



Horticultural Economy of Guangxi Province, China

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Guangxi, the most southerly province, is one of the most productive agricultural areas of China. It is located on the Beibu Gulf along the southwestern coast with 240,000 km² and a population of 48 million people. The horticulture industry in Guangxi is booming and has become the most important industry in the rural economy followed by livestock, rice and sugarcane, and also serves an important social function. Horticultural production is a high input and labor-intensive industry that needs a large labor force from cultivation to processing. An abundant labor force in Guangxi and a unique climate lead to low cost horticultural production, currently lower than the national level, and only 1/8th to 1/5th the cost in developed countries. The horticultural industry contributes 30% of farmer income, and uses almost 40% of the rural labor force. More than 15 million people work in related activities, and employment opportunities in horticulture are increasing. Farmer income is highest for vegetables (¥34,500/ha) [¥1 (Yuan) = \$0.13 USD or € 0.09], followed by ¥22,500 for sugarcane, ¥15,000 to ¥19,000 for rice, ¥9,000 for cassava and only ¥4,500 for soybeans. Land utilization rate is one of the important factors of comparative advantage in Guangxi. Its crop index (crops per ha/year x 100) is 235%, which is one of the highest crop indexes in China, and it has a potential to increase 10%.

PRODUCTION STATUS

Climatic Resources

Guangxi is located between 104° to 112° East Longitude and 20° to 26° North Latitude and straddles the Tropic of Cancer. As a result, it has one of the most favorable climates in China for horticulture, such as mild temperatures, adequate light and abundant rainfall, long summers and short winters. The annual average temperature is between 16 and 23°C with the coldest temperatures in January (5°C) and hottest in July (28°C). The frost-free period is up to 300 days, the annual light ranges from 1,400 to 1,800 hours and the annual rainfall ranges from 1,000 to 2,800 mm. The rainy season is May-September, which receives 75% of the annual precipitation.

The area south of the Tropic of Cancer is known as the southern subtropical region, which contains 48% of the province's land area and 25% of the southern subtropical area of China. The annual average temperature is between 20 and 22°C, the growing degree-days ($\geq 10^{\circ}\text{C}$) ranges from 7000 to 8000, the rainfall ranges from 1,100 to 2,800 mm, and the typhoon season comes relatively late and has little effect on summer fruit ripening. The climate is very conducive to growing subtropical fruit, such as litchi, longan, banana, and mango. These fruit are of superior quality, compared with Southeast Asia where the growing temperature is higher and the temperature difference between day and night (DIF) is smaller. The part of Guangxi that is north of the Tropic of Cancer is known as the mid-subtropical climate region with an annual average temperature between

17 and 21°C, the growing degree-days ($\geq 10^{\circ}\text{C}$) ranges from 5900 to 6550, and rainfall ranges from 1000 to 2500 mm. This region is suitable for subtropical fruits and some deciduous fruit trees, such as 'Peng' tangerine, sweet

orange, mandarin, 'Shatin' pomelo, pear, persimmon, plum, peach, and grape.

Many different vegetables can be planted throughout the year in Guangxi especially in hilly and mountainous areas that have diverse geological landforms. Cultivation of vegetables in fall and winter is easier and less expensive, compared with other parts of China. Generally, in the fall, temperature will decrease 0 to 0.6°C per 100 m rise in altitude, thus temperatures at 500 m above sea level in the mountain region are about 3°C lower than the nearby plains. From August to September in the high-elevation mountains, the average temperature is about 25°C, DIF is large, and the influence of heat, torrential rains, and typhoon weather is less than in the plain region. The high-elevation mountains are very conducive to growing fruit-bearing vegetables, especially Solanaceous vegetables, legumes, root and leafy vegetables. The winter weather in all of Guangxi is warm and humid. It is essentially an open-air greenhouse and most vegetables can have normal

Figure 1. Map of Guangxi with locations of major fruits.





