

Present Situations and Future Prospects of Sericulture in China

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This paper has reviewed the China Sericulture history in the 20th century. On the basis of the current sericulture production, sericulture area distribution, problems and challenges, it has been forecasted that China sericulture will be developed as following points: 1) On a stable basis, cocoon production increased gradually to a suitable amount; 2) Quality cocoon production bases established to form a regionalized, industrialized and specialized sericulture structure; 3) With increase of householding rearing capacities, rearing facilities improved; 4) Production efficiency raised and silk product quality improved through technical innovation; 5) New and diversified products developed from Sericultural resources with new and high technologies.

Key words : China sericulture, Silkworm

Introduction

Sericulture has long history with more than 5000 years in China. China is now quantitatively advantageous in the world sericultural production and in international silk market and has a considerable development potential.

In the 20th century, China sericulture underwent an up-down-up process of development. In 1913, the world raw silk production was 39.6 thousand tons, to which China contributed 47.8% and Japan 35.5%. It indicated that in early this century, China was in the first position quantitatively in the world sericultural production. By the year of 1929, the world raw silk production increased to 70.9 thousand tons, of which 61.9% was produced in Japan and

28.6% in China. Up to 1949, the cocoon production declined to 30.9 thousand tons in China due to the war.

Since the foundation of the new China, the government has been attaching continuous importance to the restoration and development of sericulture production. With 20 years of efforts, China outstripped Japan in the yield of cocoons and silk, and become the largest country again in sericulture by 1970s.

From 1980s to the first half of 1990s, cocoon production increased gradually and the cocoon yield surpassed 650 thousand tons in continuous four years from 1992 to 1995. The sericulture production was covered in all over the country except Qinghai, Tianjin and Tibet. There was one farmer family in every ten and one county in every two practicing sericulture as a sideline cottage industry with total 18 millions of farmer families engaged in sericulture activities in 1100 counties.

Because the cocoon yield increased every year, the production surpassed the demand and the cocoons were overstocked. This led to the decline in cocoon price from the second half of 1995, resulting in substantial decrease in cocoon production to 400 thousand tons in 1996. From 1996, the government took measures to regulate the sericulture industries including cocoon production, reeling and weaving. It is therefore the cocoon production was maintained 400-450 thousand tons from 1996 to 1999. The cocoon yield is also expected to be more than 400 thousand tons in 2000.

At present, there are 600 thousand hectares of mulberry, 15 million boxes of silkworm eggs (25 thousand eggs per box) are distributed for rearing to produce 400 thousand tons of fresh cocoons yearly. There are more than 1700 reeling and weaving enterprises with about one million staff and workers to produce more than 50 thousand tons of raw silk, output value of about 70 billion RMB Yuan (1US\$ = 8.3 RMB). 3 billion US dollars can be earned by exporting cocoons, raw silk and silk fabrics. Both the production and exporting trade of cocoons, silk and silk fabrics are taking about 70% of the world total.

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Sericulture areas

Generally sericulture areas of China can be classified as Yangtze river, Yellow river and Pearl river valleys or as East China (Zhejiang, Jiangsu, Shandong, Anhui), South China (Guangdong and Guangxi), Southwest China (Sichuan and Chongqing) and North China (Shaanxi). In the East China, the mulberry trees are planted acre by acre with Husang mulberry which are pruned as medium trunk form. In the South China the mulberry trees are planted acre by acre with Guangdong mulberries which are pruned as lower trunk form. In the Southwest China the mulberry trees are planted around the roads, ditches and farmer houses. In the North China, the mulberry trees may be planted acre by acre or inter-planted with some other crops.

As the statistics of cocoon production in 1998, the total cocoon production in China was 445.7 thousand tons, of which 278 thousand tons (62%) were produced in Zhejiang, Jiangsu and Sichuan Provinces, 79.8 thousand tons (18%) produced in Shandong, Anhui and Congqing Provinces/City and 56.2 (13%) thousand tons in Guangdong, Shanxi, Guangxi and Hubei Provinces. That means 414 thousand tons of cocoons (93% of the national total) were produced in the above ten provinces/cities. The details are listed respectively in Table 1.

