

# **The emergence and development of vegetable sector in China: An analysis from the sectoral innovation systems perspective**

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## **Abstract**

This paper surveys the development of vegetable sector in China in the past twenty years; it is part of the on-going Catch-up Project which embrace more sectors in more developing countries. The study uses a “learning —capability/knowledge-base —interactions” framework for analysis of sectoral innovation systems in developing countries. The work traces the evolutionary process of the sector development, analyzes the driving forces and source of opportunity. The paper then goes on to analyze the development of market institutions that backed up the emergence, expansion and deepening of the sector, the transformation of technological and knowledge regimes and capability building, and sorts out the roles that the government played for the development of the sector. The paper ends with major findings from the case study.

## **1, Introduction: research objectives and analytical framework**

In the past twenty years China experienced profound restructuring of agricultural production. Vegetables and fruits have increased most rapidly while the plantation of staple food crops reduced. By 2002, China had the fruits and vegetables production index prominently high, in comparison to a number of developing countries (Gu 2007). Vegetable production caused the major change of land use and peasants farming activates. Most of the plantation of vegetables uses the land previously planting wheat and other cereal crops thanks to the advances of cereal crops yields. This transformation was confronted with serious challenges in all aspects of technological supply and institutional settings.

Technologically, vegetable seed breeding and extension services were not well developed in the past, when the provision of basic foodstuff was the priority—in this connection less dramatic changes were with the rice production in the decades in study, in which R&D and extension services maintained some degree of continuation although adaptation to a changed production system has to take place. In terms of institutional change, there has been much experimentation for the institutional development for production, transportation and distribution, and for the transformation and strengthening of knowledge base and extension services. Distinctive of the vegetable sector in comparison to cereal or cotton is that the vegetable sector has to deal with vary diversified variety, and fulfill the sensitive demand in food safety.

Analysis on the vegetable sector in China has great potential to reveal sophisticated process of transformation and to illuminate policy implications.

This work employs a “learning--capability and knowledge-base—interactions” framework for analysis of sectoral innovation systems developed in the Catch-up Project (Nelson 2006; Malerba 2006; Malerba 2004). The major aspects of the framework are the following.

*Evolution and characteristics of the sector.* We capture the major composition and features of the sectoral system, the producers, the distributors, the network and institutions in the development process of the sector. Tracing the process of institutional changes (Nelson 2006) is informative as how it was emerged and adapted through selection and dissemination that depicts an institutional learning trajectory. We give attention to distinctions between large-scale farm and smallholder farm—in China’s case smallholder farms dominate; features in network, distributional channels, and poverty reduction effects may differ wildly with different producer’s organizations. We give attention to distributional agents, international trader and local trader—in China’s case the majority is local traders, examine their role in bridging up supply and demand and in transferring

technical information. We capture major institutional change, including that which supports the market to work, provided that the development of market mechanisms is one of the most crucial aspects for the agro-food sector in the context of developing and transition economies.

*Sources of growth and opportunities.* Unlike high-tech sectors such as medical and pharmaceutical sector and aircraft and spacecraft sector where research and development, or scientific invention, play important role, the development of agro-food sector heavily relies on factors from demand side. Expanding and ever sophisticated demands, increasing concern about safety and living standards intrigues learning and technological upgrading and institutional change in the agro-food sector. From supply side in terms of technology, agro-food sector often uses general-purpose technologies, such as biotech, chemical, and mechanical, developed outside the sector. As a “mature” or “old” industry, it serves as a massive “carrier” in application of new technologies, harnesses the benefits of technological progress (von Tunzelmann and Acha 2005). We investigate the driving forces to the growth of the sector as where they come from, from international market or domestic consumers? What changes occurred in this regard in the past ten years under the WTO regime? How the changes in demand side conveyed or expressed themselves to trigger technological learning and institutional change? What were the differences in demand factors, which were from international or local market? What were connections of international and domestic market in their impact on the growth of the sector?

*Supply of technology: Public R&D versus international companies.* We distinguish between (1) product technology (new variety of crop seeds), (2) process technology (used in plantation), (3) technologies for quality control and distribution, and (4) technologies for food processing, with the first three as the focuses of our analysis. Product technology is often embodied in seeds, process technology involves large part of tacit knowledge and skills, and technologies for distribution and quality control are often provided in the form of tools and equipment. We explore how the absorptive capacity is developed with regard to embodied and external-sourced technologies? What was the responses by public R&D and the extension system, how they evolved during a time span of ten to twenty years—how capability and institutions developed and reorganized to cope with the change of the sector? How has been the local public R&D and extension system perceived the challenges from the coming of new generation of biotechnology and how did they reflected to the challenge?

*The role of government.* We differentiate the role of government into direct and indirect involvements. Indirectly it relates to the role in investment in knowledge and technological infrastructure services. Uniquely massive efforts made by the government might be devoting to

the market-supportive institutional development, and other institutional change. Direct involvement might be in the initiative to structural change via administrative guidance and financial subsidies. What kinds of involvement have already taken place and what were experiences and lessons we could draw out?

*Research method:* This study is basically descriptive. We use quantitative data and qualitative reports, papers, government documents from various sources. The author has been involved in training and survey in this area for several years, from which observations obtained serve as important references.

Following Section 2 gives an overall picture of agricultural restructuring and the emergence of vegetables sector, explains driving forces for the development of the sector. Section 3 depicts the evolutionary process that the sector grew, which contains several wave-like stages. Sections 4 discusses the development of market institutions and the emergence, expansion and deepening of the sector under mediation and supports of increasingly sophisticated market mechanisms. Section 5 analyzes the transformation of technological and knowledge regimes and capability building, addresses absorptive capacity from peasants skills and innovation, and the development of R&D infrastructure and extension services. Section 6 sorts out the roles that the government played for the development of the sector. The final section sums up the major findings from the case study.

## **2, Background –the context in which the vegetables sector emerged and grew**

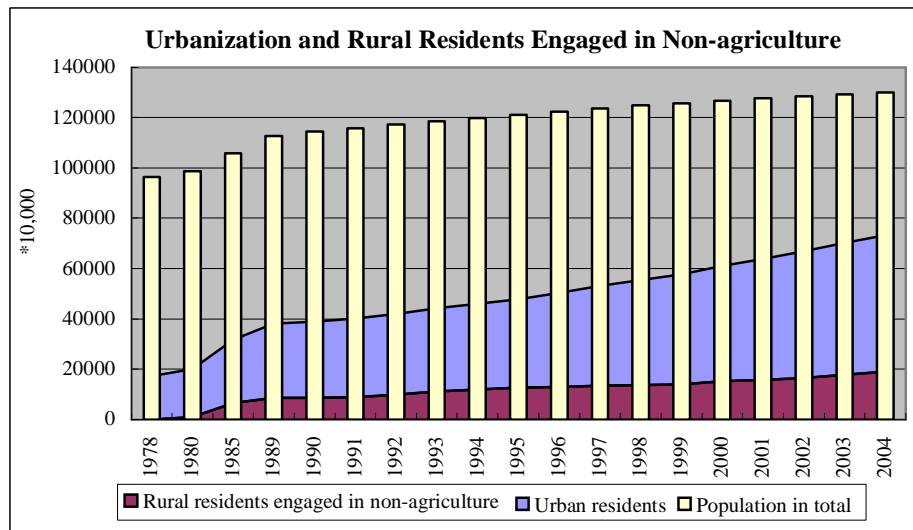
China has a high population of about 1.3 billion by 2004, with tightly restrictive arable land, at the level of 0.1 hectare per capita. Historically securing the supply of staple food crops had perpetually been the top priority of agriculture policies. It is only in the recent decade that China gets the feasibility, and necessity too, to turn some land for other-than staple food crops. The vegetable sector emerged from this background of agricultural restructuring.

### *Rapid economic growth and mobility of population.*

It is fair to state that the major driving force to the development of the vegetable sector came from the increasing size and sophisticated tastes of demand. Population growth is one of the factors contributing to the demand increase. During the thirty years, the total population of China grew from 900 million in the end of the 1970s up to 1.3 billion in 2004, increased by around 40 percent. Besides, the proportion of the population who rely on the commercial provision of foodstuff increased at an even higher rate: this came from two moves. One is the rapid expansion of urban residents; and the second is “temporary” migration of rural labor, who work for non-agricultural jobs in both rural and

urban areas, meanwhile keep their village homes remaining permanent residential bases.<sup>1</sup> Altogether in a rough and conservative calculation, the proportion of the population who is left from the land and live with commercial provision of food had increased from 20 percent in 1978 to be more than half in 2004.

Beyond these were also changes in qualitative terms of demand. Having incomes continuing increased, people became affordable and demanding for fresh, tasty and healthy vegetables. In wintertime, for example, consumers in North China no longer satisfy with the few traditional vegetable commodity--Chinese cabbage, potato and turnips which were conventionally stored from warm season's production. They now desire as rich choices as in summer time. Recently in addition to tasty and fresh vegetables in demand, consumers pay more attention to whether the vegetables are produced from green or organic farming. All these are so obvious if one has a visit to supermarkets in the cities, or watch at the dinner tables of households.



