

Present Situation and Prospects of Sericulture in China

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Since 1970, China has become the biggest cocoon producer in the world, and made the highest historical record of cocoon output for 759,800 tons in 1995. However, in 1996 cocoon production reduced sharply to 470,900 tons. After a ten-year adjustment and reform, sericultural areas have shifted from developed regions to developing regions and from the east to the west. From 2000, the cocoon output has started to increase restoringly. By 2004 it recovered to 547,091 tons. With the development of market economy, sericulture management has been changed, including mulberry fields concentrated to the specialized households and cooperatives, cocoons produced in larger scale instead of individuals. Silkworm egg producing enterprises gradually changed into non-governmental joint-stock ones. The mechanism of market cocoon price has been gradually established. The management model of combination of trade, industry and agriculture is pushing and improving. It is the fruit of modern science and technology, especially sericultural basic research, that provides China's sericulture with the opportunity and vital force. China's sericulture, therefore, will continue to develop steadily in future.

Key words: China's sericulture, *Bombyx mori*, Sericulture economy

Introduction

Since the 1950s, more attention had been paid by the Chinese government to sericultural education, research and

production (Lü, 1995). Sericultural science departments had been set up in many agricultural universities and colleges in China, such as Zhejiang Agriculture University, South China Agriculture University, South West Agriculture University and so on. In 1951 the East China Sericultural Research Institute (now the Sericultural Research Institute, SRI) was established. Thereafter 20 provincial sericultural research units were set up one after another. As a result, the sericulture research team increased greatly. And F₁ hybrid silkworm eggs were applied speedily all over the country. At the same time, sericultural technical guiding stations were set up in counties and main towns of sericulture areas to provide farmers with techniques and service of silkworm egg incubation. So that China's sericulture recovered rapidly and developed continually. By the year of 1970 the cocoon output of China reached to 121,500 tons exceeding that year's of Japan (111,736 tons)(SRI, 1984), being the biggest cocoon producer in the world. During 1979 to 1995 China's sericulture obtained the most speedy development. In 1995, China made the highest cocoon output record for 759,800 tons (Gu, 2003).

However, from 1996, China's sericulture decreased sharply. The cocoon output increased fast, while the consumption of silk products did not increase led to the depression of cocoon price seriously. On the other hand, the quick development of national economy resulted in the lower comparative benefit of sericulture. So that lots of farmers left sericulture for other crops or went to cities to make money. In 1996, the cocoon output of China reduced to 470,900 tons and in 1999 only 398,400 tons (Fig. 1)(Gu, 2003; Wang, 2004).

Present Situation of Sericulture in China

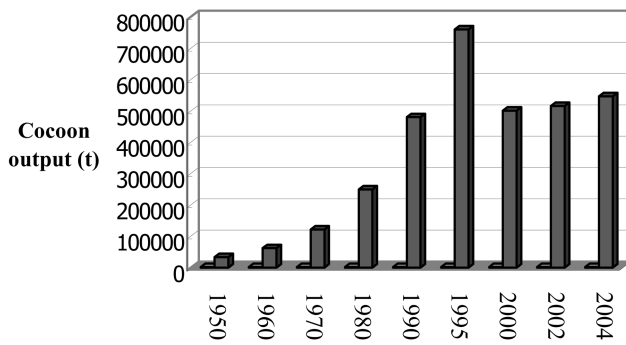
Distribution of sericultural area

The southeast region of China along the coast had been

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(Data cited from the Silk Yearbook of China)

Fig. 1. Changes of cocoon output since 1950's.