Figure 2. Farmhouses in Guangxi countryside.

growth without winter protection. The minimum temperature ranges from 5 to 15°C on the coldest month (January), growing degree-days ($\geq 10^\circ\text{C}$) is 1000, the frost period is ≥ 60 days, illumination ranges from 460 to 545 hours, and rainfall ranges from 150 to 300 mm (December to February). In the southern region and the Youjiang River Valley region the degree-days are always above 2000 and there is never any winter frost, making Guangxi an important source of winter vegetables for northern China. The crop index exceeds 300% for some of vegetable-growing areas in the southern region and the Youjiang River Valley region of Guangxi. To fully utilize the light, temperature, water resource, the land in these areas has been converted to various combinations of rice and vegetables totaling 3 crops per year, e.g. rice - vegetable - rice, or rice - vegetable - vegetable.

Fruit Production

Since 2002, Guangxi has been the fifth largest fruit producing province in China. Production of fruits in 2006 was estimated at about 6.18 million t with 8.65 million ha under cultivation. Production of tropical fruits, such as longan, litchi, banana, are in the top three nationwide, and it leads the country in the production of citrus, pineapple, ginkgo, macadamia, avocado, 'Shatin' pomelo, and kumquat. The fruits are consumed fresh and seldom processed, and are almost entirely sold in the domestic Chinese market including 30% consumed in Guangxi province. Only about 5% of the fruits are exported (to southeast Asia, Japan, the EU, the US, and Canada).

Citrus production in Guangxi is ranked at the top in fruit total production nationally with 33%, followed by banana with 23%, longan and litchi with 12%, mango with 3% and other fruits at 29%. Citrus production annually is ca. 2.05 million t in Guangxi. Tangerine (*Citrus reticulata*) accounts for 34% of this production with the major cultivars being 'Peng' (or 'Ponkan'), 'Shatang' and 'Nanfeng'. Kumquat (*Fortunella crassifolia*) is included in this group.

Sweet Orange (*C. sinensis*) production is ca. 24% with the major cultivars being 'Navel', 'Valencia', and 'Liucheng'. Mandarin (*C. unshiu*) production is 19% with the major cultivar being 'Satsuma' and Pomelo (*C. pyriformis*) production is 17% with the major cultivar being 'Shatin'. Citrus fruit is available in the market year-round (fresh and stored) but freshly-picked citrus fruit is only on the market between August and May.

Banana production is 1.43 million t, mainly planted in the southern region of the province and provided year-round. Longan production of ca. 0.38 million t is 6% and litchi production of 0.35 million t is 5% of the total fruit production in Guangxi. Longan and litchi are mainly produced in the southern region of Guangxi and harvested from early May to the end of September. Mango production of 0.20 million t is mainly in the Youjiang River Valley region, which is located in the western part of the province. Guangxi is the most important source of Chinese longan, litchi and mango fruit. A number of other minor fruit crops in Guangxi include persimmon, plum, pear, peach, grape, and pineapple.

Vegetable Production

In 2006 Guangxi had ca. 1.66 million ha of vegetables with an estimated yield of 22.8 million t, valued at ¥22.13 billion. This production area was 8.7% of Chinese production, ranking Guangxi seventh in the country. Most of the vegetables are marketed fresh with only a small portion of the vegetables processed.

There are ca. 4,316 cultivated vegetable and wildlife species and cultivars in Guangxi of which only about 33 are considered major. The vegetables grown in Guangxi, in order of portion of total production, are: Chinese cabbage-type vegetables (19.1%), comprising both Pekinensis and Chinensis groups; leafy vegetables (12.7%), mainly lettuce, spinach, water spinach, and celery; fruit-bearing vegetables (11.4%), mainly melon, bitter melon, cucumber, and pumpkin; root and tuberous vegetables

(11.2%), mainly radishes, carrots, taro, ginger, Chinese yam; cole vegetables (10.5%), mainly head cabbage cultivars, Chinese kale, and broccoli; *Solanum* vegetables (9%), mainly tomato, bell pepper, and eggplant; leguminous vegetables (5.5%), mainly French or Green bean, pea, mung bean; bulb vegetables (3.9%), mainly garlic, onion, and leek; and aquatic vegetables (3%), mainly watercress, water spinach, lotus root, and chufa (tubers of *Eleocharis dulcis*, also known as Chinese water chestnut). Guangxi is now the largest white button mushroom-producing province in China followed by Fujian province. In 2006 0.27 million t were produced. The expansion of the vegetable production area and improved productivity has led to year-round availability of fresh vegetables in the market at reasonable prices. There is no longer a vegetable "off" season in the summer and fall in Guangxi.

