sample, there are some important and indisputable trends:

- Between the early 1990s and after 2000, yields (kilograms/mu)
- Output per man day also rises steadily over the study period
- After rising in the early 1990s, since the late 1990s, total production cost per ton of output has tended to fall (or at least stay constant)
- Of the total costs, the share constituted by labor is rising over time; there are two factors that account for this: a.) as demand for vegetables have risen, farmers are putting more intense effort into their commercial production of vegetables; b.) the wage at which their family labor is being costed is rising.
- The share of material (non-labor) cost that are provided by fertilizer and pesticides are rising
- Seed costs are relatively high; farmers buy most of their seed from the free market and there are no regulations on seed prices.

When all of these facts are put together, it is clear that vegetable production in China is becoming more efficient. The amount of labor that is being used is enormous, but it is being used more effectively in producing vegetables. In other work that I am doing, we show that when a farm moves into vegetables, his cropping income rises substantially, though this comes at the cost of a lot of family labor.

Comparisons with California

Two figures (Figures 29 and 30) provide a comparison in cost of production between crops grown in California and China. The data for China were collected by my research team and put into categories that were designed to be similar to cost of production categories collected by the University of California's cost of production extension surveys. In Figure 29, it can be seen from the left panel that a high percentage of the cost of vegetable production in China and the US are in labor. When this is so on the right hand part of the panel it can be seen that China's producers have a very large absolute cost advantage in production at the farm gate (that is, not counting marketing and processing costs). In Figure 30, we look at the rice (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 are lower (than vegetables—left hand

panel of Figure 30). As a result, when comparing the farm gate cost of production, the costs in China and California are almost the same (right hand panel). Clearly this shows that in crops that are labor intensive China has an enormous cost advantage.

The cost advantages also show up in food prices of consumers (Figure 31). While the price of rice and poultry are about half of what they are in the US, the retail food prices of tomatoes and apples are only about 1/8th as high. Quality differences certainly exist, but these are also disappearing.

Potential Constraints

China's producers also face many constraints. It is beyond the scope of this report to analyze these in depth, but it is an important area of research to see what factors are likely to hold back China's growth as a horticultural producer. Several possible constraints:

- Water: I have included a recent paper of mine for those that are more interested in this topic: Supplemental Paper 5. It should be noted, however, that when water gets scarce producers are often going to look to move into the production of crops that give them high return to the scarce resource. In other words there is a tendency for water scarce areas to invest in horticulture production facilities and install water saving technology.

- Farm size: The very nature of China's production and trading and trucking sector means that ensuring food safety and quality and reliability will be difficult. In the meantime this means that there could be possibilities for niche markets for consumers that demand high quality, safe products.

- Wages: As China develops more and more, ultimately wages are going to go up. This will not happen soon (to any great degree), but if China continues to grow at 5 to 6 to 7 percent a year for 20 more years, wages will rise appreciably.

IV. Export segment

Although the export segment of the horticulture economy in China is small, it is important for several reasons. First, because international vegetable export market tend to be fairly thin, even small shifts from the domestic to the export sector can have dramatic impacts on the international markets. In addition, the great gaps between the export market and its demand for quality, reliable and safe product and the relatively simple domestic market means that there are many things to be learned from those that are facing international competition. Finally, to the extent that importers are able to bring fruit in from international markets, it provides a yardstick for measuring the efficiency of the sector and its ability to compete with the quality and branded products that can come from abroad. In sum, the external sector of China's horticulture market means that there

is a source of potentially lucrative segment of the market to be captured, there is learning that can be done and there is discipline imposed on the sector.

Although the focus of this report is not the export segment of the market, in the rest of this section, we will trace out the recent trends in horticulture exports and imports. From these illustrations, the following points are important:

Exports

- Since 1995 fresh vegetable exports have increased steadily. The most rapid rise came in the years after China's accession to the WTO (2001). The pace of expansion has slowed in 2004 and 2005. China has begun to become the world's dominant supplier of garlic, carrots and onions/shallots (Figure 32).

- Although fresh vegetable exports have risen rapidly, processed vegetables have always been higher (since 1995) and have remained higher (in 2005). Growth has been rapid in the tomato paste and frozen vegetable product categories. Processed and preserved vegetable categories, although still large, have grown slower (Figure 33).

- 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 targeted at nearby markets. In the case of onions/shallots exports largely go to Japan, Malaysia and Russia (Figure 34). In the case of garlic, with the exception of Brazil, most of the large markets also nearby (e.g., Japan, South Korea, Malaysia and Southeast and South Asia—Figure 35).

Imports

- Although China is the fourth largest agricultural export destination for the US (after Canada, Mexico and Japan) and rising (Figure 36), almost all of the $5.5 billion exports from the US are made up of bulk commodities—soybeans (29%); vegetable oils (15%); cotton and wool (17%); hides (12%) and grains (5%). Only part of other agricultural products (24%) is vegetable and fruit (Figure 37).

- In terms of performance, fruit imports have grown in recent years, although the growth rate is fairly flat (Figure 38).

- Vegetable imports into China fell sharply after the late 1990s and remain at only around 20 million tons (Figure 39).

Trade Trends

- 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 land 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 (Figure 40).

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