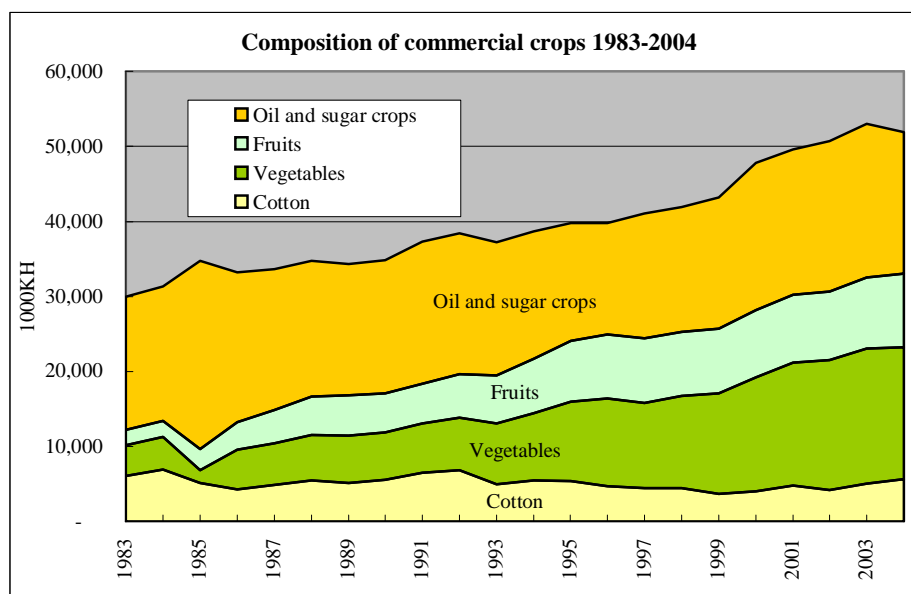
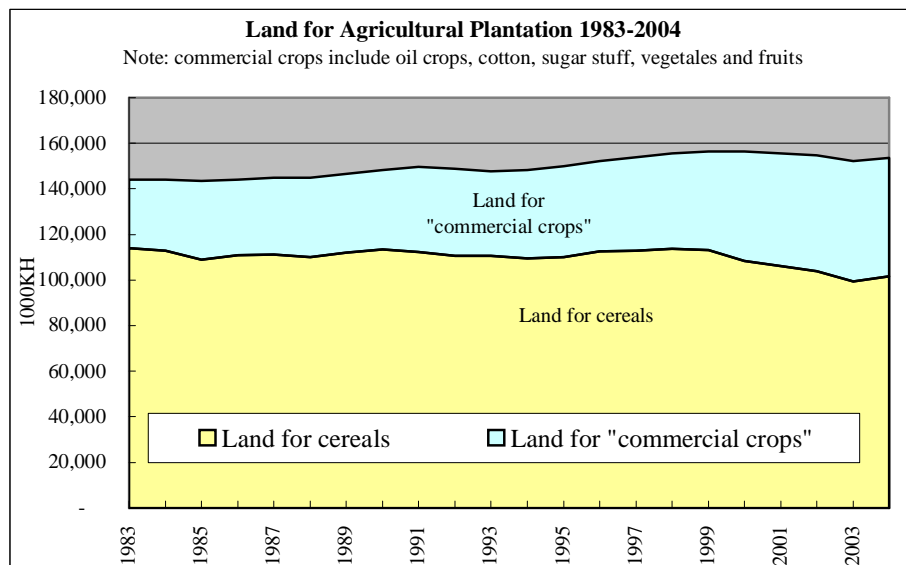
Source: Reproduced based on Tables 4.1 and 13.4, China Statistical Year Book 2005 (<http://www.stats.gov.cn/tjsj/ndsj/2005/indexch.htm>)

### *Agricultural structure change*

Agricultural restructuring can be observed from plantation composition of farming land. The trend has since the mid-1990s apparently been in the reduction of cereals plantation and a

<sup>1</sup> In the latter part, the non-agricultural rural labor, almost half of which went to cities working there most of the times of a year based on temporary residential permission. Many of them kept their family members in their village homes and left land for family members or other contractual planters. This phenomenon began to appear in the 1980s, and this part of rural labor increased to 100 million in the first decade of the 21<sup>st</sup> century. We put them into the category of the population as who required commercial provision for Food stuff.

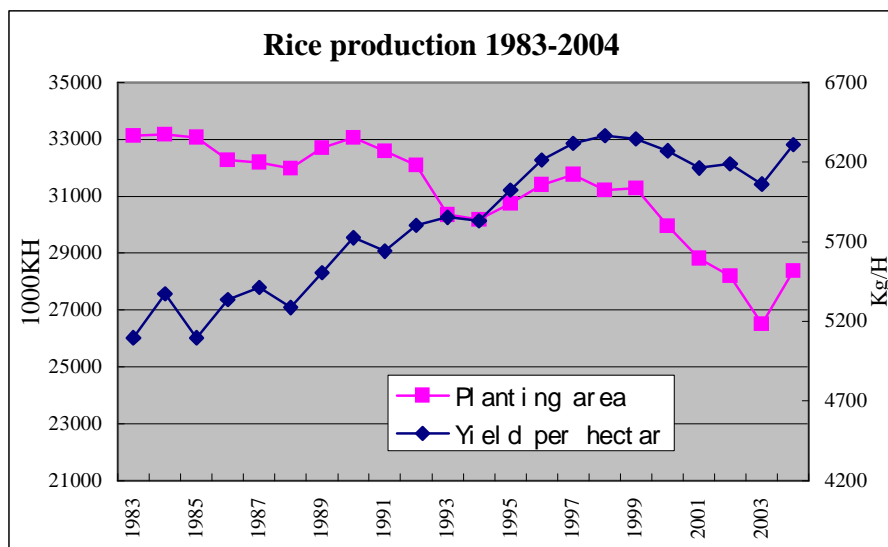
significant increase in the plantation of “commercial crops”, as termed in the China’s agricultural statistics; the “commercial crops” include oil and sugar crops, fruits, vegetables, and cotton. Among these “commercial crops”, vegetables and fruits plantation underwent the most dramatic increase: the planting areas enlarged to be 17.6 and 9.8 MH (million hectares) in 2004, from 4.1 and 2.0 MH in 1983, respectively. Both were expanded by more than 3 times, and as a result, one third (34 percent) of the cultivated land is now used for other than cereals production; in comparison, this figure was one fifth (21 percent) in 1983—a historical change in China’s standard.



Source: Author produced based on Table 7, China Agricultural development report 2005, By Ministry of Agriculture of China at <http://www.agri.gov.cn/sjzl/baipsh/2005.htm>

*Increase in land output of staple food crops.*

To satisfy the increase in demand, the rise of land output of cereals made it possible the transferring of a part of land for vegetables and fruits. China has from the time of planning economy been investing in technologies for staple food crops, such as rice, corn, wheat, broomcorn, and has throughout the years and well into the recent decades achieved impressive progress. Average land output of cereals increased from the level of 1000 kg per hectare in 1949, to 2000 kg in 1970, 3000kg in 1982, 4000kg in 1992. The figure for 2004 was 4620kg. Seed development, together with the improvement in plantation, use of fertilizer, and infrastructure development, together attributed to the growth of land output of cereals. The below figure shows rice production in China between 1983 to 2004, pointing out the trends in yield increase which compensates more than that from the decrease of cereals planting land. Surely China, the most populous country in the world, must keep caution about food security; and explore further potentials in land productivity for cereals supply.