Production technology

Mulberry cultivation

China is rich in mulberry germplasm resources. The cultivated varieties are mainly belonged to *Morus multicaulis*

Table 1. Cocoon production of ten major Provinces

Provinces/Cities	Cocoon yield (Tons)	Ratio to national total (%)
Zhejiang	104,000	23.33
Jiangsu	88,400	19.83
Sichuan	85,592	19.20
Shandong	28,720	6.44
Chongqing	26,349	5.91
Anhui	24,700	5.54
Guangdong	15,000	3.37
Shanxi	14,023	3.15
Guangxi	13,940	3.13
Hubei	13,265	2.98
Total	413,989	92.88

perr. such as Hu mulberry, and secondly to *Morus alba linne* and *Morus atropurpurea raxb.* Since 1970s, hybrid mulberry varieties were bred out and popularized in the Zhujiang and Changjiang river valleys. Mulberry plants are mostly grown in orchard type, while grown along road and around cultivated land in Sichuan and other provinces. The mulberry trees of orchard type are dense-planted with medium to low stem, in which 1500-2000 Kg of leaves can be harvested from one *mu* (30000 Kg/hectare) in a year.

Since 1970's, the hybrid mulberry races "Zhongsang 5801 × Yu 82" and "Sha 2 × Lun 109" have been extended quickly in China because F1 mulberry seeds can produce more seedlings which no need to be grafted. Meanwhile the F1 mulberry leaves can be harvested and used to rear the silkworm in the first planting year. Generally, the F1 mulberry seedlings output is increased by 3-4 times and the leaf output is increased by 40% in the first 3 years after planting the mulberry compared with the control race "Husang mulberry".

Silkworm rearing

Countywide cooperative incubation of eggs and village-wide cooperative young silkworm rearing are being practiced. The young larvae of 3rd instar are distributed to individual farmers. In some well-organized areas, disinfection of rearing rooms and control of mulberry diseases and pests are conducted collectively. Silkworms are reared in a hot-ground chamber in which the temperature and humidity are easily controlled by indirect heating technology and the rearing bed is covered with plastic film, 2-4 feedings a day. The widely used mountages are paper-board cocooning frames, plastic mountages and centipede-like straw cocooning frames. Harvested fresh cocoons are sold to silk companies for drying and processing.

Silkworm varieties

New silkworm varieties should be certified either at national level or provincial level before extension. The technical system for silkworm egg reproduction has been established, i.e. Three grade multiplication and four grade egg production system for great grandparent, grandparent, parent and hybrid eggs. F1 hybrids of bivoltine white cocoon varieties have been popularized. Since the foundation of new China, practical silkworm varieties have been renovated four times, once almost every ten years, and the biological and economic characteristics of silkworm varieties reached a higher level as showed in Table 2.

To strengthen the silkworm egg production management, the silkworm seeds are controlled by the provincial government company which is in charge of the silkworm

Table 2. Renovation of silkworm varieties in China

Seasons	Varieties	Years	Larva-pupa Survival ratio (%)	Cocoon Shell per 10000 larvae (Kg)	Cocoon Shell Percentage (%)	Length of Cocoon Filament (m)	Raw silk Percentage (%)
For spring rearing	Yunhan × Huajiu	1950s	96.68	4.457	19.88	1055	14.95
	Su16 × Su17	1960s	98.10	4.808	22.85	1252	17.21
	Dongfei × Huahe	1970s	97.85	4.958	23.48	1205	18.48
	Su5 × Su6	1970s	98.04	5.254	25.30	1381	19.35
	Qingsong × Haoyue	1980s	96.27	5.575	25.32	1427	20.45
For autumn rearing	Yunwen × Huashi	1950s	82.51	3.328	19.52	948	14.05
	306 × Huashi	1960s	84.19	2.753	19.36	975	14.84
	Dong34 × Su12	1960s	87.00	2.746	19.38	901	14.28
	Su3Qiu3 × Su4	1970s	82.75	2.915	20.58	997	14.67
	Furong × Xianghui	1980s	94.62	3.480	23.32	1106	17.28

egg quality control including egg quantity, good egg percentage, hatchability, hybrid percentage *et al.*

At present, the cocoon production per box of eggs is 30 Kg and that per hectare of mulberry field is 750 Kg on a national average. The losses caused by the diseases are controlled by less than 10% and only 5 hour man power is needed to produce 5 kilogram of the cocoons.

