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Sericulture Development in Thailand

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ABSTRACT

The main objective of this study was to analyze the productivity as well as the efficiency of existing technology and practices of the silk industry at both the village and town levels with regard to improve the production and marketing of silk products.The study results revealed that indigenous raw silk produced by most farmers was not suitable for warp production. The cost of production of silk by traditional farmers was about 5% higher than that of the commercial ones; while the productivity of the commercial sericulturist was 1.4 times of the traditional one, leading to a higher profit rate. In fact, the low return of traditional sericultural farm was due to mainly to the lack of high-yielding silkworm eggs and high-yielding mulberry varieties. A poor technical know-how in sericulture cultivation was also found among traditional sericulturists and extension workers.The conversion ratio from cocoons to silk yarn and the labor costs in yarn reeling (processing) differ between the traditional and commercial farms.For the production cost of silk material,on the average, the cost per designed material was higher than of solid material. It was found that a greater expansion of silk industry had a substantial impact on sericulture development.The quick introduction of new tecnology necessarily caused a dual structure in Thai sericulture. A comparision of the cultural practices and the cocoon output received between the traditional and commercial sericultural farms indicated that the cocoon productivity of commercial farms was substaintially higher than that of the traditional farms. A very distinctive difference between these two groups of sericulture farmers was that in one crop, a commercial farm could raise silkworms of higher yield than a traditional farm while applying more chemical and used more mulberry leaves. A commercial sericulturist received more training than the traditional sericulturist and cocoon productivity was 10 times more than of the traditional one. A test of productivity difference also confirmed the superiority over traditional technology of the high-yielding, high-input technology employed by commercial sericulturists. Factors influencing the adoption of such a new technology included,the level of silk knowledge of technical know-how of farmers and the farmer's training participation.

Key words: sericulture, sericulture development, Thai silk.

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INTRODUCTION

Silk production is one of the major industries in the rural area of Thailand. About half a million of farm households are engaged in the silk industry with the annual production of 700 tons for native silk yarns, 16 tons of thrown silk yarns, and about 3.5-4.5 million square meters of silk material. About half of the silk production is designed silk material, being used mainly by domestic consumers. However, silk yarn shortage as raw materials used for the production of silk is still a serious problem, e.g. the domestic demand is more than 2,000 tons / year while domestic production is only about 1,000 tons / year yet (Dept. of Agri., 1993). There are many aspects not known about the cultivation practices and marketing system of sericulture in Thailand.

The objectives of the study

The main objective of this study was to analyze the productivity as well as the efficiency of existing technology and practices of the silk industry at both the village and town levels. In specific,the study was aimed to conduct the follwing:

1) A description of sericulture development in Thailand;

2) An analysis of factors influencing sericulture production and technical changes in silk industry;

3) An analysis of technology adoption and transferation in silk industry; and

4) An identification of policy and measures to improve silk industry.

METHODOLOGY

Data Collection

Data utilized in this study were mainly obtained from an intensive suvey of 282 sericulturists (141 traditional sericulturists and 141 commercial sericulturists) conducted in 16 provinces and 160 agricultural extension workers in 9 provinces (Figure 1).