PROBLEMS

The Guangxi fruit and vegetable industry at present is not positioned to quickly and efficiently meet changing markets. China's admission to the World Trade Organization (WTO) has made this more obvious because it increases the exposure of Guangxi to globalization and increased market competition. The major problems in the industry are imperfect marketing, low investment capacity with small scale farmers, shortage of postharvest technologies, and lack of scientific-based management of crop production.

The development of the fruit and vegetable industry is seriously constrained by insufficient development of an efficient marketing system, which is currently dominated by many small producers trying to supply a larger market. Currently, in Guangxi, 60% of agricultural production is sold by the farmers to wholesale dealers and only some farmers sell their product at retail prices to consumers in farm markets. The agricultural product markets are dominated by a large number of wholesalers or middlemen, which means not only that the producers (farmers) have a lower profit but also the consumer does not have access to lower-priced fruits and vegetables. According to a survey in Guangxi, farmers only receive 30% or even lower of the retail price. For example a consumer will buy bananas at \$1.20 - \$3.00 / kg in the market in Beijing, Shanghai and other cities, while in Guangxi they are sold for \$0.60 - \$1.00 / kg by the farmer. This situation where agricultural produce marketing profit is much higher than grower profit is a large problem.

Poor postharvest handling in Guangxi is responsible for large losses, which may exceed 40% of production. Current harvest and handling practices are not providing sufficient high-quality production for storage or processing; with only about 6.5% of fruits being processed, and in vegetables only 1% are stored and 2% processed.



Farmer income is low, approaching only ¥3,000 a year. There are insufficient investments in storage and irrigation facilities while fruit production investment is only about 50% of what is needed. Many of farmers are poorly-educated and rely on experience rather than scientific management. It is estimated that less than a half of the production of fruits and vegetables is up to standard for improving market competitiveness, despite high productivity, and in Guangxi only 10% of 'Navel' orange is up to the international standards (Shi et al., 2005).

There are huge problems in developing exports. Currently, only 0.7% of the fruits and 0.5% of the vegetables are exported, which is quite low considering Guangxi is a major fruit and vegetable-producing province in China. Although Guangxi is a major area of tropical fruit production in China, the tropical fruits, such as litchi, longan, banana, mango, pineapple, are rarely directly exported by sea to other countries because of deficiencies in international marketing structure and technology.

MEASURES TO IMPROVE THE HORTICULTURAL INDUSTRY

The fruit and vegetable industry is now in a transition period that is developing from expanding quantity to increasing quality and efficiency. It is facing the double pressure of trying to improve production technology and improve market competitiveness. The key to market competitiveness is to exploit the comparative production advantages that exist in Guangxi and provide innovations to improve the competitive market advantages.

Market Development

Fruit and vegetable products are agricultural products with high elasticity of demand, which means that the development of desire to consume them will pull market demand. To improve Guangxi fruit and vegetable production there is a need to vigorously develop export markets by changing to a single dedicated export channel that can move immediately into international markets. This will rely on market research to determine the consumer demand and the competitiveness of similar products in the target market, to understand the agricultural product import and export legislation, to know the brand image and market share for Chinese agricultural products in the target market, to set up a good relationship for mutual trust with foreign-related industry associations and non-governmental organizations. At the same time, the government should increase its efforts to support the agricultural export trade. The agricultural financial subsidies of the government should focus on supporting agricultural production areas, expanding employment, increasing the income of the farmers and guiding the farmers to increase investment for human capital. Another thing that must be

Figure 3. Vegetables of Guangxi: (A) mixed vegetables; (B) potato under rice straw; (C) white mushroom processing factory; (D) Mr. Zhang Meipei (left) (Leader, Guangxi Ministry of Agriculture) talking with a tomato farmer.



done is to train more personnel who either understand foreign languages or have a background in fruit and vegetable production, processing, and management.

