RECENT DEVELOPMENT OF VEGETABLE PRODUCTION IN CHINA

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ABSTRACT

Vegetable production has made rapid progress in recent decades.

1. Both production area and total production of vegetables increased markedly. In 1988, the total production reached 157.5 million tons with a total planted area of 3 million ha. The average consumption per capita was 134.2 kg (total including watermelon).

2. Different types of production under protected cultivation have developed fast since 1978-1988, and the total area increased from 16,000 ha to 112,700 ha, hence the improvement of the vegetable supply to the northern cities.

3. Considerable changes have taken place in the raising of seedlings. Traditional backward instruments and methods used by farmers for small scale production have been gradually replaced by large scale and automated methods using electric heating cables for increasing the soil temperature.

4. In addition to the improvement of production conditions in suburbs of large cities, there are five commercial vegetable production centers in different parts of China. The products are transported to the cities with a shortage of vegetables in different seasons to improve the supply situation of vegetables. At the same time, the conditions of transportation and storage of vegetables have also improved to some extent.

5. For the development and stability of vegetable production, research on vegetables is being promoted. In addition to progress on production under protected cultivation, the methods for raising, vegetable transportation and storage have also been improved. Major achievements have been obtained in the breeding of new cultivars, disease resistance breeding, pest and disease biological control, soilless culture, etc. Although a great deal of progress has been made, compared with developed countries, both equipment, techniques and research lag behind and there are still many problems that remain to be solved, mainly :

a. Continue to stabilize and increase production of vegetables per ha.
b. Enhance IPM for pest and disease control.
c. Accelerate post-harvest handling and improve vegetable supply in the cities all the year round.

Basic considerations on vegetable production in China

Vegetables are among the most important food products especially fresh produce, for the Chinese people. The history of vegetable production in China dates back to more than 3000 years. According to the statistics, more than 209 species and varieties belonging to 31 families are produced all over the country. In general, every large city cultivates 80~90 species belonging to 22 families.

In 1988 the area of vegetable production nationwide exceeded 3 million hectares, the total production amounted to 157.5 million tons, and the average vegetable consumption to 143.2 kg per capita per year. The rural population which accounts for 80% of the total

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population in China produces vegetables for its own consumption and not for the market. Commercial vegetable production only supplies urban residents who account for 20% of the total population. As the post-harvest handling and transportation conditions of vegetables are not adequate, most of the commercial vegetable production sites which are located in city suburbs supply vegetable to the local residents. The small amount of vegetables produced in a special site for long distance transportation to supply different cities all over the country, plays a role in regulating the vegetable supply. The vegetable production area in the suburbs of the 35 main cities in China which covers 171,000 ha with a total production of more than 8.99 million tons supplies vegetables to 58.65 million people (average consumption of 153.3 kg year per capita).

Before 1980 the farmers produced vegetables based on plans drafted by related units of government. All the produce was sold to the State Vegetable Company, and then to the city dwellers. The price of vegetables was controlled and managed by the government. The relationship between the production and marketing in recent years has changed. A contract for selling about 60% of the production to the State Vegetable Company is signed. Thereafter the vegetables are sold to the city residents, and the rest (40%) is sold by the farmers themselves in the market.

Four systems relating to vegetable production, i. e. research, technical extension and education have been established in China.

1 Vegetable production system

In addition to the officers of the Ministry of Agriculture who are in charge of vegetable production, the government of every main city has established some special departments for vegetable production guidance, such as vegetable office or division, with the following duties : planning of vegetable production, organization for the implementation of the vegetable production plan, information about vegetable production conditions on time, assistance in solving the problems of production, etc. They also deal with the vegetable supply, and coordinate activities with the Vegetable Company to supply vegetables regularly all the year round.

2 Vegetable research system

This system consists of vegetable research institutes, at different levels. The Institute of Vegetables and Flowers, Chinese Academy of Agricultural Sciences is operated by the government. There are also 24 provincial Institutes of Vegetables and 99 belonging to the prefectures. Their main task is to carry out research on vegetables.