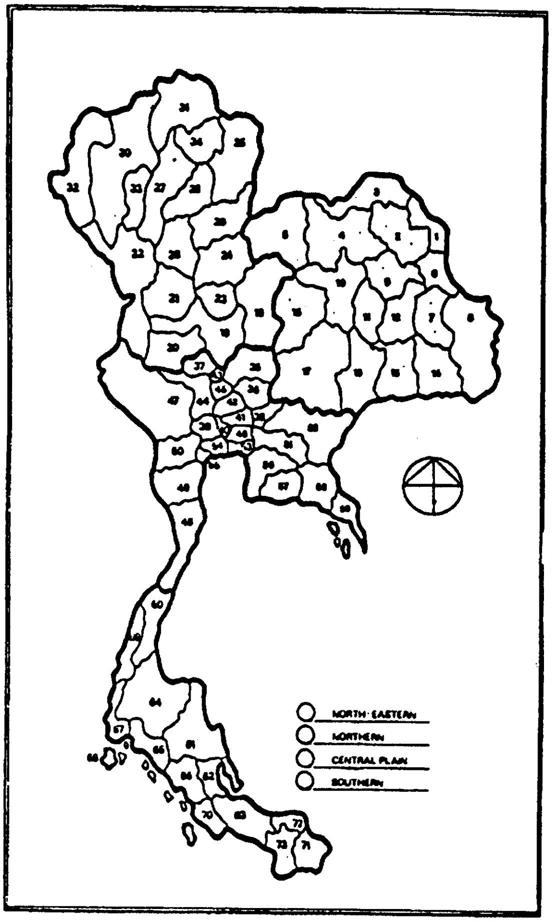

Figure 1 Map of Thailand.
Region: Northeastern Region consists of 17 provinces, North Region consists of 17 provinces, the Central Region consists of 25 provinces, and the Southern Region consists of 14 provinces.

Analytical Method

A descriptive analysis was employed to analyze the development process of silk industry, a comparison of costs and return of silk production and objective assessment of Japanese cooperation

List of Provinces and Regions

Northeastern

1. Nakhon Phanom
2. Sakon Nakhon
3. Nong Khai
4. Udon Thani*
5. Loei
6. Mukdahan*
7. Yasothon
8. Ubon Ratchathani*
9. Kalasin
10. Khon Kaen*
11. Maha Sarakham
12. Roi Et
13. Buriram*
14. Si Sa Ket*
15. Surin*
16. Chaiyaphum*
17. Nakhon Ratchasima*

Northern Region

18. Nakhon Sawan°
19. Phetchabun°l'
20. Uthai Thani° *
21. Kamphaeng Phet°
22. Tak°
23. Phichit°
24. Phitsanulok°
25. Nan
26. Phrae
27. Lampang
28. Sukhothai°
29. Uttaradit°
30. Chiang Mai
31. Chiang Rai
32. Mae Hong Son
33. Lamphun
34. Phayao

Centrl Plain Region

35. Lop Buri
36. Saraburi
37. Chai Nat
38. Nakhon Nayok
39. Nakhon Pathom*
40. Nonthaburi
41. Pathum Thani
42. Ayunhaya
43. Sing Buri
44. Suphan Buri*
45. Ang Thong
46. Bangkok Metropolis
47. Kanchanaburi
48. Prachuab Khiri Khan*
49. Phetchaburi
50. Ratchaburi"
51. Chachoengsao
52. Prachin Buri
53. Samut Prakhan
54. Samut Sakhon
55. Samut Songkhram
56. Chon Buri
57. Rayong
58. Chanthaburi
59. Trat

Southern Region

60. Chumphon*
61. Nakhon Si Thammarat
62. Phatthalung
63. Songkhla
64. Surat Thani
65. Krabi
66. Trang
67. Phangnga
68. Phuket
69. Ranong
70. Satun
71. Narathiwat
72. Pattani
73. Yala

Note : * The sericulturists' study areas
° The extension workers' study areas

program. A test on silk knowledge of the extension workers was done by using the Chi-square test.

The test of productivity differential was carried out on the basis of current level of technology used and cultural practices by individual sericultural farms. The production equation expressed in a logarithmic form specified the production volume of silk / cocoon as a function of the following input variables; the number of labor use / year, the rearing period / crop of silkworm up to cocoon production stage, the mulberry leaf consumption of silkworms / year, and the quantity of chemical used / year.

To analyze the factors influencing technology adoption, Rogers and Shoemaker adoption process was selected for the frontier estimation in this study. In the adoption process, once farmers are very confident on the outcome of technology uses they start adopting the practices in the fullest.