the largest sericultural area producing more than half of total cocoons. With the speedy development of economy, sericulture revealed lower comparative benefit here and has been diminishing. In Zhejiang province, for example, the cocoon output was 116,700 tons in 1995, but by the year of 2003 only 79,110 tons left. Meanwhile, in the developing regions sericultural areas are expanding because of its comparative benefit and stable income. For instance, in Guangxi autonomous region mulberry fields and cocoon output increased rapidly in the recent few years from 17,333 hectares and 14,000 tons in 1995 to 86,667 hectares and 72,500 tons in 2004. Within a province, sericultural area redistributed in the same way, that is from the advanced region to developing ones. Jiangsu province can be the case of this. In the southern part of Jiangsu, which was the one of the most developed sericultural region in the past and now there are few mulberry fields (China Association of Silk, 2004). While in the northern part sericulture is increasing stably. Guangdong province has successfully transferred sericultural area from the Pearl River delta to the mountain areas by the end of 20th century and its cocoon output almost kept the same as before (Sun, 2005).

The statistics showed that China's sericultural areas

have been transferred from the developed region to the developing region and from the east to the west during the adjustment of economy structure. By the year of 2004, there were 781,107 hectares of mulberry fields and the largest 11 provinces were listed in the Table 1.

Cocoon output

In 1996, the cocoon output dropped down sharply. Thereafter sericulture in China came into the adjusting period. And by 2000 year it began to increase restoringly. The statistics revealed that the cocoon output of China was 547,091 t in 2004. The changes of cocoon output of the main producing provinces in different ages were as listed in the Table 2. The cocoon output of Guangxi autonomous region increased about 7 times from 1995 to 2004. And Yunnan and Hubei provinces showed an increasing state too. But in Jiangsu, Zhejiang, Sichuan, Shandong and Anhui provinces cocoon outputs were reduced by 20% to 50% unequally. In Hunan province cocoon output reduced the most (by about 80%). While in Guangdong and Shanxi (Xi'an) provinces, cocoon output kept the same level of 1995.

Raw silk output

The changes of raw silk output of China corresponded to the cocoon output. From 1951 to 1995 year, raw silk output increased continuously, by 1995 it reached 77,900 tons creating the historical record. During period of 1996 to 2000, raw silk output reduced sharply. In 2000 it only 51,278 tons reduced by 34.17 than that in 1995. Since 2001 raw silk output began to restore. And in 2003 it restored to 84,615 tons. The changes of raw silk output of the world are revealed in Table 3.

By 2003, the amount of silk enterprises of state-operated and of non-state-run with higher than 5,000,000 yuan of sales per year was 1,867, including reeling factories, spun silk mills, silk weaving factories, silk dyeing and printing factories. The total number of reeling ends was 1987,120 in China (China Association of Silk, 2004).

Table 1. Mulberry fields of the 10 larger provinces in 2004 (hactares)

Province	Sichuan	Jiangsu	Guangxi	Zhejiang	Anhui	Shanxi (Xi'an)
Mulberry field	133333	96667	86667	75067	45333	45333
Percentage	17.07	12.38	11.10	9.61	5.80	5.80

Province	Yunnan	Shandong	Henan	Guangdong	Hubei	Total
Mulberry field	41333	40000	22000	21333	21333	781107
Percentage	5.29	5.12	2.82	2.73	2.73	100

(Data provided by the China Association of Silk)

Table 2. The changes of cocoon output in the main sericulture provinces (ton)

Region	1950	1960	1970	1980	1990	1995	2000	2002	2004
Total	33720	62370	121500	249850	480179	759800	454614	515885	547091
Jiangsu	7680	9890	23800	38200	120021	145500	95600	10000	112000
Guangxi	/	100	700	1800	7432	14000	26000	57750	95000
Sichuan						155850	73012	77823	82500
Chongqing	5360	13500	25750	91750	143448	21887	28270	27450	23820
Zhejiang	11600	21350	41250	65000	117975	116700	93500	98796	84112
Shandong	1625	1450	1650	10500	13725	42677	36458	43019	34580
Anhui	185	1125	1900	4800	18840	44900	24615	25620	27100
Guangdong	5615	665	18050	21650	25488	25000	17500	28000	27000
Yunnan	90	250	450	700	2482	8100	8510	10000	18500
Shanxi	315	1355	1600	2850	9504	16586	15500	14878	16360
Hubei	775	1400	1800	5700	7007	2000	13000	13420	12600
Henan	145	505	650	900	1343	1390	4700	5700	7373
Jiangxi	/	300	150	200	2639	13000	7100	6420	6500
Shanxi	75	975	750	1900	3323	5100	4360	3300	3550
Hunan	60	265	300	2100	2422	2690	876	495	547

