

## MAIN FACTORS CONTRIBUTING TO THE INCREASE OF COCOON OUTPUT IN ZHEJIANG PROVINCE\*

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**Abstract:** Three factors contributing to the increase of cocoon output are: the cocoon output per box, the area of mulberry field, and the egg amount raised per unit area of mulberry field. These three main factors were analyzed based on the statistical data on cocoon output collected in Zhejiang Province from 1963 to 1998, and the proportions of the contribution to the increase of cocoon output were calculated by the factorization method. The results showed that the importance of the factors in increasing cocoon output was in the order: egg amount raised per unit area of mulberry field > cocoon output per box > area of mulberry field.

**Key words:** cocoon output increase, factors contributing to cocoon output.

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### INTRODUCTION

Traditional silk products export from China dominate world silk markets; totaled 42.2 billion US \$ during 1950 - 1998; and have a significant role in China's foreign trade and national economics. After China's development of sericulture techniques and the expansion of production scale, cocoon output increased very fast except for a few years. However, what are the main factors contributing to cocoon output increase? How to measure the proportion of their contribution individually? These very important problems in sericulture economics were studied by the factorization method using 1963 - 1998

cocoon output data collected in Zhejiang Province.

### METHODS

#### Objective

As one of the highest quality cocoon production provinces with the most systematically collected sericulture data among all the main cocoon production provinces (Table 1), Zhejiang Province has a long sericulture history, so its sericulture techniques were selected as representative of those of the whole country and selected as the target of the present study.

**Table 1** Yearly cocoon output in main cocoon production provinces of China(10<sup>4</sup> tons)\*

Province	1980		1985		1990		1995		1998	
	Output(%)	Output(%)	Output(%)	Output(%)	Output(%)	Output(%)	Output(%)	Output(%)	Output(%)	Output(%)
Zhejiang	6.5	26.0	8.5	25.1	11.8	24.6	12.2	16.1	10.4	24.0
Jiangsu	3.8	15.2	7.2	21.5	12.0	25.0	18.6	24.5	8.9	20.6
Sichuan <sup>a</sup>	9.2	36.8	10.0	29.8	14.3	29.9	20.3	26.7	8.6	19.9
Guangdong	2.2	8.8	2.1	6.3	2.6	5.3	3.3	4.3	1.5	3.5
Country-wide	25.0	100.0	33.6	100.0	48.0	100.0	75.9	100.0	43.2	100.0

\* Source:《CHINA STATISTICAL YEARBOOK》. <sup>a</sup> Before 1996, cocoon output of Sichuan province included that of Chongqing

### Method of measurement

Cocoon output can be resolved into three contributing factors: cocoon output per box, area of mulberry field, and egg amount raised per unit area of mulberry field; and can be expressed by the following formula:

$$\text{Cocoon output} = \text{cocoon output per box} \times \text{area of mulberry field} \times \text{egg amount raised per unit area of mulberry field}$$

Analysis of collected data on the above three factors will yield their proportional contribution to the cocoon output.

## RESULTS AND DISCUSSION

### The characteristics and trend of cocoon production in Zhejiang Province from 1963 to 1998

#### 1. Overall characteristics

The development of cocoon production in Zhejiang Province showed the following three characteristics after 1963: constant increase of cocoon output in overall trend, unbalanced developing speed in different stages, insignificant area increase in mulberry field, which showed that the increase of cocoon output mainly depended on the increase of the cocoon output per box and the egg amount raised per unit area of mulberry field.

#### 2. Characteristics and trend of different stages

In order to understand the trend of cocoon output clearly, three-year-shifting revision method was used to analyze the data on cocoon production from 1963 to 1998 (Table 2). The results are shown in Fig. 1.

In Fig. 1, the area of mulberry field changed slightly, it only increased by 29.3% compared to the maximum production year (1994) and the minimal production year (1964). But there were

significant increases in cocoon output per box, egg amount raised per unit area of mulberry field, and cocoon output. The cocoon output per box of the highest production year (1984) increased by 63.5% over that of the lowest production year (1964). The egg amount raised per unit area of mulberry field of the highest production year (1992) increased by 298.3% over that of the lowest production year (1964), and the total output in the highest production year (1993) increased by 649.7% over that of the lowest production year (1964). Analysis of the above factors show that the increase of cocoon output was mainly due to the advance of science and techniques which enhanced the cocoon output per box and the egg amount raised per unit area of mulberry field.