Improve Postharvest Handling

To improve market prices and reduce postharvest losses, the fruit and vegetable industry must improve postharvest handling and expand processing productivity. Postharvest techniques would allow quality to be retained over an increasingly longer period. Very good handling practices can decrease postharvest product losses and thereby, maximize the inputs of labor, materials and capital. However, modern postharvest handling technologies can cost more than what the average Guangxi farmer can afford. This problem could be solved by larger enterprises, and/or by farmers joining together, especially if it is supported by the government. This will have to be done in order to develop a cold chain logistics implementation model to reduce product losses in the Guangxi industry.

Technological Innovation

Innovation is ever more important in today's increasingly global economy. Competitiveness depends on innovation and this truly applies to the Guangxi fruit and vegetable industry. First, it should actively introduce commercial postharvest technology from developed countries, which have had a history of over 100 years of research and development of such technologies, so that deterioration of produce is reduced as much as possible during the period between

harvest and end use. Secondly, advertising should be strengthened and product packaging should be improved to promote the brands and improve the visibility in the international market. A change to first-class quality and first-class packaging would completely change the current image of Guangxi fruits and vegetables, which is "poor products, crude packaging." Thirdly, innovative production technology must be introduced to improve productivity and quality. This would involve improving the farmers' crop production knowledge, promoting better seed, and improving irrigation.

Scale of Production

On average, each farmer in Guangxi has no more than 1 ha of fruit and no more than 1/3 ha of vegetables. To improve the market competitiveness of the fruit and vegetable industry there has to be a change to reduce the dispersal of production on widely-scattered small fields, improve the choice of cultivars to ones that can be marketed together, and improve production efficiency. Thus, work needs to be done to organize the many farmers who are small business operators into larger partnerships such as: (1) marketing or processing company + small farmers; (2) marketing or processing company + one or more large specialized farms + small farmers; or (3) taking advantage of the Farmer Organization for Economic Cooperation or agricultural trade associations to improve the organization of the industry and increase the scale of operation. The large specialized farms should be central production bases of moderate size, at least 60 ha for fruits and 30 ha for vegetables, that have a unified

cultivar base, and advanced technologies and management.

CASE STUDIES

Citrus

Citrus is the most important fruit in Guangxi and ranked fourth in output in the country. Since Guangxi is one of the areas in China where citrus production is optimum, it was included in the national plan, which determines the most competitive products for each region of China. The citrus production region is currently in northern Guangxi (Guilin), but could be also expanded into southern Guangxi. Experts believe (Chen et al., 2004) that citrus would mature about 10 days earlier for every drop in latitude degree, if the same cultivars were cultivated in different latitudes from the South to the North in ecologically-appropriate citrus regions of China. Since Guangxi spans about 4° latitude, the same species could have at least 40 days to supply the market. As a result, Guangxi could supply the market with fresh citrus fruit starting with precocious 'Satsuma' in early August and continue into March-May of the next year with late 'Valencia' orange.

The future of the citrus industry looks promising since there is good domestic consumer market demand, citrus farmers are technologically advanced and, in particular, with China's accession to the WTO and its participation in the China-ASEAN (countries of the Association of Southeast Asian Nations) Free Trade Area, citrus fruit exports could be increased to Southeast Asian countries (because citrus production is low in ASEAN countries), Europe, and the United States. The greatest concern for the citrus industry is Asian citrus greening disease (huang long bing), which is not effectively controlled. This disease can only be prevented, it cannot be eliminated. The best method to prevent the disease is to eradicate diseased trees and use disease-free seedlings. However, only a few of the farmers understand and accept this advice. Most of them think it is a waste of time and money. The citrus industry currently stores ca. 45% of the annual production, but 80% of this stored crop is stored on-the-farm (Liang, 2006; Fan, 2006). Since most of this storage capacity does not use modern storage technology citrus quality drops quickly from February to April.