Tasks in the future

China is a biggest sericulture production country, but not a silk qualified producer. Comparison with advanced silk produced countries, China has many drawbacks including: silk finishing technology is not so good, lack of the famous brand in the world silk garments markets, silk fashion color, design are behind of the trend. Meanwhile, the sericulture farmer size is too small, sericulture equipments are too simple, productivity is lower, cocoon quality is not satisfied enough to the silk reelers / weavers. Therefore, to improve the silk quality, we must:

Enlarge the scale of silkworm rearing

Now, average area of mulberry field per silkworm rearing farmer family is less than one *mu* and average amount of eggs reared per family less than two boxes. This small engagement has hindered the improvement of rearing facilities, the application of new technologies and increase in production efficiency.

Transfer sericultural areas to western part of China

With industrialization and urbanization, sericultural production is declining eastern and coastal areas. It is, there-

fore, necessary to transfer the sericultural production and processing from the eastern part to the middle and western part in well-planned steps.

Improve cocoon quality

Due to the small scale of silkworm rearing per farmer family but wide distribution of sericultural areas, the cocoon grading and pricing system of Cocoon Pricing Based on Reeling could not be implemented properly and the cocoon quality is not so good. The ratio of reelable cocoons is low (85-90%), the reelability unstable (50-70%) and the raw silk percentage is not high (12-15%). The raw silk from these cocoons is mostly in 2-3A grade and small quantity in 4A grade. These are not suitable for the modern high speed weaving machineries.

Accelerate technical innovation for silk industries

Technical equipment in silk enterprises in China is generally still in a lower level, about half of the equipments were made or imported in late 1970s. With the under-advanced equipments and technologies, the silk products are mostly medium to low graded.

Development prospects

Sericulture is a good industry with economic, social and ecological benefits. In the next century, sericulture still has a splendid future because following 3 major reasons: 1) the population increases quickly in the world; 2) a lot of energy consummation especially with the oil source decrease will limit chemical fiber production; 3) with the ecological trend development in the world,

more and more people will like nature fiber; China, as the biggest silk production country, still has a potential to develop silk industry in the future, especially in recent time, we must pay more attention to:

On a stable basis, cocoon production increased gradually to a suitable amount

The government is designing the Tenth Five-Year Plan. As personal ideas, it is advisable to develop the area of mulberry field to 10 million *mu* (650-700 thousand hectares) and the cocoon production to 500 thousand tons in the near future.

Quality cocoon production bases established to form a regionalized, industrialized and specialized sericulture structure

It is advisable to regionalize the silkworm rearing to suitable areas and to stabilize major production areas, to develop the primary process of cocoons such as drying and reeling in the western developing areas and to improve the silk processing, such as weaving and its onward processing in the eastern and coastal areas, so as to form a relatively specialized structure of the sericultural industries.

With increase of householding rearing capacities, rearing facilities improved

As the sericultural production is regionalized, the cooperative rearing and the management will also be further developed in major sericulture areas. With the increase in rearing scale per family and the development of cooperative rearing, the facilities and technologies for sericulture will be improved and standardized.

Production efficiency raised and silk product quality improved through technical innovation

Emphases should be placed on the development of automatic reeling machines, shuttle-less weaving machines and advanced production lines for dyeing, so as to automate the production process and raise the level of processing technologies.

New and diversified products developed from sericultural resources with new and high technologies

As far as known, during silkworm rearing process, a lot of the by products are produced. It was guessed that the

mulberry branches contained 44% of the dry materials and the mulberry leaves 56% in which 36% are taken by the worm, 20% are mulberry wastes. Furthermore, in consumed leaves, we found the 22% of the dry contents goes to silkworm litter, 3% goes to the pupae and 3% goes to cocoon.

For the main products of sericulture, it is necessary to develop both long and short silk products, both shuttle weaving and knitting products and both pure silk and composite silk products. At the same time, the by-products of sericulture such as mulberry shoots, fruits and leaves, silkworm faeces, pupae and waste silk will also be processed and utilized with new and high technologies, for example, cultivation of edible fungus on mulberry shoots, mulberry fruit drinks, mulberry tea, chlorophyll from silkworm faeces, silkworm larval powder, BmNPV (*Bombyx mori* nuclear polyhedrosis virus) as bio-reactor to express foreign genes, pupae protein, silk powder etc. The sericulture will be the industries of multilevel and multi-utilization in the future and its economic benefit and market competitiveness will be further increased.

Conclusion

The ancient Silk Road facilitated the exchanges between China and other countries in the world. Nowadays, the opening China would like much to cooperate with foreign countries with the silk as links. In the field of sericulture, we would like to cooperate with colleagues of Korea, Japan and all other countries in every possible form to develop the silk industry and sericultural culture.

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