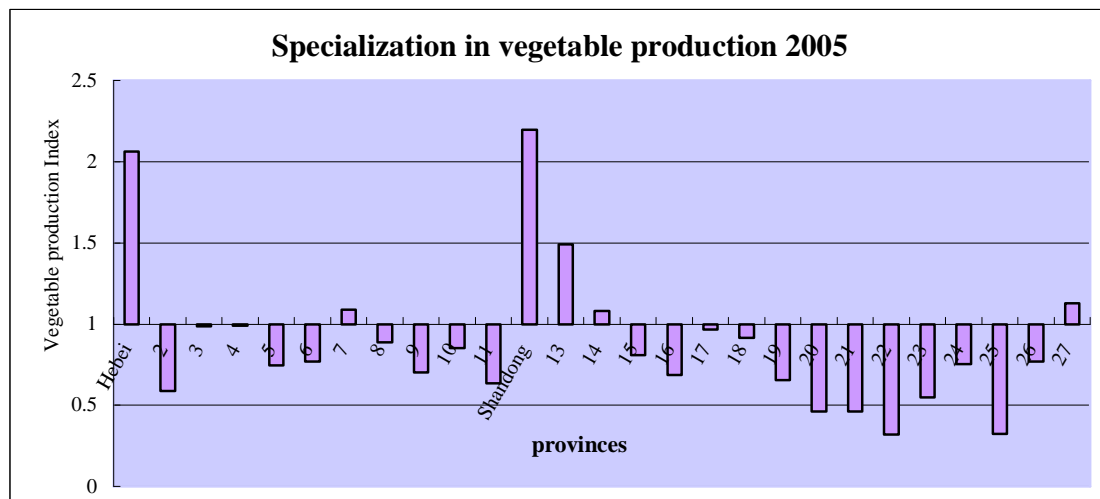
Source: China Agricultural Development Report 2005, Table 14 (2005 nian zhongguo nongye fazhan bapao), Ministry of Agriculture, China <http://www.agri.gov.cn/sjzl/baipshu.htm>

*Provincial distribution of vegetable production*

A final message on the overall picture in which the vegetable sector emerges regards provincial distribution of vegetable production. The production-distribution-wholesale networks of vegetables have mainly developed surrounding large cities within provincial territories. However two provinces stand out as specialized vegetable producers, they are HeBei and ShanDong provinces (See the figures below). Of the two, ShanDong is particularly worth noting. It is in the

middle of east coast, with several hundred Kilometers in distance to each of the largest cities Beijing, Tianjing and Shanghai; while HeBei, which encircles Beijing and Tianjing; its interaction with the demand from the largest cities deemed more direct. Hence ShanDong must have some unique strength for its position being as the largest vegetable base in east China.

ShanDong has been ahead in the development of market institutions, which is important for linking up supply and demand in a period of economic transition. The largest and most advanced wholesale center in China is developed there; it is the home land of peasants innovation in vegetable plantation technology—a kind of cheap and simple green house that made effective production in wintertime affordable for smallholder peasant families in middle-north China. And ShanDong is one of the leading provinces in green and organic production of vegetables. ShangDong hence has been an important contributor in experimentation in technological and institutional change, played a role like what leading firms in industrial sector do. Within ShanDong, the County ShouGuang is the representative in developing all the aspects of ShanDong’s strengths, although it’s one million population accounts for only one percent of the provincial, it produces 5 percent of vegetables of the province, and 70 percent of peasants family income earned from vegetables. It is therefore convincing that by referring to ShouGuang and ShanDong, we get important details about the China’s vegetable sector.<sup>2</sup>



Source: Reproduced from Ministry of Agriculture of China: National Agricultural Statistics Summary 2005 <http://www.agri.gov.cn/sjzl/>, and China Statistical Yearbook 2005

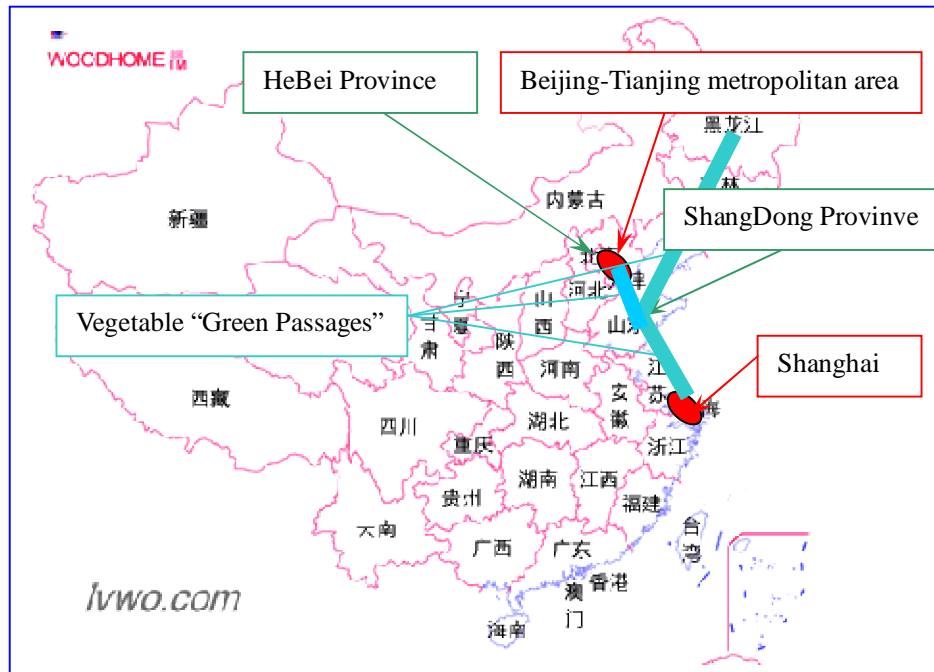
Note:

- 1, The four giant cities Beijing, Tianjing, Shanghai and Chongqing are excluded;
- 2, Province “2” represents Shanxi, 3 Inner-Mongolia, 4 Liaoning, 5 Jilin, 6 Helongjiang, 7 Jiangsu, 8 Zhejiang, 9 An’hui, 10 Fujian, 11 Jiang’xi, 13 Henan, 14 Hubei, 15 Hunan, 16 Guangdong, 17 Guangxi, 18

<sup>2</sup> Sources: Author’s field survey; and from the ShouGuang government Web: <http://www.shouguang.gov.cn/nyzy/default.asp>

Hainan, 19 Xichuan, 20 Guizhou, 21 Yun'nan, 22 Xizang, 23 Shan'xi, 24 Gansu, 25 Qinghai, 26 Ningxia, 27 Xinjiang;

3, Provincial vegetable production index is calculated by comparing the certain provincial per capita output with the national average. An index, which equals 1 means that the certain province stands at the national average.



### 3, Development of the vegetable sector: factors and features in an evolutionary process

We take government policy initiatives as the clue to trace the evolution of the sector, given that development of the sector has been characteristically alone with strong policy intervention.

“Vegetable Basket” Program was central in policy initiatives. The Program started in the 1980s, has been expanded and modified over time, in response to the newly exposed bottlenecks/impediments of the sectoral development. The “Vegetable Basket” Program has passed through three stages, illustrating the trajectory of the sector growth.

*Stage 1:* from the late 1980s to the mid-1990s. In 1988, the “Vegetable Basket” Program <sup>3</sup> was initially announced. The Program aimed at the expansion and consolidation of vegetable production, the introduction of superior varieties of vegetables, and promotion of vegetable distribution channels for overcoming the supply shortage problems for large cities where industrial and commercial population increased while the supply system developed in the planned time had been invalid after the abandonment of the agricultural “commune” organizations. This stage is

<sup>3</sup> Xinhua News Agency: “vegetable basket” Project memorabilia, released 24 July 2002, see <http://www.cctv.com.cn/news/china/20020724/132.html>

featured by the formation of scattered production and distribution networks mainly surrounding large cities. The launch of the “Vegetable Basket” Program also signaled that agriculture policies began giving attention to other-than-staple crops, which traditionally had been overwhelmingly the policy priority.

*Stage 2:* from the mid-1990s to early the first decade of the new century. This stage was in many aspects an extension of the first stage towards covering small cities, towns and the rural of every region, to fulfill further expanded demand. In addition, the intent that vegetable production would contribute to the structural adjustment of agricultural production<sup>4</sup> was incorporated in the goals for the new stage of “Vegetable Basket” Program, as officially announced in 1995. Up to the middle of the 1990s, on the one hand, the provision of staple food crops was relatively abundant so that the government storage system could hardly buy in all the harvests; meanwhile the improvement of peasant family income had been stagnant comparing to the better off of their urban counterparts. The policy therefore aspired to handle the relatively worsening position of the rural in their income terms by the development of the commercial crops including vegetables. However by and large the poverty reduction goals were proved not well satisfied, gaps between the urban and rural residents widened continuously since then.

In this stage, the expansion and consolidation of vegetable production, the introduction of superior varieties of vegetables, and promotion of vegetable distribution channels, which were developed in the first stage in limited places surrounding large cities, spread to all provinces with much broader extents and contents. A nationwide supply-distribution network was formed in this period upon enlarged and intensified local networks.

This stage also featured the start of public investment in R&D for the absorption and adaptation of technologies introduced from external.

*The third stage* began recently, signaled by the important speech by Mr. WEN Jiabao, the then Vice Premier Minister and currently Premier Minister, to the annual National Working Meeting on Vegetable Basket Program (2002 June),<sup>5</sup> and soon after the State Council’s Requisition on Advancing the Vegetable Basket Project (2002 August).<sup>6</sup> This period is characteristic of deepening the established production-distribution-consumption networks, incorporating them

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<sup>4</sup> Xinhua News Agency: “vegetable basket” Project memorabilia, released 24 July 2002, see <http://www.cctv.com.cn/news/china/20020724/132.html>

<sup>5</sup> WEN Jiabao: Speech to the National Working Meeting on Vegetable Basket Project, 23 July 2002, Xinhua News Agent reports 18 August 2002; see [http://news.xinhuanet.com/newscenter/2002-08/18/content\\_528865.htm](http://news.xinhuanet.com/newscenter/2002-08/18/content_528865.htm) and <http://www.people.com.cn/GB/shizheng/19/20020818/802377.html>

<sup>6</sup> State Council: Requisition on Advancing the Vegetable Basket Project, 19 August 2002, see: <http://www.people.com.cn/GB/paper464/7025/681240.html>

with strict governance and technological support for quality and safety provision of vegetables.