After the estimation of adoption process frontiers, 69 sample traditional farms were tested an empirical adoption function. Then, the test employed a statistical regression equation specifying the adoption of new variety of silkworms producing white cocoon as a function of 5 variables, namely the sericulturist's age, frequency of training participation of sericulturist, the price ratio of white cocoons and yellow cocoons, the number of occupation groups participated by sericulturist, and the score point on a test of silk knowledge of sericulturist. This adoption equation was estimated using the Ordinary Least Squares techniques.

RESULTS

1. Cost and Return of Silk Production

Based on data and information obtained from the comprehensive field survey, it was found that indigenous raw silk produced by most farmers was not suitable for warp production. Therefore, import of thrown silk is required. Generally speaking, the technology of silkworm rearing and silk reeling in Thailand is rather backward and by far below the international standard.

Native silkworms are polyvoltine varieties produced both yellow and white cocoons. The Thai Hybrid silkworm is improved by cross-breeding of bivoltine and polyvoltine races. Foreign hybrid silkworms are a kind of bivoltine produced white cocoons with high percentage of cocoon shell, being suitable for machine reeling.

1.1 The comparison of cost and return of cocoon production.

The farmers cultivating sericulture in Thailand were classified into 2 groups, namely the traditional farm (hand-reeled silk) and commercial farm (machine-reeled silk). The traditional farm was characterized by: an average of mulberry leaf production of 1,200 kg / rai / year with average product cost of 0.98 baht / kg. Sericulturists could rear silkworm 1-8 crops / year, with an average of 3.10 crops / year or 7.06 sheets / year. Average labor used in rearing silkworm was 151.94 hours or 18.99 days / crop. Given the selling price of cocoon in 1992 which was average at 80 baht / kg, a sericulturist had a loss of 7.83 baht / kg of cocoon produced. However, if family labor cost of 25.39 baht / kg was excluded, farmers still earned a profit of 17.56 baht / kg. For a commercial farm, the production of mulberry leaves was averaged at 1,800 kg / rai / year, equivalent to 1.07 baht / kg. A commercial sericulturist could rear silkworm 2-15 crops / year with an average of 7.4 crops / year, being equivalent to 29.74 boxes / year. The labor use was average at 188.94 hours / crop or 23.61 days / crop. With the average selling price of reelable cocoon of 93 baht / kg and waste cocoons of 35 baht / kg, a commercial sericultural farm could earn a profit of 9.52 baht / kg. If the family labor cost of 36.89 baht / kg of cocoons was not taken into account, the profit would increase to 46.41 baht / kg.

The comparison of costs, and returns of cocoon production by traditional and commercial sericulturists suggested that, on average, the cost of production by traditional groups was about 5 % higher than that of the commercial groups; while the cocoon productivity of the commercial sericuturists was 1.14 times of that of the traditional one, leading to a higher profit rate, e.g. 46.41 against 17.56 baht / kg, being 164 % higher (Table 1). In fact, the low return of traditional sericultural farm was mainly due to the lack of high yielding silkworm eggs and high yielding mulberry varieties. A poor technical know-how in sericultural cultivation was also found among traditional sericulturists and extension workers.

1.2 Cost and returns of silk yarn production

The conversion ratio from cocoons to silk yarn differs between the traditional and commercial sericultural farms. That is, 10 and 7 kg of cocoon can yield 1 kg of silk yarn for traditional and commercial farms, respectively. This is equivalent to raw material costs of 878.30 and 638.96 baht, respectively. The labor costs in yarn reeling (processing) were 250-300 baht / kg of silk yarn produced. This labor costs plus the raw mate-

Table 1 A comparison of costs and returns of cocoon production, between the traditional and commercial farms, 1992.
Number of observations :282.