According to the range of output fluctuation, the changing process of 34 years can be divided into four main stages, the average growth rate per annum was 11.6% from 1964 to 1974, -2.1% from 1974 to 1977, 6.3% from 1977 to 1993, -9.1% from 1993 to 1997.

The changes of the cocoon output per box could be divided into six stages: the average growth rate per annum was 3.6% during 1964 - 1973, 0% during 1973 - 1978, 2.8% during 1978 - 1984, 0% during 1984 - 1988, -1.9% during 1988 - 1994 and 3.7% during 1994 - 1997. The statistics show that there were two fast increase stages: first from 1964 to 1973 and then from 1978 to 1984, mainly due to the development of new silkworm and mulberry varieties, the adoption of new techniques and economic policy, and also to the role of science and techniques in the process of breakthrough-stabilization-breakthrough. The year-by-year decreasing trend in fluctuation of cocoon output per box showed that the sericulture farmers had learned advanced techniques in Zhejiang Province.

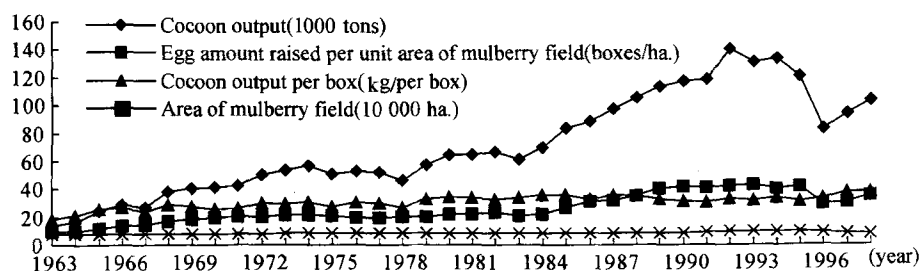


Fig. 1 Changes of the main factors and cocoon output in Zhejiang province

Table 2 Statistical data on sericulture production in Zhejiang Province (1963 ~ 1998) \*

Year	Cocoon output (1000 tons)	Eggs reared (10 000 boxes)	Cocoon output per box (kg/per box)	Egg amount raised per unit area of mulberry field (boxes/ha.)	Area of mulberry field (10 000 ha.)
1963	13.6	74.6	18.3	9.7	7.7
1964	16.6	77.9	21.3	10.1	7.8
1965	24.1	94.2	25.6	12.1	7.8
1966	29.1	108.4	26.9	14.0	7.8
1967	26.8	113.9	23.6	14.7	7.8
1968	37.9	130.2	29.1	16.8	7.8
1969	40.7	146.3	27.8	18.7	7.7
1970	41.3	158.7	26.0	20.0	8.1
1971	43.1	163.4	26.3	20.2	8.1
1972	51.0	167.5	30.4	20.4	8.1
1973	53.8	181.4	29.7	21.7	8.4
1974	57.1	185.1	30.8	21.6	8.5
1975	51.6	185.6	27.8	21.2	8.8
1976	53.1	172.3	30.8	19.7	8.9
1977	52.6	173.7	30.3	20.0	8.6
1978	46.9	173.8	27.0	20.5	8.5
1979	57.8	173.3	33.3	20.6	8.4
1980	65.0	187.5	34.7	22.3	8.4
1981	65.3	190.7	34.3	22.6	8.5
1982	67.1	203.3	33.0	23.9	8.5
1983	62.1	181.5	34.2	21.3	8.5
1984	70.2	194.9	36.0	22.6	8.6
1985	84.2	232.0	36.4	26.9	8.8
1986	89.0	268.9	33.1	31.5	8.6
1987	98.0	268.9	36.4	32.2	8.3
1988	106.0	296.8	35.7	35.8	8.3
1989	114.0	343.8	33.2	40.8	8.3
1990	118.0	372.1	31.7	42.3	8.7
1991	119.0	385.8	31.0	41.5	9.3
1992	141.0	415.7	33.8	42.8	9.9
1993	132.0	433.0	32.5	43.4	10.0
1994	134.0	411.1	34.3	41.1	10.1
1995	122.0	404.1	31.9	42.0	9.9
1996	83.7	262.7	33.6	29.3	8.8
1997	94.8	259.6	38.5	31.3	8.1
1998	104.0	288.8	38.0	35.5	8.1