Pressure for the improvement came from both domestic consumers and the demanding international markets. Domestically, consumers become increasingly considerate about food quality and safety. Toxic food incidents happened and reported that provoked strong criticisms and appeals for improvement. Internationally, the heightening food security standards set forth by Japan, European Union and United States, lifted non-tariff barrier. Trade disputes due to high pesticide remains emerged earlier in 2001-2002 with for example Japan regarding to green Chinese onion, garlic and other agricultural items—provided that vegetables, a labor and skill-intensive branch of the agricultural sector, make up the most comparatively advantageous in agricultural products to Japan. Japan has been one of the major destinations of agricultural exports and ShanDong the biggest exporter of vegetables.<sup>7</sup> Recently in 2006 EU and Japan both formulated even tougher regulations and standards in food safety. Frustration in exporting served both stimulus to change and learning sources for change to the sector, we will return to this point soon below.

This stage sees new set of legal, regulatory and institutional initiatives with regard to quality and safety provision of agricultural products. Public investment in agricultural science and technology expands to testing and monitoring technologies, and deepened to more “upstream” areas of bio-technology in relation to new variety creation.

*Role of domestic demand: one of the most influential driving forces for growth*

One feature of the development of the vegetable sector in China is that throughout the process, domestic needs serves as the most important driving force. In this case, opportunities for development came from population increase and massive expansion in industrial and commercial activities, which transferred large proportion of the population permanently or temporarily out of the agricultural sector in a time span of two decades. This illustrates one type of development opportunity for the agro-food sector in an era when rapid growth becomes achievable and the growth entails profound changes in production and consumption structure of agro-food products.

There are, of course, other sources of opportunities for the sector development, notably from international markets. Factors such as natural endowments and population pressure determine how much and what opportunities and restraints incur to the sector in a certain economy. In this regard, China, and India and Vietnam likely, is positioned in the category of “resource- restricted and with high population pressure” (Shukla 2007, Gu 2007), deemed sensitive to the changing

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<sup>7</sup> Refer to The Economic Observer (in Chinese *jingji guan*), 19 June 2002

domestic market. Developing countries with rich-agricultural resources and less dense population would more likely embark on export-oriented agro-food development such as Brazil and Argentina. In this connection, a general policy prescription emphasizing on export-oriented agriculture may be misleading in many cases, especially for China.

However, as we observe in the case, the vegetable sector of China, which initially and mainly developed in response to domestic needs, began exporting later on when it became stronger and its comparative advantages spelled out. External demands such as for high quality and safety foodstuff triggered, together with domestic demands, the sector in regulatory, managerial, and technological learning. On the other hand, the export-oriented coffee sector in Costa Rica (Orozco and Diaz 2007) for example, has expanded domestic market penetration, is now in the tenancy being integrated with newly prosperous (domestic) tourism businesses. It seems that the relationship between domestic market and international market changes over time; the roles of the two markets show blurred in the context of trade globalization and swift information circulation around the world (Ostry and Nelson 1995).

#### *Wave-like evolutionary trajectory*

Overall the process demonstrates a wave-like evolutionary trajectory, a prominent feature of uneven development. The wave-like trajectory observed is in contrast to the prediction by conventional thoughts, which assume that change takes a steady-state process, and that there is harmonious relationship between policy initiatives and the growth outcomes, towards a certain end. The evolutionary and innovation systems perspective presumes differently that growth and structural change moves ahead in an uneven manner, it causes uncertainty and involves massive micro-complications, hence it is open-end process (Schumpeter; Nelson and Winter 1982; Bart Vaspargen 2005). The survey plan, guided by innovation systems perspective that we do, uncovers waves by tracing the history, and thereby informs in more detail on dynamics behind different stages.

Three stages of the sector development have passed through up to the present, with rather different momentums—solving the supply shortage problem for large cities, expanding the supply throughout provinces and regions and thereby increasing income for peasant families, and quality and safety supply of vegetable basket, respectively. They were figured out from changing scenario of demand-supply imbalances. Policy responded to it can be said relevant and rather in time, while as we will see a great deal of difficulties and uncertainty involved in implementation of the policies, because of enormous micro-level complications, including the need for

managerial and technological capability building and institutional development. **4, The creation of market institutions and the emergence of specialized actors** We now turn to elaborate institutional development that underpinned the emergence and growth of the sector. Institutional development brings about new social construction that enables broadening participation of people, better use of existing factors or the creation of new factors. (Metcalf, Ramlogan and Uyarra 2003; Nelson 2006) In the case of vegetable sector development in China, central has been the creation and deepening of market institutions that provided new ways, other than central planning that was the governance structure previously installed, in support to transactions and linking-up between producers and consumers. What characterizes the experience in China is that the development of market institutions took rather dense footsteps, begun from very rudimental basis. The sector grew together with the development of markets, and often policy inducement for market development provided preconditions for the sector to move into a new stage.

#### *Wholesales and their networking*

Wholesale markets have been managed by the policies as the pivot spots for the development of market institutions. Wholesale markets hold rules for transactions; they also offer physical conditions for the conduct of transactions such as sheltered space, transaction and storage facilities. Reform policies had from very beginning encouraged farmers to engage in trade and transportation of their outputs. Local authorities in charge of agricultural, or industrial and commercial affairs contributed to the transformation of the small number of distribution centers already in place in the planned economy, or newly created some, by providing necessary physical investment and managerial capacity, following the abandonment of strict control of purchasing and marketing of agricultural products. In some cases villagers did that collectively too for the creation of relatively smaller and nearby wholesale spots, as I learned in field visits. By the mid-1990s, wholesale markets had grown rapidly; they, however, operated in segmentation with little connection to each other.

Since the mid-1990s, with the new objectives of the "Vegetable Basket" Program which posed strategic importance to the vegetable sector for agricultural restructuring, policy of central government gave more attention to the improvement of operation of the wholesales and to the integration of segmented local markets. In 1995 the Ministry of Agriculture started to give certification to the first group of 23 markets, assigned them as "central" or "regular" wholesales. To them the Ministry provides management guidance and some subsidies, and these markets are required to report on market information in price and sales volume, and on progress or problems they made or recognized. Upon the sources of information the Ministry created information

center, which electronically circulates vegetable price and supply-demand status on daily basis, making a move ahead towards nationwide integration of the sector. The coverage of price information soon expanded to 33 such markets from 28 large and medium cities by late the year 1995, and now the network has included more than 150 wholesales around the country.<sup>8</sup>

The current thrust for quality and safety provision of foodstuff adds more strategic roles to wholesale nodes. They are assumed to play the role in monitoring quality of vegetables upon standards. The Agricultural Ministry planned that in the coming five years 500 wholesale markets are to be lifted becoming capable in quality management, for this purpose, the ability of the markets in encoding and delivering electronic information are to be strengthened.<sup>9</sup> Necessary investment is led by the central government--the government started in 2003 issuing treasury bonds of 300-400 million Yuan per annum (exchange rate between Chinese Yuan to US Dollar: about 7:1), together with complementary resources from local government budgets, private investment and wholesale houses self-accumulations, for the renewal of information and test systems for key wholesales.<sup>10</sup>

#### *The emergence of specialized venders and blockers*

Along with the production and distribution system the sector grew larger in which division of labour evolved increasingly finer. In addition to *vegetable planters*, which now account for dozens of millions, and *wholesales* which developed to several thousands as transaction focal points, the supply chain spread to include even a larger number of local fairs and supermarkets, adjacent to either production or consumption. Specialized venders and blockers emerge who channel up the whole sequence operational in vigor.

*Vegetable venders* appeared who are involved in the distribution and transaction of vegetables in small lot. *Small vegetable vendors* or *peddlers* engaged in rural vegetable fairs, which had been broadly opened since early the 1980s, and in urban fair trade, which Vegetable Basket Program promoted as part of distributional channels. Small vendors run with very small-scale businesses, they mainly came from the rural, constituted a part of the seasonal immigration of rural population. *Vegetable blockers* or *middlemen* emerged and grew in size too, who deal with the transactions in large lot with longer distance; they came from the rural or small towns, are among the most active and better-educated previous rural residents. Vegetable blockers have now often owned their own trucks, heavy or light, as means for transportation services, some of them began

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<sup>8</sup> Refer to <http://www.agri.gov.cn/pfsc/>

<sup>9</sup> Source: [http://www.agri.gov.cn/dfxlb/cqxxlb/t20070109\\_753495.htm](http://www.agri.gov.cn/dfxlb/cqxxlb/t20070109_753495.htm)

<sup>10</sup> Refer to [www.chinagate.com.cn](http://www.chinagate.com.cn)

to invest in storage facilities. The population of this group is at the level of hundred thousands.<sup>11</sup> The vegetable venders, both smaller and bigger, link up the production locus, the rural fairs, the urban fairs, the wholesale centers, the super markets, and in some cases, help stretch the distributional channels directly up to organizational consumers such as university cafeteria.