Items	Traditional (B)	Commercial (B)
Cost/box/sheet		
Labor	706.63	1,235.83
Silkworm eggs	15.50	352.50
Chemicals	14.46	123.79
Materials	1.23	3.20
Mulberry leaves	1,330.00	2810.46
	(220 kg X 1.50B)	(470 kg X 1.50B)
Transportation	5.36	22.50
	5.07	20.00
R&Mbuilding&equipment		
Depreciation	86.58	154.31
Interest & opportunity cost	64.76	185.83
Total cost	1,229.59	2,810.46
	(87.83/kg)	(83.47/kg)
Returns/box	2,727.77	3,355.44
Returns/crop	4,961.09	13,421.98
Returns/year	2,172,960.00	13,985,514.00
Returns/kg	78.34	105.01
Profit/box	488.72	1,474.11
Profit/crop	1,111.93	5,931.83
Profit/year	487,026.60	6,180,976.60
Profit/kg (with family labor cost)	-7.83	9.52
Profit/kg (without family labor cost)	17.56	46.41

rial costs made a total costs of silk yarn production of 1,128.30 and 938.96 baht / kg for traditional and commercial silk production, respectively. This is to suggest that rearing the hybrid silkworms of bivoltine variety yielded greater returns and profit than the native or a Thai Hybrid silkworms (Table 2).

1.3 Production cost of silk material

The production cost of silk fabrics includes the cost of raw materials used, labor cost, overhead cost and an allowance for depreciation of machines and equipments. On the average, the cost per unit of designed material is higher than that of solid material (Payanun,1991). Silk yarns form a major pro-

Table 2 Costs and returns on silk yarn production, 1992.
Number of observations :282.

Reeling cost/kg silk yarn	(hand-reeled)	(machine-reeled)
Raw silk : cocoon ratio	1:10	1:7
Labor cost (processing cost)	250.00	300.00
Cocoons cost	878.30	638.96
Raw silk cost/kg	1,128.30	938.96
- percentage grade output		
grade 1..... 90%		
grade 3..... 10%		
Sale price		
.......grade 1	1,000.00	900-1,000.00
.......grade 3	350.00	-

portion of total costs, accounting for 66-72 % for designed silk material. The cost of hired labor accounted for 20 % and 10 % for the designed and solid materials respectively. However, the share of the labor cost in the total cost increases in the production of high quality products. The depreciation costs of equipment and other capital for solid material production are relatively high compared to those of designed materials. This is due to a higher cost of equipment used in solid material production. The ratio of the labor cost to the depreciation costs is about 20:1 for the designed material and 3.4:1 for solid material one, indicating a highly labor intensive production of the patterned silk fabrics. The overhead cost accounted for about 4 % , with the range of 2.2 to 6.9 %, of the total cost / unit of material (Payanun,1993).

2. Determinants of Silk Market

Based on the data and information obtained from the comprehensive field survey, it was found that silk product market is the most important part of the domestic sericulture industry, because all products response to their market demand. Silk products must be developed both form and quality at all time beginning from ended products such as finished products, silk material, raw silk and cocoons. Quality in each step of production is very important to ended products continuously, so each step of production must be developed systematically both quality and patterns from cocoon sorting and reeling method to reel quality and suitable yarn size. The marketing of silk products are performed by sericulturists who producing both yellow and white cocoons. Exports of silk material in 1991 had been decreased from 1990 level but increased in 1992 with quantity and value. Most of silk material exports was destined to Japan, USA, Belgium and United Kingdom (Figure 2). Silk yarn import had decreased in 1991 from 1990 and increase in 1992. Approximately, 90% of silk yarn was imported from China and Brazil (Figure 3).