3 Technical extension system

It consists of technical extension stations and experimental stations at different levels. General Agricultural Technical Extension station set up by the central government is under the supervision of the Ministry of Agriculture. Every province and important city set up their own agricultural technology extension station as well. Their main task is to introduce new cultural methods and traditional methods of production to farmers, and providing technical advisory services including, technical training etc. Every township has its own experimental station for extension work and some trained farmers work there. The main task is to propagate seeds of good vegetable cultivars and demonstrate new cultural methods.

4 Vegetable science education system

There are 25 agricultural universities or colleges which have set up a department of horticulture or are specialized in vegetable production for training high-ranking technical personnel dealing with vegetable science. Besides, some provinces and large cities have established agricultural high schools for the training of technicians specialized in vegetables.

These four systems are closely related in order to enhance vegetable production.

Table 1 Comparison of vegetable area, yield and production in China in the past decade

Year	Area(1,000 ha)	Yield(kg/ha)	Production (1,000 tons)
1978	1665	45000	74923
1987	3000	52500	157500

Table 2 Percentage of increase of area, yield and production of some main vegetables in the past decade

Vegetable	Increase %		
	Area	Yield	Production
Cabbage	7.7	19.7	28.5
Cauliflower	24.0	8.7	35.4
Tomato	17.3	10.3	29.3
Eggplant	11.6	32.3	47.2
Pepper	11.6	26.6	41.2
Cucumber	12.1	25.0	39.6
Pumpkin	17.7	25.9	49.0
Onion (dry)	12.3	21.3	36.0

Table 3 Increase of vegetable production area under structures (ha)

Year	1978	1987	+,−(%)
Glasshouse and plastic greenhouse	5,300	34,000	+538
Middle and small plastic tunnel	10,670	78,666	+637
Total area	16,000	112,666	+604

Expansion of vegetable production in the past decade and current problems

1 A large increase in the area, yield and production of vegetables in China was recorded from 1978 to 1987 (Table 1).

In the past decade, the area, yield and production of some main vegetables have increased. The proportion of increase is as follows (Table 2):

2 A rapid development of vegetable production under structures has been observed in the past decade. The area of vegetable production under structures during the period 1978 to 1987 is as follows (Table 3) :

The main reasons for the rapid development of vegetable production under structures are as follows :

(1) The arable land of China is limited, accounting for only a little more than 1/4 area of the world average. As the yield of vegetables under structures is two fold higher than that in open field, land for vegetable production can be saved.

(2) Due to the long cold season with low temperature in the northern, north-western and north-eastern parts of China, the supply of vegetables is difficult. Vegetable supply in early spring and late autumn can be improved through the promotion of vegetable production under structures.

(3) The most important reason is the difference in prices between seasons and high yield that can be achieved. The net income from vegetable under structures is 2~3 fold higher than that in open field. Therefore the farmers like to produce vegetables under structures.

Areas where this type of cultivation is developing fast include Henan, Anhui, Jiangsu, Hebei, Shanxi provinces and the cities of Beijing and Tianjin. They account for 79.2% of vegetable cultivation in China. In the central and lower regions of the Yellow River (plain at 32°~37° N. Lat.) the soil is good, transportation is convenient and light-heat

resources are abundant. This region will be developed to promote vegetable production under structures.

The technique of plastic mulching introduced from Japan since 1978 was applied over more than 260,000 ha in 1988 due to its convenience and high yield obtained. The main crops include tomato, cucumber, eggplant, pepper, cabbage, bean and spinach for spring mulching, Harvest takes place 10~20 days earlier than in open field with a yield increase of more than 20%.

3 Raising of vegetable seedlings is gradually shifting from the scattered traditional backward type to a larger scale using automatic control heating cable. In the traditional raising of vegetable seedlings simple facilities were used, cold bed frames were covered with plastic film and seedlings had a long growing period. However under continuous cold and cloudy weather, healthy seedlings could not be raised and they experienced severe damage. In the mid-1970s Shanghai attempted for the first time to use temperature controlled heating cable for increasing the soil temperature in seedling raising. This method which has been gradually improved since 1980 is becoming more popular in central and northern China. Seedling raising is gradually shifting from individual small scale operation to large scale specialized operation. For example, in Wuxi city, Jiangsu Province, the total area devoted to vegetable production was, 1,066 ha, and in the spring season, 1/3 of the area for cultivation of fruiting vegetables. The total of 22 million vegetable seedlings required was according to this method and the seedlings were then sold to the farmers. This method spread rapidly to Beijing and Shanghai municipalities, as well as Jiangsu, Shandong, Shanxi, Hebei, Liaoning Provinces and Inner Mongolian Autonomous Region.