### *Limits of the markets*

Impressive the market development of the sector has been, many limits remain, not only compared with advanced economies, but also apparently so in comparison to those in developing market economies such as the coffee market in Costa Rica (Orozco and Diaz 2008).

Inadequacies are manifested themselves in the comments widely made by Chinese authors as the following (*e.g.* Cheng 2007).

- (1) The distributional effect of the system is low. It is reported that often losses of vegetables from harvest in production through consumption might be as high as at one fifth to one fourth.
- (2) The information function of the market system, improved after enormous efforts though, still stay far behind satisfaction. The transmission of demand information went limitedly and slowly to producer (and to vender too) so that surplus and shortage of certain item of commodity appeared by turns from year to year. Small croppers remain largely the same as they used to in making decisions, namely, either following the suggestions by local administration or imitating neighbors. The consumption locus found it difficult as well in tracing the place and process a certain lot of supply comes from for the judgment of entwined health or safety quality, incentives surfaced thereby served less intimately for the improvement and better-off at the production end.
- (3) Vegetable pricing is to an extent formed arbitrarily with small producers squeezed to the lowest margins of profits.

Many reasons attributed to the problems. Certainly the efficiency of the markets unavoidably holds low with still thin accumulation of physical facilities (supportive to all the functions--storage, transaction, transportation, communications, which are more sensitive to the distribution of perishable vegetables), and managerial capacity. The venders came from the rural or small towns; and the wholesale managers derived from local officials. Both were not the major beneficiaries of the elite-oriented education. Investment in the market system has been basically from individual or local, marginal to the vast capital assets of the country, which has been posed towards metropolises and advanced industries. Hence, one sees that trade at the wholesales often had long been carried out in traditional manner, through face to face negotiation taken from stock and complete in cash, except not

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<sup>11</sup> The vegetable blocker population is the author's estimation based on scattered reports. Roughly one blocker deals with the vegetable output of 500 MU (slightly more than 30 Hectares).

many the model wholesales like that in ShouGuang (see Box 1) where auction and electronic settlement of account became in common. Information about demand and supply from arbitrary and opportunistic trading activities deemed partial and approximate, and it flows merely in constricted circles—not really approachable to the large number of producers, nor is it unmistakably to end consumers too.

The initiatives to improve information systems and quality monitoring capacity of the markets are relevant though, they by themselves remain fall short of solving the information and pricing problem of the markets as pointed. Serious is the weak position of smallholder croppers in the governance structure, if we understand that market is an economic system bringing together the forces of supply and demand for a particular good or service, in which the mechanism for establishing prices and effecting transactions is determined by the power relationship between customers, suppliers, and distributors (GU 2004). In case where the supply-end composes vast small producers, for the sustainable development, a third party with legal responsibility in monitoring pricing for fair distribution of profits, and/or collective marketing by means of small producer cooperatives, are to be evolved as observed in many well-developed systems, which China is yet to proceed. In the Coffee sector in Costa Rica (Orozco and Diaz 2008), a government body, the Institute for the Costa Rican Coffee –IDECAFE was created in 1933, which is a case of the first approach just mentioned. IDECAFE took responsibly to regulate relations among coffee growers, processors and exporters, seeking for the distribution of the final price through uniting small producers. Coffee farmers cooperatives emerged in Costa Rica in the 1960s, which is a case of the second approach to the upgrading of the governance structure. The cooperatives brought about better conditions to farmers in the trade of fresh coffee; the organization of cooperatives also opened the chance for farmers to go to vertical integration over the value chain, including milling and export. All these changes were developed in a social process through struggling by small growers and through interactions between the producer, the processor and the regulatory and policy makers.

### Box 1 The development of market institutions in ShouGuang, ShanDong Province

ShouGuang is a County in the middle of ShangDong Province, with a population of one million. Traditionally ShouGuang people was apt at vegetable production, they developed some special variety of leek, for example, which had historically served as an article of tribute to the Qing Emperor at Forbidden City. Now ShouGuang becomes “the first vegetable garden” of China, and the brand of ShouGuang Vegetable is known in China as the most prestigious.

The development of ShouGuang vegetables is owed a lot to the efforts for circulation (distribution) channels, or, the creation and cultivation of market institutions. Local government summarizes their experience as “promote circulation meanwhile bolster production”.

The central transaction spot in ShouGuang is the ShouGuang Vegetable Wholesale Market. The ShouGuang City Government decided to open it in 1984 in response to the difficulties that vegetable cropper peasants were faced with in selling out their products. The Industrial and Commercial Bureau of ShouGuang implemented this decision upon a bank loan and some small amount of personal money. Since then the Market has experienced many times of expansion invested mainly from the local government budget. In parallel, 20 or so smaller vegetable markets, some of which are more specialized in certain category of vegetables, created around ShouGuang, complementary to the central one. The ShouGuang Wholesale and the smaller ones together constitute a network penetrating down to every village. In 2003 the market was, in the co-sponsorship of Shenzhen Agricultural Products Co. Ltd, reorganized to become ShouGuang Vegetable Wholesale Market Co. Ltd. This reorganization introduced advanced management and additional capital investment from the ShenZhen co-sponsor, provided that the Shenzhen Agricultural Products Co. Ltd, as a listed company, has been one of the leading investment company in agricultural products distribution, accumulated rich experiences in wholesale business.

From a simple and crude transaction location, ShouGuang Vegetable Wholesale Market Co. Ltd now possesses trading building of 100,000 m<sup>2</sup>, comprise of not only transaction on vegetable and fruit products, but also that for capital goods for vegetable production such as seeds, fertilizers, agricultural pharmaceuticals, green house construction materials. It provides a wide range of business services from electronic action and storage to exhibition and consultancy. The first electronic vegetable auction in China was opened there in 2003.

ShouGuang was probably the first region in China giving attention to green production, which started in 2001. Frustration in vegetables exportation to Japan intrigued actions of this kind. Up to 2006, a Branch Station of the National Quality and Safety Test was set in ShouGuan and formally put in function. The opening of the Branch Station in ShouGuan will certainly bring in technical and managerial support from the national initiative. It is planned that quality monitoring function is to be incorporated into the central Wholesale and expanded to 16 spots of vegetable markets in the county territory.

In addition, ShouGuan established demonstration bases to further secure quality of vegetables. The demonstration bases develop, employ and transfer standard production procedures. They are equipped with test facilities and assigned to provide training and test services to small family farms. In order to control quality from appropriate use of land, the bases are committed to take the responsibility in monitoring of land environment. All these measures begin in act just recently. How successful they will be in helping the vastly mass smallholder croppers to consolidate quality and safety production in every detail, which is very necessary, remain to be seen.

The creative management of ShouGuang in the development of market institutions has been important for ShouGuang, and to an extent for the Province of Shangdong, in maintaining cyclic expansion and upgrading of the vegetable sector. Through this and the creation of cross-provincial-border “ShouGuang-Beijing Green Passage”, and “ShouGuang-Ha’erbin Green Passage” (see the map of China above) which was made under cooperation between provinces, ShangDong Province, and prominently ShouGuang County, grew up to be the most nation-wide important supplier of vegetables.

#### References:

- 1, Author’s field survey notes;
- 2, On the opening of Quality and Safety Test Station of vegetables at the ShouGuang Wholesale Market, refer to <http://www.sda.gov.cn/cmsweb/webportal/W354/A64015531.html>;
- 3 On the Shenzhen Agricultural Products Co. Ltd, refer to <http://www.szap.com/english/web/gsk.asp>

## 5, Transformation of knowledge regime

Accompanying with the rapid development, the vegetable sector in particular and the agro-food in general, is experiencing *transformation of underpinning knowledge basis*. Biotechnology in relation to seed breeding for new varieties with higher yields or finer tastes, technologies used for test and quality monitoring which are electronic, optical and mechanical based, environmental and ecological knowledge and technologies aiming at projection and strategic management of land use and environmental protection, and knowledge and competence in management of a modern commercial agro-food sector, are among the areas which are indispensably and directly supplemented, or to be introduced, into the knowledge basis. We focus on the first two elements *i.e.*, biotechnology in relation to new varieties, and test and quality monitoring technologies, to illustrate the necessary renewal of knowledge base.

### *Externally introduced seeds and adapted by peasant's plantation skills and local innovations*

The development of the sector was started relying heavily on externally introduced seeds, or *embodied product technology*. Up to the present time a lion share, between 50-80 percent, according to scattered reports, of new varieties of vegetable has been supplied by multinational companies either directly through sales of their subsidiaries opened in China, or indirectly through local seed agencies' importation and distribution.<sup>12</sup> Regional agricultural R&D centers conducted the role in selection of imported varieties as whether they are appropriate to local soil and whether conditions.