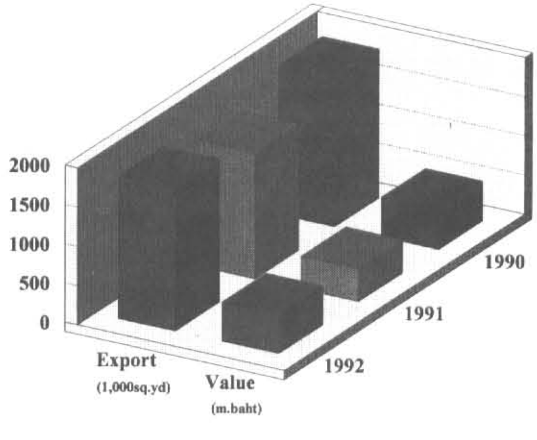

Figure 2 Silk fabrics export, 1990-1992

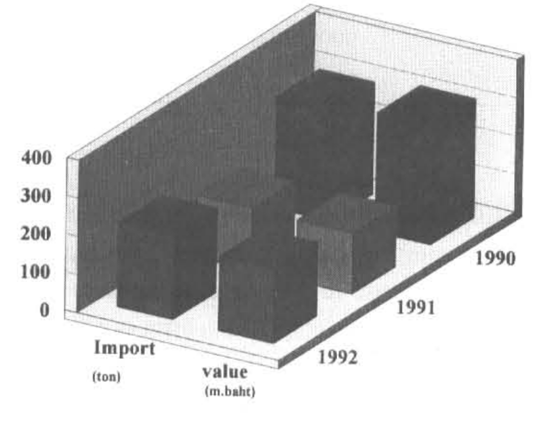

Figure 3 Silk yarn export, 1990-1992

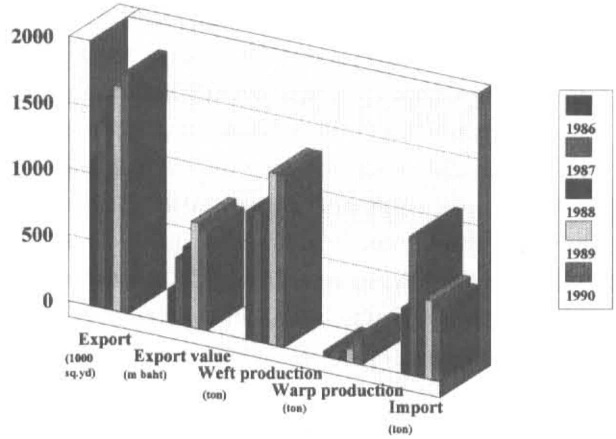

Figure 4 Silk marketing development, 1986-1990

This study revealed that a greater expansion of silk industry had a substantial impact on sericulture development. Hybrid silkworm variety has been introduced to produce cocoons for reeling factory so as to make warp silk. Nevertheless, there is a small quantity and a slight increase of silk yarn production. As a consequence, silk yarns are imported to meet the increasing demand of silk industry (Figure 4).

3. Determinants of Objective Assessment of Japanese Cooperation during the Period of 1969-1978.

From 1969 onwards, research in cultivation of mulberry has been carried out, the Royal Thai Government promotes breeding of new bivoltine varieties from Japan instead of polyvoltine land-varieties which cannot produce good quality cocoons. In the plan to breed new bivoltine varieties, hybrids from Japan with high productivity were picked up for cross-breeding. The policy had, so far, put stress on the self-supply of the warp funneling funds both public and private, into this sector. The last stage of development is the Thai Hybrid silkworm production. It tries to combine properties of bivoltine and polyvoltine races. By the form of management, Japanese Technical Cooperation is extended to follow-up in 1978-1980. In reality, the formulating technique of Technical Cooperation of Japan's sericulture development project can be said to reach target successfully (Figure 5).