Such a method of seedling raising which is superior to the traditional one, still lags behind those adopted by developed countries. In Beijing municipality two townships introduced automatic Seedling Vegetable Seeding Machines from the United States and used them for seedling raising. A vegetable seedling demonstration station has been established by Beijing Agricultural Technology Extension Station in collaboration with the EEC in order to supply equipment and promote technical assistance. This project will be completed and put into operation in the near future.

4 Commerical vegetable production base area has been established to some extent.

Urban vegetable supply mainly depends upon city suburb vegetable production. The defects of this type of supply are associated with the limitations of the local climate. At present there are five commercial vegetable production base areas in China, to compensate for the local market shortage. These vegetables are transported to the different parts of cities all over the country. The base areas are as follows :

(1) Vegetable production base area for transport to northern China cities :

This base area includes five provinces, i. e. Fujian, Guangdong, Guangxi, Yunnan and Sichuan. Most of these areas are located in the subtropical zone which is the "natural greenhouse" of China. The main crops produced in winter are pepper, cucumber, tomato, snap bean, cauliflower and eggplant, etc. for long distance transportation to supply residents in northern cities of China. About 1 million tons of vegetables are transported each year.

(2) Huihai vegetable production base area :

The center of this base area is Xuzhou city in Jiangsu Province. This area includes the northern part of Anhui Province, eastern part of Henan Province and southern part of Shandong Province. The vegetables produced in winter are celery and spinach mainly for the cities of north-eastern China. Tomato, eggplant, pepper and cucumber, etc. produced in early spring are mainly transported to the cities of northern and northeastern China. The quantity of products transported is about 1 million tons per year.

(3) Northern China Chinese cabbage production base area :

This area which includes the two provinces of Shandong and Hebei mainly produces fall Chinese cabbage to supply some large cities. The amount of products transported is about 600,000 tons per year.

(4) Zhangjiakou summer-fall vegetable production base area :

In this area which is located in the northwestern part of Hebei Province, the cool summer climate enables the production of tomato, pepper, snap bean, to supply Beijing, Tianjin and the northeastern cities in summer and autumn off-season. Amount of products transported is about 200,000 tons per year.

(5) West corridor of Yellow River vegetable production base area :

This area which is located in the center of Gansu Province, mainly produces cabbage and onion, to supply large cities in the eastern part of China. The amount of products transported is 200,000 tons per year.

The above five commercial vegetable production base areas supply nationwide about 3 million tons of vegetables every year. For a developing country, this amount of vegetables is rather high. In order to decrease the amount of loss during transportation, experiments have been carried out by scentists, experienced farmers and workers, leading to the improvement of the conditions of transportation and storage.

5 Research has significantly contributed to the sustained development of vegeoable production. The main contributions in the past decade are as follows :

(1) Use of heterosis and new cultivars for breeding vegetable crops :

We have developed cabbage and Chinese cabbage accessions with self-incompatibility, genic male sterile Chinese cabbage, all female cucumber, radish and pepper male sterility lines and maintainer lines, etc. Methods for the production of vegetable F_1 hybrid seeds have been developed. In the past decade we had bred 20 species including 400 F_1hybrid cultivars, which are cultivated over an area of 270,000 ha and mean production increased by 10 to 30%. Using conventional breeding methods we bred some cucumber cultivars which are grown over 80% of the total cucumber production area. Biotechnology procedures have been used for vegetable breeding. We used the anther culture method to promote sweet pepper breeding. As a result, three sweet pepper cultivars have been released and distributed all over the country.