While the majority of new varieties of vegetable have thus far been obtained from external, *plantation skills* that peasants had built up from generations lent a ground for the successes in employing imported seeds in production. We have learned plentiful evidences from field visits that skillful vegetable croppers managed well in fitting new varieties in their land; and not rarely they develop small tricks to solve problems apparent in their production. This explains why vegetable production is often more successful in those counties or villages such as ShouGuang, where traditionally peasants were apt at vegetables cropping.

Compared with cereals production, vegetables entail more labor and physical inputs. It requires

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<sup>12</sup> Message told in the author's field survey was that about 80 percent of seeds sold in ShouGuang were from foreign companies. Some report confirms this estimated share of multinational companies' supply (People's Daily of ShouGuang, March 27, 2007). At the national aggregate, the share of multinational companies in the vegetable seed market is reportedly at the level of above 50 percent (HUANG Gang 2006: News Letter on Work in the Rural Areas, Issue No. 449, May 30 2006. The author is vice-president of the Academy of Agriculture of SiChuan Province). Multinational companies hold the top rated, superior grade and high quality end of the seed market. By 2005, 70 foreign companies have entered in China's vegetable seed market. The size of the overall seed market is estimated at 100 billion Yuan or more; a not small share of it is for vegetables (*ibid*).

regular watering and shields to protect the crops from too low in temperature or too strong of sunlight. The agricultural administration in China had since the 1980s planned and funded for the introduction of green house equipment from abroad. However, in reality it was the plantation facilities farmers developed themselves that maintained the massive field production. Because imported green houses, which were developed under rather different factor conditions, are too large to be suitable for small family-based farms and too expensive that small producers could not afford them.

One of the most important peasants innovations came out in 1989 from ShaoGuan, ShanDong, made by Mr. WANG Leyi together with his villagers. What they invented was a cheap and simple structure serving as green house for vegetable plantation. This invention made possible the massive production, at low cost, of fresh vegetables in wintertime in middle and middle-north China, where it is rather cold in wintertime and the production had either to be in halt or under fuel-heating. This invention turned to be highly welcomed and soon disseminated widely in the provinces with similar latitude to Mr. Wang's homeland, which cover an area with several hundreds of million in population. Up to the present time, this peasant's innovation remains the principal mode of green houses in the provinces, although roof frame and column prop become of steel-made and simple machine is substituting men in rolling up and down the strew covers, when small farms get better-off in their financial capacity.

Box 2: A peasant innovator of green house: Mr. WANG Le'yi from Shouguang Country, Shangdong Province



Mr. WANG inside their innovative green house

He is a peasant with only four years primary education, while he contributed greatly to the so-called “white revolution” (Their innovative result is write plastic screen roofed simple green house) on vegetable production in middle-north China, by the invention of cheap, simple but effective green house.

Mr WANG’s home village SanYuanZhu, ShouGuang County, ShanPong Province, is located in north latitude 37°with frozen winter for several months. People in Shouguang did produce vegetables in winter time in traditional coal-heating green houses which uses coal of 5-6 tons per MU (equivalent to 1/15 hectare) a minter season. It was not only expensive but also not effective could only produce leaf vegetables but not fruit vegetables like cucumber. Neither the traditional green houses nor the imported green houses from Israel and Holland, which were too expensive, were widely used.

In 1988 Mr. WANG got known that some capable farmer in even Northern Liaoling produced fresh cucumber in a non-heating green house, he and other villagers went out seven times to learn from him, and based on what learned Mr. WANG tested systematically on the frame, the roof, the wall, and the frontage orientation of their innovative green house. It turned out having a thick soil wall in the north side to prevent from cold wind and board and transparent roof open in daytime and covered with strew shade in the night. In 1989 first 17 peasant families of the village established such green houses and successfully produced cucumber sold in Chinese Spring Festival season, all the 17 families earned more than 20 thousand Yuan upon the green houses. The next year all the some 200-villager families took this technology.

In the following years Mr. WANG was committed by the County administration to teach local peasants on this technology; he did this enthusiastically as a result, his home Country now becomes the most famous vegetable producing country in China. He also traveled around the country as far as to XinJiang Province some several thousand KM away to give help for peasants there. His village moved ahead non-stop in improvement of the green houses; they developed green production with their own brand, and expanded to vegetable processing. The average income of his villagers is now as two to three times higher than the national average. Mr. WANG won enormous reputation and is awarded as “model communist party member”.

Sources:

- 1, renmin ribao (People’s Daily) 2006-01-20
- 2, nongmin ribao (Farmer’s Daily) 2005-12-05
- 3, Author’s flied visit to Shouguang, Shangdong Province 2003, 2004

### *Seed breeding and the establishment of bio-agricultural R&D infrastructure*

After 20 years of attempting for the establishment and strengthening of a modern bio-scientific and technological basis for the vegetable sector, such a basis is now in a shape, although its effectiveness

has yet to be consolidated. A family of R&D institutions of vegetables and flowers is formed. It embraces 33 units at the central and provincial academies of agriculture science; they make up the core body. To it to be added are other some 20 centers or branches specialized in vegetables at the lower municipal/city levels of the same agriculture science academy system. Furthermore, around 30 vegetable and gardening departments established in agricultural universities, and a number of research centers more generally on life sciences were created or improved in the prestigious Chinese Academy of Sciences and in top comprehensive universities.

To shed a light on the newly in-shaping knowledge system, we take a close look to the Institutes of Vegetables and Flowers, Chinese Academy of Agriculture Science. Being a small unit of Chinese Academy of Agriculture Science since the 1950s, the Institute experienced unusual re-organizations and affiliation-changes. In 1960 it was “graded down” to be a research institution affiliated to Beijing city; in 1962 it moved back belonging the Agriculture Academy again; in 1970 it moved down once more under the administration of Beijing city, then back to the Academy in 1976. Unprecedented development came since the 1990s, through which the Institute grew rapid and stable. It now has 152 research staff, with one having been erected as Academician of Chinese Academy of Engineering Science, 13 doctorate degree holders and 30 masters. The Institute is composed with eight departments. One is for vegetable generic resources whose tasks are in the collection, conservation, identification, propagation and evaluation of domestic and exotic vegetable genetic resources. This department serves also as the supporting unit and central node of the National Genebank project of Vegetable Genetic Resources. One is the Department of Biotechnology created in 2001, engaged in application-oriented basic research of vegetable biotech such as molecular genetics, gene engineering, molecular marker assisted breeding. It is also the institutional basis for the National Open Laboratory of Vegetable Genetics and Physiology. The rest departments include one for vegetable culture and post-harvest technology; one for plant protection and several for selected varieties breeding.<sup>13</sup>

Of the many actors in R&D infrastructure sketched above, the research centers in the academies of agriculture science are the major task force for vegetable variety breeding and vegetable agronomy. But in order to be successful, gene resources, bio-scientific knowledge and basic bio-tools are all indispensable. These elementary abilities are now possessed in the comprehensive structure of the knowledge system. China took two decade to build it from a rather limited basis. In retrospect this process may have proceeded faster if investment in agriculture science and technology could be kept without hesitation. As a matter of fact, investment in agricultural R&D had been declining since 1985, when the market-oriented reforms for S&T system start. This

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<sup>13</sup> Refer to <http://www.ivfcaas.ac.cn/ENGLISH/index.asp>

investment lowered from 0.31 percent of agricultural GDP in 1985 to the bottom of 0.19 percent in 1997. It was since 1997 that the declining trends began to alter. The figure was recovered to 0.21 percent in 2002, and surely in further improvement in the following years.<sup>14</sup> Besides, a bias of the national programs in favor of “high-tech” sectors was attributable to the delay in investment in agricultural R&D too. This may have impeded necessary inputs until fateful challenges—shown in the absolute dominance of multinational companies in knowledge-intensive and highly value added seed technology, had become real and urgent.

However, a competitive seed supply is to be based more than only on a relatively good R&D infrastructure. Capable seed companies in seed propagation and breeding, production, processing, distribution and demonstration, their links with the knowledge infrastructure, and an effective legal and regulatory environment, are among additional and necessary conditions. Currently, the players of seed industry in China embrace those transferred from previous state seed agencies; those newly entered private companies, sales branches of agriculture R&D institutes, and multinational companies. Domestic companies are mostly small, lack of managerial and technological capacity, and suffer from institutional separation between R&D, seed breeding and seed production;<sup>15</sup> they are inferior in competition with multinational companies. Necessary institutional and capability building has attracted the attention by the policy makers, actions already made include a Seed Project aiming at improving technological capability for the industry, and the Seed Law that was issued and emended in 2004. We have stop here of the important seed industry issue with the limited space of the paper.