\* Source: The data (1963 - 1995) comes from «Agriculture Production Statistics in Zhejiang Province» compiled by the Statistical Bureau of Zhejiang Province. The data of eggs after 1993 is adjusted according to the increase of egg amount per box.

The area of mulberry field has been relatively stable. From 1964 to 1976, its average increase rate per annum was 1.1%, -1.07% from 1976 to 1980, 0.2% from 1980 to 1988, 3.8% from 1989 to 1994, -5.8% from 1994 to 1997.

The egg amount raised per unit area of mulberry field is an important indicator of the utilization rate of mulberry field. Its changes could be divided into four stages: its average growth

rate per annum was 7.3% during 1964 - 1974, -2.4% during 1974 - 1977, 5.1% during 1977 - 1992, -5.5% during 1992 - 1997. The relatively higher increase from 1964 to 1974 was mainly due to the increase of mulberry leaf yield per unit area due more frequent application of fertilizers and the increase of rearing times per annum was due to application of artificial hatching techniques. The higher increase from 1977 to 1992 was mainly due to the great increase of

mulberry leaf yield per unit area what was caused by the popularization of new mulberry varieties such as tetraploid plants. However, panic buying of cocoons caused cocoon production to increase greatly and broke the balance of supply and demand which led supply > demand after few years. Supply > demand made cocoon price dropped down dramatically and decreased the volume of silk export which resulted in the low utilization rate of mulberry field, because many sericulture farmers gave up silkworm rearing during 1992 - 1997.

### Determination of the main factor's proportional contribution to the increase of cocoon output

The increase of output is due to the increase of: cocoon output per box, area of mulberry field, and egg amount raised per unit area of mulberry field. Here the concept of each factor's proportional contribution to increase of cocoon output is used.

Let A to be the output change of the analyzed year compared to the base year.  $X_1$  and  $Y_1$  represent the egg boxes raised and the cocoon output per box in the base year, respectively.  $X_2$  and  $Y_2$  represent the egg amount raised and the cocoon output per box in the analyzed year, respectively, then:

$$A = (X_2 - X_1)Y_1 + (Y_2 - Y_1)X_1 + (X_2 - X_1)(Y_2 - Y_1) = (X_2 - X_1) \cdot 1/2(Y_1 + Y_2) + (Y_2 - Y_1) \cdot 1/2(X_1 + X_2) \quad (1)$$

$(X_2 - X_1) \cdot 1/2(Y_1 + Y_2)$  was considered as the contribution of egg boxes raised,  $(Y_2 - Y_1) \cdot$

$1/2(X_1 + X_2)$  was considered as the contribution of the cocoon output per box; Their proportional contributions are:

$$d_x = (X_2 - X_1) \cdot 1/2(Y_1 + Y_2)/A \cdot 100$$

$$d_y = (Y_2 - Y_1) \cdot 1/2(X_1 + X_2)/A \cdot 100$$

In the same way, the increase of egg boxes raised is due to the increase of: mulberry field area, and egg boxes raised per unit area of mulberry field. Then the proportional contribution of mulberry field area to the increase of egg boxes raised times the proportional contribution of egg boxes raised to the increase of cocoon output equals the proportional contribution of mulberry field area to the increase of cocoon output. Also the proportional contribution of egg boxes raised per unit area of mulberry field to the increase of egg boxes raised times the proportional contribution of egg boxes raised to the increase of cocoon output equals the proportional contribution of egg boxes raised per unit area of mulberry field to the increase of cocoon output. The proportional contribution changes of cocoon output per box, area of mulberry field and egg amount raised per unit area of mulberry field to the changes of cocoon output in Zhejiang Province are shown in Fig. 2 using 1964 as the base year.