(2) Breeding of vegetable crops resistant to diseases :

We identified the strains and types of viruses affecting tomato, sweet pepper, cabbage, Chinese cabbage, etc. and evaluated different strains of TMV, CMV and TuMV. New tomato cultivars with high resistance to TMV and tolerance to CMV as well as cucumber cultivars with multiple resistance have been bred. Besides, methods of diagnosis of Phytophthora and Fusarium diseases of cucumber were developed.

(3) Exploration, collection and evaluation of germplasm of vegetable crops are being promoted and 17,000 accessions were classified, of which 11,200 accessions have already been deposited in national gene banks for long term storage, and the rest will be completed by 1990.

(4) Studies on methods of cultivation of vegetables under structures have enabled to develop techniques for high production of cucumber and tomato in plastic greenhouses. In order to prevent the occurrence of soil-borne diseases during continuous cropping, many institutes cooperated in the development of research on soilless cultivation methods which have been already used for commercial vegetable production.

(5) In addition to the breeding work on disease-resistant cultivars, research on pest and disease control methods is being promoted, i. e. integrated control methods for black rot of Chinese cabbage, etc. Through research on biological control, *Bacillus thuringiensis* and *Pieris rapae* L. granulosis virus (PrGv) were used and found to be effective in the control of *Pieris rapae*. The use of *Encarsia formosa* to control the white fly in the greenhouse is effective too.

(6) Research on post-harvest physiology involves the identification of optimum temperature for the storage of cucumber, snap bean, pepper and tomato. By putting ice into the van combined with natural ventilation, long distance transportation of vegetables by rail was improved with a loss decrease of about 10~15%. For the development of the processing industry, the Institute of Vegetables and Flowers, Academy of Agricultural Sciences, bred a series of tomato cultivars suitable for processing, such as red Agate, etc.

6 Main problems in vegetable production

The main problems are as follows :

(1)The average yield of vegetables per ha per year is low, i. e. only 5.25 tons. Yield of tomato was 67% that of the world average figures and cabbage, 73.8%. These figures are even lower compared with these of the developed countries. Research on vegetable cultivation is hampered by the lack of both facilities and technical personnel. Vegetable production is still depending largely on farmers' experience, and less on scientific modern techniques.

(2) Strengthening of IPM (Integrated Pest Management) :

The damage caused by pests and diseases in vegetable production is increasing year by year and accounts for about 15~20% of the loss of vegetables. Due to the lack or low quality of chemicals, some pests and diseases can not be controlled on time. Also due to the lack of variety in the chemicals, pathogens or insects become rapidly resistant to the chemicals. Control of greenhouse white fly and tomato nematode, black spot of Chinese cabbage and scab of cucumber, etc. is still limited. Mechanical devices for pest and disease control are not modern. It is thus essential to strengthen IPM for effective control of pests and diseases in vegetable production.

(3) Vegetable supply to urban residents all the year round is still a problem to be solved and commercial vegetable production base areas will have to be further developed. In the off-season, a larger amount of vegetables is transported to the cities. In this regard, although production can be secured, post-harvest handling and long distant transportation are difficult. At present the main means of transportation are trains and the amount of vegetable transported exceeds 3~3.5 million tons every year. Due to the lack of pre-cooling facilities, vegetables are loaded directly at high temperature. Vans with refrigerator can only transport 20% of the vegetables, the rest (80%) being transported with an ordinary van, using ice placed in the package when the ambient temperature is high and coldproof materials as cover. Therefore optimum temperature can not be controlled. During the transportation, about 25~35% of the vegetables decay. Trains can only transport vegetables over long distances. For distances within a 1000 km radius trucks are used. How to preserve vegetables during transportation with trucks, is a major problem in China.

Discussion

Henry, G. (CIAT) : Is the share of Chinese cabbage which is an important vegetable in China accounting for 57% of daily consumption per caput, declining in favor of other vegetables such as fruit or flower vegetables in terms of consumption and production in China?

Answer : It is a difficult question. In the northern part of China winter is very cold and lasts almost 6 months. During that time fruiting vegetables can only be produced in greenhouses or transported from South China. Such vegetables are thus very expensive. On the other hand Chinese cabbage can be easily stored and is affordable to most people. Therefore it is likely to remain a very important vegetable in China. In the southern part of China, Chinese cabbage is not very important.