The goals for the Guangxi citrus industry are to improve the ratio of high quality fruit; to stabilize the planting area of tangerine citrus and grapefruit; to accelerate the development of early-maturing mandarin, late-maturing 'Navel' and 'Valencia' orange cultivars, and kumquat; to modernise storage systems; to improve export volume; and to improve economies of scale in production of precocious mandarin, late-maturing 'Navel' and 'Valencia' orange cultivars, kumquat, and 'Shatin' pomelo.

Figure 4. Fruit of Guangxi: (A) orange ready for harvest in April; (B) typical banana handling system used to reduce mechanical injury; (C) extension worker advising a grape farmer; (D) litchi harvesting; (E) kumquats under rain shelter produce more valuable fruit; (F) 'Shatin' pomelo.



Banana

Banana has great potential for development of domestic and foreign markets because it is the largest-selling fruit in the world. In recent years, the world's banana market annual increase is 12%, which has a powerful market 'pull' for the Guangxi banana industry. Guangxi is one of the areas in China that is ecologically suited for banana production. It has the advantage of a subtropical climate, which can produce bananas of first-class quality, appearance and taste. Future development of the banana industry would rely on the following three factors: (1) improving postharvest handling; (2) using seed and adjusting maturity; and (3) increasing the scale of operation. In recent years, Guangxi banana producers have begun to improve commercial postharvest handling (Li, 2004, 2006) by not allowing the fruit to rest on the ground after removal from the plant and reduction of "mechanical injury." This is improving the marketable percent and quality of banana. These fruit are more visually appealing and are what the retailer and consumer prefer. To increase production to achieve market availability

throughout the year the banana industry needs to focus on increasing the proportion of virus-free plantings from the currently-low 10% as well as strongly promoting cultivation techniques that improve both quality and yield. Moreover, larger-scale production needs to be achieved with the help of farmer organizations and promotion of specialized banana production.

Longan and Litchi

Longan and litchi have been cultivated for a long time in Guangxi, probably more than two thousand years. The excellent natural conditions in Guangxi produce longan and litchi that are excellent quality with bright color, special flavor and good taste. In China they were traditional luxury fruits with the name "China lingnan good fruit" for longan, and "the king of fruits" for litchi. However, in recent years it is difficult to find luxurious longan and litchi. The increase in planted area and production with poor storage, processing, and transport has led to lower quality and prices. At present, longan



and litchi farmers make very little profit or are losing money.

Development of the longan and litchi industry is seriously restricted by poor handling technology and postharvest facilities. Longan and litchi fruit have a short harvest period, during the summer season when temperatures are high, and this makes it more difficult to preserve, store and transport the fruit, resulting in a fast decline in the quality and a short shelf life. Currently, there are very poor methods to handle longan and litchi fruit, with the most popular method being SO₂ fumigation and cold storage, which is not very effective (Lu et al., 2004). As a result of a postharvest loss rate of 20% to 40%, most of the longan and litchi fruit are only sold in Guangxi Province and this also seriously limits exports into the rest of China and the international market. The quantity of processed fruit currently is insignificant compared with fresh fruit output, at less than 5% of litchi production and 30% of longan production, respectively. There are no popular processed products for longan and litchi in China except dried longan fruit and canned litchi. The selection of current cultivars also puts marketing pressure on fresh fruit sales. Currently, 80% of the longan and litchi are mid-maturing cultivars and only 15% are early cultivars and the remaining 5% are late-maturing cultivars. Thus, much of the fruit is available at the same time in mid-season and not evenly spread over time. The litchi fruit availability is concentrated in early June to mid July and the longan fruit in late July to mid August.