As a result, there are many recommended varieties of polyvoltine varities, all of which depend on climatic factors. The quick introduction of new technology necessarily caused a dual structure in Thai sericulture. Finally, it should be noted that there is a coexistence of the modern and traditional sectors in sericulture. In sprite of the gradual diffusion of new technology into traditional cocoon-production areas, a rapid change in sericultural

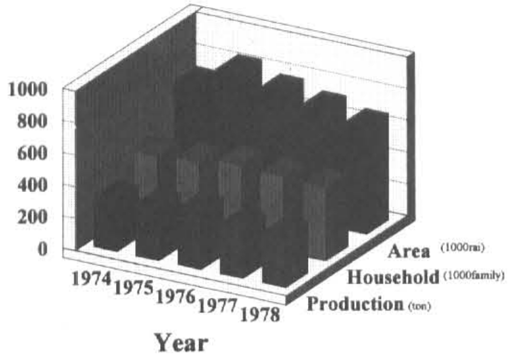

Figure 5 Sericulture, 1974-1978

technology did not take place in Thailand in the 1979s.

4. Role of Extension Workers in Sericulture Development

In addition to sericulture development, this study also paid attention to the role of agricultural extension workers in sericulture development. Unfortunately, the level of sericultural knowledge of agricultural extension workers in the study area was found to be quite fair and poor in the sericultural knowledge, which is not enough to provide support to farmers (Table 3). From the fact, all of them need to attend the training course. By employing the Chi-Square test on the independency between the level of training need and the level of education of extension workers, it appeared that at significance level at .05 the calculated value is less than the value in Chi-square Table, indicating that the level of training need is not different from the level of education of extension workers , e.g. between Bachaloris degree and vocational diploma levels (Table 4).

5. Technology at the Farm Level

The fact is that, total yield of cocoons produced by the commercial farms was much higher than that of the traditional farms. The silkworm rearing period up to cocoon production stage of the former was shorter e.g. 118.94 against 151.94 days, suggesting that the silkworm variety used by the commercial farms, which is of bivoltine strain was more productive although consumed more mulberry leaves than that of the traditional farms. This means that commercial farms employed high

Table 3 Grading scale of extension workers' knowledge on sericulture, 1992.
Number of observations :149.

Knowledge	Number	%
excellent	3	2.0
good	14	9.4
fair	67	45.0
poor	68	43.6
Total	149	100.0

Note : Grade scale includes :
1.00-1.75 = very low knowledge (poor);
1.76-2.50 = not enough to provide support to farmers (fair);
2.51-3.25 = enough knowledge to provide support to farmers (good);
3.26-4.00 = high knowledge (excellent).

Table 4 The relationship between the level of education and the level of training need. Number of observations :149.

Items	Level of education	Level of training need: High Number (person)	High Percentage	Moderate Number (person)	Moderate Percentage	Low Number (person)	Low Percentage	X
Mulberry disease	High	55	71.4	19	24.7	3	3.9	3.88^{NS}
	Low	42	59.2	21	29.5	8	11.3	
Insect pest	High	55	67.5	20	26.0	5	6.5	1.78^{NS}
	Low	43	60.6	19	26.7	9	12.7	
Principle of mulberry plantation	High	37	48.0	34	44.2	6	7.8	0.63^{NS}
	Low	31	43.1	32	45.6	8	11.3	
Control of silkworm diseases	High	58	75.3	15	19.5	4	5.2	5.97^{NS}
	Low	40	56.3	24	33.8	7	9.9	
Production and harvest of cocoon	High	44	57.1	28	36.4	5	6.5	0.54^{NS}
	Low	37	52.1	30	42.3	4	5.6	

Note : Significant at the .05 level, df = 2,α^2 =5.99,NS = non-significant.

yielding and high input technology in farming sericulture while the traditional farm still employed low yield and low input technology in farming sericulture. Therefore, the commercial farms utilized their input more effectively and efficiently. The implication of this finding is that it is the high level of technology in sericulture that brought about promising means and ways to solve the problem of under labor employment and low income earning in rural areas. In particular, a shorter life cycle of new and productive strain of silkworms has led to more labor absorption and more silk cropping within a year round cycle.