(Data cited from the Silk Yearbook of China. Data of 2004 from the China Association of Silk)

Table 3. The changes of raw silk output of the world (tons)

Year	Total of the world	China	Japan	India	Brazil	Soviet Union/INU	Other countries/regions
1951	20933	2932	12916	625	96	1800	2564
1960	29263	5554	18048	1185	102	2358	2016
1970	40783	9706	20515	2319	318	3020	4905
1980	54492	23485	16154	4593	1170	3358	5732
1990	71654	42973	5721	11486	1694	4092	5688
1995	102365	77900	3229	12884	2466	1869	4017
2000	72011	51278	557	14432	1389	1715	2233
2002	95650	73585	391	14617	1607	2050	3400
2003	/	84615	288	13970	1563	/	/

(Data cited from the Silk Yearbook of China. Data of 2004 were from the China Association of Silk)

Management Scale and Models

Scale of silkworm rearing in farmer's

At present sericulture is still engaged as a supplementary trade to most farmers. For example, in Zhejiang province an average sericultural family held only 1033 square meters of mulberry field, fed 3.59 boxes of silkworm eggs and producing 146.51 kg cocoons (Gu, 2003). With the reform of economical system goes on and development of market economy, transformation of sericulture management is beginning. Since the labors in countryside moved to industry and cities, lots of farmers leaved their mulberry

fields. And various cooperatives of economical management are established spontaneously in villages. Fields are concentrated to the specialized households or farmer's cooperations who masters the techniques and knows how to manage sericulture. Cocoon production is developing gradually towards the orientation of larger scale with some decades or more hectares of mulberry and feeding some thousands boxes of silkworm eggs. For example, in Hanxu village Jiande city of Zhejiang province, 287 sericultural families were combined as a cooperative enterprise managing 77.3 hectares of mulberry. In 2004 it reared 3,280 boxes of eggs and produced 151 tons

cocoons with an output value of 2,810,000 Yuan (Nie, 2005).

Silkworm egg production and management system

In the times of planned economy, production and management of silkworm eggs were controlled by the national and provincial departments responsible for sericulture. With the development of economical system reform, silkworm egg producing enterprises have been gradually changed into non-governmental joint-stock ones. They produce silkworm eggs independently instead of governmental plans. But the quality inspection including pebrin inspection is still controlled by the provincial departments. By the year of 2003, there were 210 silkworm egg producing enterprises, 48 ones less than that in 2000. These enterprises produced 1,685,240 boxes of silkworm eggs (F_1 hybrid) totally in 2003. In 2004, totally 1,531,140 boxes of eggs were sold to farmers with an increase of 596,500 boxes than that of 2003 (China Association of Silk, 2004).

Business of Cocoons

Since the year of 2001, the buying and selling of cocoons has been gradually opened in order to establish the mechanism of market price. The government strengthened the supervision of quality and price to protect farmers' benefits. The combine management models with trade, indus-

try and agriculture were pushing and improving. In combine models, contracts were signed between farmers and companies on cocoon production and purchase. Thus a stable relationship between cocoon production and selling has been set up (Gu, 2003; Wang, 2004).

The National Coordination Office of Cocoon and Silk suggests a middle cocoon price every year. Then the provincial department of price confirms a suitable price in accordance with the provincial economic situation. In fact, cocoon prices are almost decided by market completely. Among many factors affecting cocoon price, the international raw silk price contributes the most (Gu, 2001). The cocoon prices of different provinces in 2004 are listed in Table 4.