Fig. 2 shows that the importance of the main factors changed in different years, and that their contribution to cocoon output increase was fully manifested after 1964. The proportional contribution to the increase of cocoon output was in the order: the increase of egg amount raised per unit area of mulberry field (> 50%) > the increase of cocoon output per box (20% to 40%) > the area of mulberry field.

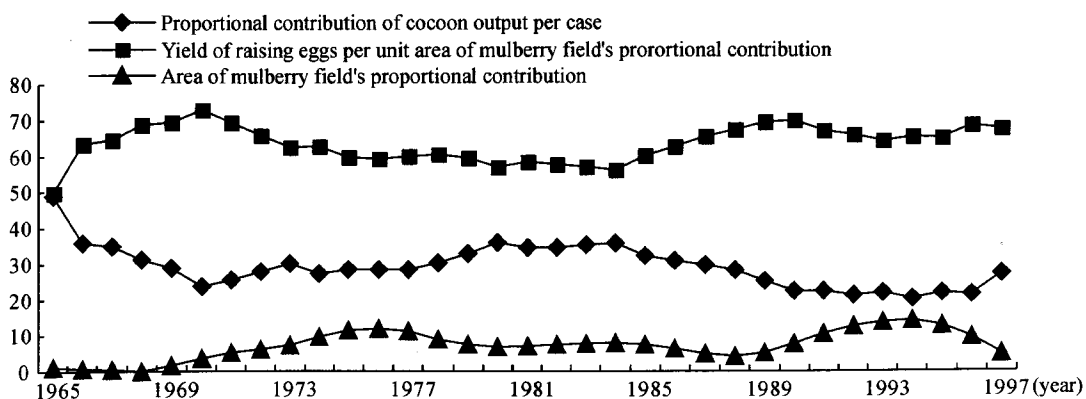


Fig. 2 Proportional contribution of three factors to cocoon output increase

## CONCLUSIONS AND SUGGESTIONS

### Conclusions

1. Zhejiang Province's overall trend of cocoon production has increased constantly since 1963, while the developing speed in different stages was not stable. No significant increase showed in the area of mulberry field. Therefore, the increase of output mainly depends on the increase of cocoon output per box and egg amount raised per unit area of mulberry field.

2. The most important factor causing cocoon output increase is the increase of egg amount raised per unit area of mulberry field; its proportional contribution is above 50%. The second important factor is the increase of cocoon output per box; its proportional contribution is 20% to 40%. The area of mulberry field has the minimal contribution. So the increase of cocoon output in Zhejiang Province mainly depends on the development of cocoon production techniques.

3. The factors affecting the cocoon output per box, the culture area of mulberry field, and the egg amount raised per unit area of mulberry field are very complicated, including popularization of new mulberry varieties, rearing techniques and productive methods, etc. Therefore, the statistical data may not be very clear and definite.

### Suggestions

Based on the analyzed results above, the following suggestions can be used as reference for achieving stable and sustainable development of the sericulture industry.

1. Stabilizing the area of mulberry field, adjusting the structure of sericulture production, streamlining management.

The area of mulberry field is the base to assure satisfactory cocoon output. It must be stabilized or steadied by reclamation of wasteland, full utilization of side land, or introduction of intercropping. It is also important to make in great efforts in increasing investment and improving

working conditions.

2. Accelerating transformation of sericulture technical achievements into practical production

The application of agriculture techniques research achievement in practical production is very inefficient in China, only about 30%, while it is 50 – 60% in developed countries. Therefore, it is very important for us to make great efforts in popularizing the sericulture techniques in order to reduce the difference of technique between sericulture farmers.

3. Breeding new silkworm and mulberry varieties, developing techniques for saving labor force and making further improvements on the competition of sericulture.

Profiting from the long history of silkworm rearing, sericulture farmers in Zhejiang Province learned advanced rearing techniques. It may be very difficult to increase the cocoon production significantly by improving rearing techniques, so the most effective and economic way is to breed new silkworm and mulberry varieties develop techniques for saving labor and make further improvements on land productivity and labor productivity.

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