A comparison of the cultural practices and the cocoon output received between the traditional and commercial sericultural farms indicated that the cocoon productivity of the commercial farms was substantially higher than that of the traditional farms, e.g. 127.64 against 1.82 kg / crop / farm. In a year, the commercial farms produced up to 944.55 kg of white cocoons while the traditional farms produced only 5.65 kg of yellow cocoons.

On input uses, the commercial farms employed greater input package than the traditional farms. In particular, a commercial farm could handle more than double the cropping of a traditional farm while employing a little more labor. Of course, the mulberry leaves used to feed silkworm were a lot higher for commercial farms which required greater mulberry planting areas.

A very distinctive difference between these two groups of sericultural farmers is that in one crop, a commercial farm could raise silkworms of higher yield than a traditional farm while applying more chemical and used more mulberry leaves. A commercial sericulturist received more training than the traditional sericulturist and cocoon productivity was more than 10 times of the traditional one.

This is to confirm that rearing new variety of high yielding silkworms resulted in a higher yield of cocoons while it enhanced efficiency in labor use and higher labor employment in a year, (Table 5).

6. Test of Productivity Difference

In addition, the high yielding and high input technology has significantly raised yield while lowering the production cost. A test of yield differential also confirmed the superiority over traditional technology of the high yielding, high input technology employed by commercial sericulturists (Table 6 and 7).

Table 5 A comparison of production, yield and input uses between traditional and commercial sericulturists in 1992.
Number of observations :282.

· Items	Traditional	Commercial
Input use		
Labor/crop (person)	3.0	4.8
Raising period/crop (hour)	151.94	118.94
No. of box (sheet)/yr (no.)	7.06	29.74
No. of crop/yr (no.)	3.10	7.39
Silkworm variety use (name)	Polyvoltine	Bivoltine
No. of silkworm/crop (no.)	44,565.95	78,812.29
Chemical application/yr (kg)	10.87	4,441.97
Mulberry leaves consume/box (sheet), (kg)	220.0	475.0
Mulberry variety use (name)	Noi, Soi, Kun Pai	Noi, KunPai, Nakhon Ratchasima 60
Planting areas of mulberry (rai/farm)	5.65	16.98
Training participation of sericulturist (no.)	1.0	3.0
Out put		
Total yield of cocoon/crop/farm (kg)	1.82	127.64
Cocoon yield/box (sheet), (kg)	0.8	91.28
Cocoon yield/year (kg)	5.65	944.55

Table 6 Estimated production function of cocoons by traditional sericultural farms, 1992.
LS // Dependent Variable is LNY.
Number of observations : 141.

Variable	Coefficient	Std. error	T-stat.	2-tail Sig.level
C	-4.5735	0.6710	-6.8160	0.000
LNX1	0.2154	0.0608	3.5422	0.000
LNX2	0.1120	0.1260	0.8890	0.374
LNX3	1.1739	0.0898	13.0675	0.000
LNX4	0.0006	0.0564	0.0104	0.992

R-squared	0.9338	Mean of dependent var	4.4520
Adjusted R-squared	0.9319	S.D. of dependent var	1.4900
Standard error of regression	0.3888	Sum of square residuals	20.5618
Durbin-Watson statistics	1.3930	F-statistics	479.8861

Where:

Y = Total cocoon production (kg/year/farm);
X1 = Number of labor used in cocoon production (person/year);
X2 = Silkworm rearing period up to cocoon producing stage (day/crop);
X3 = Mulberry leaves consumption of silkworms of all crops (year/kg);
X4 = Quantity of chemicals used in rearing silkworms (kg/year).

Table 7 Estimated production function of cocoons by commercial sericultural farms, 1992.
LS // Dependent variable is LNY.
Number of observations : 141.