Improvement of silkworm variety and cocoon quality

In the posterior half of the 20th century, silkworm variety improvement in China obtained a great progress resulting in 4-5 times of variety substitution all over the country. Since 1980 s, many varieties with excellent silk quality and high yield have been bred and put into production. The laboratory identification results of some representative silkworm varieties were shown in Table 5 (Shen, 2001; 2002).

With the development of sericultural technology, the quality of cocoons has been promoted significantly. Especially the application of partitional cocooning frames has

Table 4. The cocoon prices of main cocoon producing provinces in 2004 (Yuan/kg)

Province	Spring	Summer	Autumn	Price	
				Average	Increase above 2003
Total	16.42	13.19	16.24	15.94	2.57
Jiangsu	17.68	14.72	18.16	17.90	2.17
Guangxi	16.10	16.08	16.14	16.11	3.01
Sichuan	12.00	12.40	14.00	13.40	2.90
Chongqing	11.71	11.50	12.00	11.75	2.98
Zhejiang	18.00	13.74	16.89	17.30	2.18
Shandong	19.20	16.40	18.66	18.92	4.04
Anhui	15.12	/	16.94	15.86	1.90
Guangdong	14.00	14.74	14.64	14.62	2.69
Yunnan	17.00	/	/	15.00	3.25
Shanxi (Xi'an)	15.00	14.40	17.60	14.66	3.26
Hebei	13.40	/	13.00	13.20	0.01
Henan	19.50	/	18.50	18.10	3.30
Jiangxi	16.00	16.00	16.00	16.00	2.80
Shanxi	17.80	11.60	16.60	16.90	1.30
Hunan	13.76	/	16.68	13.68	1.72

(Data were from the China Association of Silk)

Table 5. The economical characters of silkworm varieties currently used in China

Name of variety		Cocoon weight (g)	Cocoon shell rate (%)	Filament length (m)	Non-broken filament length (m)	Reelability (%)	Neatness (Point)
For Spring	Jingsong × Haoyue	2.19	25.32	1427	1119	78.80	94.44
	Chun•Lei × Zhen•Zhu	2.14	24.95	1377	1024	74.61	95.46
	Zhongqiu × Jinleng	2.13	25.86	1378	1154	83.89	94.48
For Summer and autumn	Su•Ju × Ming•Hu	1.83	23.25	1198	887	74.02	94.58
	871 × 872	1.87	23.63	1259	920	72.88	94.81
	Qiufeng × Baiyu	1.77	21.51	1046	752	71.72	95.13
	9•Fu × 7•Xiang	1.77	21.42	1072	747	69.60	91.67

(Data cited from the Sericultural Group, National Committee of Crop Variety Examination and Approval)

resulted in high reelable percentage and better reelability of cocoons. However, China still has a long way to go to keep up with the advanced countries in cocoon quality.

Prospects of sericulture

Through ten years adjustment and reform on scale and distribution, China has almost completed the shift of sericultural areas and the amount of mulberry fields and cocoon output are gradually tend to be reasonable. As the biggest cocoon and silk production country, China's sericulture will continue to develop steadily in future.

Firstly, the fossil energy is very limited and is reducing rapidly with the increase of population and industrialization. So that the chemical fiber production will certainly decrease in future. Secondly, silk is called "the queen of fiber" and a lot of people all over the world love it very much. For the protection of environment and care of human healthness, the requirement for silk production will increase gradually in the future.

Thirdly, the fruit of modern science and technology, especially sericultural basic research, has provide sericulture with an opportunity and vital force. The establishment of silkworm transgenic technology, development of molecular marker technology, the construction of silkworm genome draft (*Bombyx mori*), have set the solid base for silkworm breeding to improve their economic characters.

Fourth, studies on the novel utilization of sericultural products have obtained plentiful fruit. For example, using the baculovirus-silkworm bioreactors, animal medicament even human dedicine are produced. Silk is used as the material of cosmetics for its well protection of moisture. Mulberry leaves are used for producing drinks. All in all, the novel uses have not only extended the utilization of sericultural products, but increased the economic benefit.

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