#### *Development of a quality monitor system*

Recently for quality and safety provision of vegetables, one sees intensive moves towards the development of a quality monitor system supportive to the distribution and production of the sector. The Law on Agro-food Product Quality and Safety was passed in 2006 April and became in act since 2006 November.<sup>16</sup> An agency called Center for Agro-food Quality and Safety established in 2003 functioning under the Jurisdiction of Ministry of Agriculture, responsible for standards development, assessment and certification of green products, and approval and evaluation of the newly created “quality and safety test stations”, in order to effectively implement laws and regulations in regard to food safety and quality.

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<sup>14</sup> References: 1, XU Xiaoxia: Science and Technology Resources in China: Current Situation and Problems (zhongguo keji ziyuan de xianzhuang ji laifa liyongzhong cunzai de wenti) in Resources Science (ziyuan kexue) 2003 Vol. 25 No. 03; 2, ZHANG Qiao: The Status of Agricultural R&D Investment and Optimization of Resources Allocation (nongye keyan touru xianzhuang ji youhua peizhi shexiang) in China Venture Capital and High-tech (zhongguo chuangyetozi yu gaokeji) Vol.4, 2004

<sup>15</sup> The seed industry association of Shanghai provides a detailed analysis.

[http://www.snhx.org.cn/zhongzi/hydt/t20040720\\_105988.htm](http://www.snhx.org.cn/zhongzi/hydt/t20040720_105988.htm)

<sup>16</sup> Refer to the Web of China Court: [http://www.chinacourt.org/flwk/show1.php?file\\_id=109820](http://www.chinacourt.org/flwk/show1.php?file_id=109820)

A network of quality and safety test stations is in formation; they work under the coordination of the national Agro-food Quality and Safety Center for of Agricultural Ministry. By far more than 100 units have been assigned as branch stations of the overall system; many of which were reorganized or created within existing central or local agents by assigning new objectives and functioning with specifically established methods and procedures. For example, a National Test Center of Vegetable Quality and Safety is created in the just mentioned Institutes of Vegetables and Flowers, Chinese Academy of Agriculture Science, as a key station of the system.<sup>17</sup>

Compelled both from domestically and internationally China is driving to quality and safety provision of foodstuff, for the implementation of the goal, sources China to refer to or equip up are mainly external. They include initiatives for technological, and legal and regulatory capability building and institutional development. One sees many study tours and survey projects organized aspiring to understand what has been done in United States, European countries and Japan. International cooperation offers forum for exchange and learning, for example, a High-Level International Food Safety Forum has held in 2007, co-sponsored by the General Administration of Quality Supervision, Inspection and Quarantine of China, the Ministry of Health of China, and World Health Organization.<sup>18</sup>

Presently test instruments are bought in with large quantity especially from Japan. International Instrument Fairs are organized for exhibition and purchase of relevant instruments. It is reported that ShouDuang, for example, had equipped test apparatus introduced from Japan for about 20 test stations in the County since 2002, immediately after frustrated trade deals with Japan.<sup>19</sup> Like that stream of policies taken for seed breeding capabilities, in order to set in a quality monitory infrastructure, China brings in technologies for immediate solutions, meanwhile began investment in R&D for quality test and control capabilities. This will take a long process to achieve some results, and how the combined efforts will produce remains to be seen in coming years.

#### *Public-private mixed services*

Services provided by the technological and knowledge infrastructure, which is emerged during economic transition, shows a character of mixture of public and private supply. It is recognizable that the forms and ways that interface the infrastructure and their innovative economic actors are in great fluidity in rapid changes in terms of user-producer of knowledge relationship and in great

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<sup>17</sup> Refer to the web of the Center for Agro-food Quality and Safety of the Agriculture Ministry at <http://www.aqsc.gov.cn/dfcjg/dfcjgShow.asp?id=121>, and the web of the Institutes of Vegetables and Flowers, Chinese Academy of Agriculture Science at <http://www.ivfcaas.ac.cn/ceshi/PINZHI/PINZHI.HTM>

<sup>18</sup> Economic Daily (jingji ribao), 29 November 2007

<sup>19</sup> Refer to the national media center Xinhua News "Focusing Talk Online" at [http://news.xinhuanet.com/misc/2002-09/30/content\\_577395.htm](http://news.xinhuanet.com/misc/2002-09/30/content_577395.htm)

fluidity in rapid changes in terms of user-producer relationship of knowledge and in the macro-economic and regulatory environments.

Markets have been the place mediating profitable provision of extension services, through the supply of “embodied” technologies such as seeds, fertilizers, chemicals and materials for the production of vegetables, together with channeling information about supply and demand. These are merits of market people in ShouGuang recognized as fresh and excited when exposed in it after the abandonment of planned control.

Multinational companies and the wealthiest domestic companies provide extension services in selected locations mostly the major production bases. Syngnta of Switzerland built its demonstration station with a few of dozens hectares in ShouGuang, upon which the company offers training and delivers information about their superb seeds to local peasants. ChaoDa, one of the largest Chinese agricultural companies provides technical assistant to local farmers in Fujian Province in use of their organic fertilizers. These extension services are part of profitable businesses, or marketing-related extension services. Some active middlemen in vegetable distribution, many of whom themselves are competent croppers, bring market and technical information to the villagers.<sup>20</sup>

In the public side, information and plantation advices come from the administrative body. Pervasively in China the county and town governments send forth information through village heads down to peasants of the villages. Thanks to the advance of information technology, local governments commonly developed IT-based agricultural information and consultancy services delivered through, among other channels, television programs and wired telecommunications approaching to peasant households; peasants welcomed this service explicitly.

Local governments tended to invite agricultural experts from academia consulting on strategically important issues, which is thought helpful. Earlier on, agricultural experts had been encouraged to give paid services more directly to peasants or peasant groups, which did not work as desired—either peasants cannot afford the expenditure, or they would not like to pay but got to have good idea just through observation and imitation.

In order to obtain specific knowledge and skills of experts from academia, local government tried to find out new ways. Baoji city of Shan’Xi Province, invented something called “Expert Houses”. The Houses offered facilities and subsidies to agricultural experts for solving selected problems. This approach has thereafter been promoted by the central government, and some other provinces

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<sup>20</sup> Sources: the Author’s field work in ShanDong, Jiangsu and FuJian Provinces; for ChaoDa, refer to <http://www.chaoda.com>

followed the suit. Fujian Province initiated in organizing officials and professionals from the provincial capital, to work in towns and villages for fixed terms, helping peasants in technical and managerial affairs. This experience has, afterwards, been promoted too, and repeated in other places. All these approaches gained positive, but limited, effects. These efforts could cover only small proportion of the massive agricultural population.<sup>21</sup>

Quality and safety vegetable production requires strict management throughout production, processing and distribution, for this the most critical is how to improve the employment of modern technologies by the vast number of smallholder farms. Among the means that are assumed to be helpful are the facilitation of demonstration farms together with public extension services for standard production (by means of local government initiatives under the subsidy of central budget), and the promotion of private agricultural companies capable in technology and management. In addition, the Law of Specialized Agricultural Co-operatives will be in act since July 2007, thereupon farmers are allowed to self-organize themselves. Co-operatives are whished to develop the capacity in learning and dissemination of new knowledge based on collective actions.

## **6, Role of government**

The government has been playing crucial roles.

The first role that the Chinese government played is in serving as sponsor and promoter of the development of distributional and transactional networks, or simply, market institutions. Along with the revival of traditional fairs in market reforms, policies since then altered towards the promotion of transaction and mediation mechanisms with a particular focus on the development of wholesale markets as the pillars of the distribution system. The central government set forth strategic vision and created the trading information service in support to the formation of a nation-wide market system. Local governments involved directly or indirectly for the wholesales development in terms ranging from necessary capital investment to managerial support and manpower transfer. In latter stage in order to respond to the need for safety and quality supply of vegetables, the government turned to focus on regulatory and standards services together with the enhancement in technical supportive capabilities and institutions for standardization and quality tests.

The way in which the Chinese government took steps forward is the one actively reflective to

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<sup>21</sup> Information comes from Author's direct involvement in survey and training for extension services under the auspices of MOST from 2002-2005.

bottlenecks that appear impediment to further development. The process hence passed a sequence in which previous effort both landed a ground for further development and pointed out problems to be solved in the next step. The experience in China demonstrated that, market institutions development, which is central for successful economic transition, is by no means light or simple. It is complicated and has to entail enormous investment in tangible and intangible assets, and it has to be built upon concrete microstructures.