Variable	Coefficient	Std. error	T-stat.	2-tail Sig. level
C	-6.1678	3.3278	-1.8534	0.064
LNX1	0.1873	0.0519	3.6081	0.000
LNX2	2.3881	1.0897	2.1916	0.028
LNX3	0.3687	0.0500	7.3778	0.000
LNX4	0.1534	0.0244	6.2735	0.000

R-squared	0.7668	Mean of dependent var	6.7377
Adjusted R-squared	0.7600	S.D. of dependent var	0.4934
Standard error of regression	0.2417	Sum of square residuals	7.9478
Durbin-Watson statististics	1.8095	F-statistics	111.8312

Where:

Y = Total cocoon production (kg/year/farm);
X1 = Number of labor used in cocoon production (person/year);
X2 = Silkworm rearing period up to cocoon producing stage (day/crop);
X3 = Mulberry leaves consumption of silkworms of all crops (kg/year);
X4 = Quantity of chemicals used in rearing silkworms kg/year).

7. Technology Adoption

The adoption of new technology and cultural practices have led to a significant improvement in sericulture productivity and a greater efficiency in input uses. Significant factors contributing to new technology adoption included the price of new technology output, the level of silk knowledge or technical know-how of farmers and the farmer's training participation (Table 8).

CONCLUSION

The findings of this study reveal that the development potential of silk industry in Thailand has been contributed by the following factors: (1) An improvement in the production process and technology in use; (2) The development and availability of approved technology; and (3) The farmer's awareness and adoption motivation of new technology; and (4) Market environments which provide incentives for changes.

Policy recommendations

Based on the above findings and conclusion, the following policy suggestions are given:

1) Research and development on high-yielding, pest resistant mulberry varieties and high-yielding silkworm strains should be seriously strengthened and expanded to make new technologies in silk industry widely available and affordable by farmers. For example, mulberry varieties namely, Kun Pai (recommended by Chul Thai Silk

Table 8 Adoption equation of new technology among traditional sericulturists, 1992.
LS // Dependent Variable is LNY.
Number of observations : 69.

Variable	Coefficient	Std. error	T-stat	2-tail Sig. level
C	3.6486	0.2042	17.8642	0.000
LNX 1	-0.0296	0.0371	-0.7976	0.428
LNX 2	0.0072	0.0028	2.6053	0.012
LNX 3	0.2752	0.0127	21.7310	0.000
LNX 4	0.0042	0.0423	0.1006	0.920
LNX 5	0.1414	0.0474	2.9813	0.004

R-squared	0.9205	Mean of dependent var	4.2400
Adjusted R-squared	0.9142	S.D. of dependent var	0.2143
Standard error of regression	0.0628	Sum of squared residuals	0.2484
Durbin-Watson statistics	2.3081	F-statistics	145.8657

Where:

Y = Percentage of white cocoons (bivoltine) in total cocoon production (%);
X1 = Age of working sericulturist (yr);
X2 = Number of training participation of sericulturist;
X3 = Price ratio of white cocoons (bivoltine) to yellow cocoons (polyvoltine);
X4 = Number of group participation by sericulturist;
X5 = Sericulturist's score points on a test of knowledge on silk.

Co., Ltd). Buriram 60 and Nakhon Ratchasima 60 (recommended by Department of Agriculture) and silkworm strain namely, Dok Bour (Thai Hybrid) and Nakhon Ratchasima 1 (K1 x K8), (foreign hybrid), should be recommended and made available to farmers.

2) Improved cultural practices such as mulberry planting and pruning techniques, and silkworm rearing schedule should be introduced and transfered to farmers. Silk production planning should be set and made to be acquainted among farmers.

3) Training program at both farmers and extension workers levels should be strengthened and expanded to accelerate the adoption of new technology. In addition, training programs on post-harvest treatments to cocoons and raw silks should be organized with a view to improve the quality of silk yarns.

4) A system of grading and standardization of cocoons and silk yarn should be set up and enforced officially to provide standards for pricing and increasing market potential of cocoons and silk products.

Suggestion for further study

For further sericultural research, it is necessary to conduct research relating to grading standardization of cocoons and raw silk to support market expansion policy.

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