Despite these issues, it is believed that the longan and litchi industry has a great opportunity for expansion in Guangxi. Experts point out (Qin, 2005), because of appropriate ecological zones, there are a few countries in the world where longan and litchi can be cultivated. Since longan and litchi are most suitably grown in a subtropical climate the climate of Guangxi makes it one of the best places to grow longan and litchi. It is the main producing area in China and also the main producing area in the world. Longan and litchi production is a competitive industry in Guangxi (mainly in the southern part). Currently, the industrial developments have two main problems to improve yield and extend the market period: (1) improving pre-cooling postharvest technology and (2) adjusting cultivar structure to plant good quality cultivars from early to late maturity, with a ratio of 3:5:2 (early, mid, late).

Deciduous Fruit Trees

Generally, deciduous fruit trees planted in Guangxi have a very poor competitive advantage with the exception of southern Asian pears, and grape cultivars ripening in spring and summer. The southern Asian pears are on the market on July or August, which is 30 to 50 days earlier than pears from northern China, which allows them to fetch a high market price. Since some of the farmers who have planted

the southern Asian pears and grapes in northern Guangxi have received significant economic benefits, it is believed there is room for further development, especially in Northern Guangxi.

The Vegetable Industry

Although no new plantations have been undertaken recently in Guangxi, the economics have steadily improved with more specialized production. Problems associated with growing vegetables are the shortage of reliable high quality seeds, inadequate irrigation, and insufficient large-scale production. Production remains low, despite cultivar replacement in recent years resulting in improved vegetable cultivars being used on 80% of the area.

In Guangxi vegetables can be planted throughout the year but the most promising area for

development is in fall and winter vegetables. The industry depends mainly on the domestic market and it could expand if it exported into the international market. In 2007 China's share of the EU-27's fresh fruit and vegetable import market was 6.8% (Martinez-Palou and Rohner-Thielen, 2008), and, in 2006 the Asian countries' share of the U.S. fresh fruit and vegetable import market was 2.7% (Huang and Huang, 2007), however, very little of this was from Guangxi. Therefore, the vegetable industry in Guangxi, especially fall and winter vegetable producers, could improve their competitiveness in exports to Europe and the Americas. Main products should be the vegetables that are popular in these markets, such as cabbage, lettuce, spinach, celery, cucumber, cauliflower, Chinese cabbage, tomato, bell pepper, eggplant, radish, carrot, bean, taro, ginger and chufa.

REFERENCES

- Chen, T., Gan, H., Chen, G. and Wen, Q. 2004. Exploring the conditions and development of Guangxi Early Satsuma production. *Guangxi Horticulture* 15(6):12-13.
- Fan, R. 2006. Postharvest commercial handling and the competition ability for Guangxi citrus industry. *Guangxi Horticulture* 17(5):7-9.
- Huang, S. and Huang, K. 2007. Increased U.S. Imports of Fresh Fruit and Vegetables. FTS-328-01, September 2007, Economic Research Service/USDA, available at: [http://www.unitedfresh.org/assets/files/Increased U.S. FFV Imports.pdf](http://www.unitedfresh.org/assets/files/Increased%20U.S.%20FFV%20Imports.pdf).
- Li, D. 2004. The current situation and possible solutions for the banana industry in Guangxi. *Guangxi Horticulture* 15(5):12-15.
- Li, D. 2006. The postharvest technology of banana in use commercially. *China Tropical Agriculture* 2006 (4):17-18.
- Liang, S. 2006. A discussion of the current situation, advantages and development of the Guangxi citrus industry. *China Fruit News* 23(7):8-11.
- Lu, M., Guo, W., Pan, J. and Zuo, R. 2004. Analysis of production and trade of lichee and longan in the world and its countermeasures. *World Agriculture* 304(8):23-26.
- Martinez-Palou, A. and Rohner-Thielen, E. 2008. Fruit and vegetables: fresh and healthy on European tables. Eurostat, Statistics in focus, 60/2008, available at: http://www.epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-08-060/EN/KS-SF-08-060-EN.PDF.
- Qin, R. 2005. The problems and countermeasures in Guangxi litchi production. *China Fruit News* 22(3):13-14.
- Shi, J., Chen, T., Shen, L. and Chen, G. 2005. The current situation and possible solutions for Guangxi orange production. *South China Fruits* 34(4):19-21.

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