The second role the Chinese government exerted is in the renovation of knowledge base for the vegetable sector. The government served as the initiator and principal investor and co-coordinator. In order to introduce a modern biotechnology infrastructure incorporated into the base, investment was organized through national programs and national S & T funding agencies. The works on crop species (generic resources) was financed by the National Seventh Five-Year Plan (1986-1990) on Key Scientific and Technological Development, and continued in the National Eighth Five-Year Plan (1991-1995).<sup>22</sup> Investment in basic and applied research, including that on bioscience and biotechnology came from the National Basic Research Program (“973” Program, started since 1997), National High-tech Research and Development Program (“863” Program, started since 1986), and National Natural Science Foundation (created in 1986) (Yu 2007).<sup>23</sup> In parallel, the Ministry of Agriculture initiated Seed Project since the second half of the 1990s, in order to enhance the seed industry covering from breeding to commercial production. In order to obtain

For technologies in relation to effective plantation, the National Ninth Five-Year Plan (1996-2000) on Key Scientific and Technological Development included the *Demonstration Project of Effective Factory Agricultural Production*, largely focused on the need in vegetable and flower production.<sup>24</sup> Agricultural production technologies were continuously inclusive in the Tenth National Plan (2001-2005) on Key Scientific and Technological Program. These programs resulted the capacity to provide technologies and equipments for large scale of plantation or demonstrative farming, while as earlier pointed simple and cheap technology of peasant innovation remains very important for smallholder plantation. In order to obtain and enhance capability in monitory of foodstuff quality the

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<sup>22</sup> Refer to the web on National Five-Year Plans on Key Scientific and Technological Development <http://gongguan.jhgl.org/intro75.htm> and <http://gongguan.jhgl.org/intro85.htm>

<sup>23</sup> All these programs and plans were initiated during market reforms, when direct appropriation of public funds was abandoned. New management methods are introduced in these programs and plans including the establishment of advisor committee, mid-phase and result evaluation and accounting. Goals of these plans and programs are, with some overlaps, complementary in which the National Five-Year Plans aim at solving confronted crucial problems in economic and social development, and the others at related scientific and technological foundations.

<sup>24</sup> Ministry of Science and Technology: The Ninth Five-Year National Program on Key Scientific and Technological Development. Refer to [http://www.most.gov.cn/bstd/bstdbsfw/bstdfxzkk/bstdfxzkjgg/bstdfxzkjggwn/200604/t20060420\\_31516.htm](http://www.most.gov.cn/bstd/bstdbsfw/bstdfxzkk/bstdfxzkjgg/bstdfxzkjggwn/200604/t20060420_31516.htm)

*Special Project “Key Technologies for Food Safety”* was officially initiated in 2002 as part of the National Tenth Five-Year (2001-2005) Plan on Key Scientific and Technological Development. The major components include the development of testing techniques and tools, a renewal, adaptation and establishment of standards and evaluation procedures, the development of control, monitoring and warning system for food security in which monitoring and warning for foodstuff import and export is particularly emphasized, and the establishment of demonstration bases for comprehensive application of food safety techniques and management.<sup>25</sup>

The way in which the Chinese government took action for the knowledge infrastructure is reflective too, often made in response to the challenges appeared urgent. Looking back the process one would comment that a long-term foresight is necessary for the knowledge infrastructure development, because transformation of knowledge base has to pass a long gestation period. In China, such a base has not been functioning well in real terms by far, after more than ten years of the initiation of the programs.<sup>26</sup>

The policy institution in China is characterized by strong central initiative, and a top-down approach. The strong developmental central government has positively attributed to quick mobilization of policy resources in achieving identified goals. The weakness is in inadequate incorporation of local governments and ordinary people’s participation. Local governments are still weak in policy and managerial capacity in dealing with locally specific problems. Blind imitation of some experience in neighboring places often happened that slowed down the pace of policy learning and institutional innovation in provinces.

## **7, Summary and discussion**

The story about the vegetable sector development in China illustrates a transformation of the agriculture sector with great width and depth in one of the largest agricultural countries, China. It shows immense potential for the often thought “traditional” and “backward” sector of agriculture, in the tide of rapid economic growth, fierce competition and intimate interplay between international flows of knowledge and domestic efforts. The study sheds a light on the strategic importance of the agro-food sector for development (Sisler and Oyer 2000), and contributes its part to systemic measurement of relevant policies.

1, The China’s vegetable sector is experiencing profound transformations in multiple sense. It emerged to become a large-scale industry mediated by increasingly sophisticated nation-wide

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<sup>25</sup> Refer to the Ministry of Science and Technology Web  
[http://www.most.gov.cn/swzdkjzx/spaq/200404/t20040426\\_13247.htm](http://www.most.gov.cn/swzdkjzx/spaq/200404/t20040426_13247.htm)

<sup>26</sup> See various annual reports of the National High-tech Research and Development Program at its homepage  
[http://www.863.org.cn/863\\_105/index.html](http://www.863.org.cn/863_105/index.html)

market institutions, out of a marginal and regionally segmented agricultural sector. It is also in the process turning to rely increasingly intensively on modern science and technology, from a traditional experience-based sector. The vegetable sector in particular, and the agro-food sector in general, in developing countries is, and should be, no longer understood and treated in policies, as backward or low-tech sector.

2, The driving forces came from, first of all, the demand side. Rapid economic growth changed employment and residential structure of the population that drove the sector to grow in parallel. Concerning domestic demand oriented and export oriented development. The development of China's vegetable sector was initially mainly aimed at the fulfillment of changing demand inside the country. Exports began when the sector became stronger. We observe that both the demanding domestic and external consumers contributed the incentives to move the sector towards higher quality supplier. It seems that how to combine the merits in terms of learning and sectoral dynamics from the two orientations is a topic worthwhile to further explore.

3, Institutional change is very central to sustaining development potentials of which market institutions are crucial for and during economic transition. To facilitate the growth, the China's government correctly captured the crux of wholesales in the development of market institutions. The experience in China manifests that the inclusion of market institutions is wealthy and comprehensive. Physical capital, assistant to transaction, transportation, storage and distribution, and quality monitory, intangible assets—legal and managerial capacity, norms and trusts people follow, and the governance over the relationship between producers, traders and consumers, all matter. It also shows that institutional change is costly and time consuming; it proceeds through interactions of the actors and the regulatory framework and is shaped by the size and structural depth of the sector.

4, The development of the sector in survey relied heavily on external sources of technology and knowledge, notable new varieties which are embodied in seeds, and testing method and equipment, and standardization. Absorptive capacity rests, vastly and basically, on peasants' experiences and skills in plantation in which incremental innovations have been important but these are often less noticed. R&D institutes assisted to the absorption by testing the fitness of the imported to local climate and soil conditions. A number of national research programs followed later on, in order to deepen the absorptive capability, and to consolidate a knowledge base to support locally rooted creative capability.

5, Under tightening competition and with demanding and knowledgeable consumers, the vegetable sector specifically and the agro-food sector by and large in developing countries is

necessarily to transform the knowledge base. This is also feasible in the circumstance where relevant scientific and technologic knowledge is relatively mature and widely disseminated. Modern biotechnology for example, is taught in universities of everywhere, its research tools have been available in international technology market. However, to have such knowledge base effectively working for the sector rather than merely played in academia by a group of scientists, strengthening and re-organization of the agricultural R&D infrastructure is indispensable. One lesson from China's experience is that a long-term foresight is necessary in order to win a time span for such a base to grow soundly in intuitional and human resources terms, since the transformation would often undergo a rather long gestation period.

6, The role of government has been crucial for the development of the sector, as sponsor and promoter for the development of market institutions, and as initiator and principal co-coordinator for the renovation of a new knowledge base. But the knowledge base becomes increasingly multi-disciplinary. China is not very successful in incorporating the machinery, chemical and pharmaceutical, and ecological knowledge for the development of the sector yet, which we did not address much in the paper. Beside, strong central initiative and a top-down process of policy-making in China need complemented with more participation from the bottom.

7, We did not discuss much on the effect or implications of the sector in poverty reduction for poor peasant families. We know that the land output from vegetables is about several to ten times higher than from planting cereals, which is surely good. However, if ask how much the vegetable production could offer for peasants in narrowing the gaps with respect to urban residents? The answer is to some degree, but without doubt very restricted—because the tiny lot of land that peasants' family in China holds could put an inescapable ceiling.

8, The perspective of innovation systems puts the creation, diffusion and application of knowledge as key to growth, that takes place through interactions between various actors of an innovation system (Ludvall 1992; Nelson 1993). The analytical approach of sectoral innovation systems this study takes focuses the survey on certain sector. By sensitizing specificities to an industrial sector, the SIS approach tends genial in the probe of particular details. The analysis of driving forces indicated the type and feature of opportunities rather clear and unique to the vegetable sector. The analysis of the transformation of knowledge base is very illustrating to the necessity to revise the conventional notion about the sector, which is to be considered no longer "traditional". The exploration of evolution of the sector showed important information about the dynamics behind its rapid growth. A trace of the interaction between domestic market and international competition, and the relationship among various sources of knowledge, external and

internal, brings observation across national boundaries. All these merits and findings detailed our understanding that contain useful policy implications relevant to the sector, in comparison, a national IS perspective concentrates more on the aggregate level of national production and innovation systems. We contend that sectoral and national IS approaches are better employed in a complementary way. Analysis of a national IS has to embrace the study down to representative sectors, and analysis of a sectoral IS has to keep a view of the national IS as important background.

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