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SEMINAR ON THE INTEGRATED SILK PROCESSING INDUSTRY

THE PEOPLE'S REPUBLIC OF CHINA

Terminal Report*: Observations made during the several factory visits conducted during the seminar


Based on the work of Jagannatha Rao,

Silk Consultant

United Nations Industrial Development Organization
Vienna

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The Integrated Silk Processing Seminar

The second session of the Intergovernmental meeting on Agro and Allied Industries held in 1978, observed that the proposal, to examine the development of the silk industry, was important and timely in the context of employment generation in rural areas.

The employment potential of the silk industry, especially in increasing the income of the villagers, was of particular interest. The foreign exchange earnings from the export of silk products would be considerable. The capital required was low and the technology involved was simple and has been developed within the region.

A consultative Mission to be followed by a workshop/seminar to examine the findings of the Mission in order to exchange experiences, share knowledge, know how and technology and undertake similar cooperative activities was conceived.

In accordance with the directive of the Intergovernmental Meeting on Agro – and Applied Industries (1978) which was later endorsed by the committee on Industry, Housing and Technology and the Economic and Social Commission for Asia and Pacific (ESCAP) and at the request of the participating Governments, a consultative Mission comprising of a team of two Dr.C.B.Jagarnatha Rao, UNIDO Silk Production and Processing Advisor as Team Leader and Mr.N.Yamatani, Silk Marketing Advisor were fielded in 1979.
The report, which consisted of two parts Part A - regional report and Part B - country reports, which emphasized the need to organize a workshop or a seminar with a view to considering its findings and recommendations and to provide a forum for the exchange of experiences, to discuss areas of technical and economic co-operation and the regional institutional mechanism to promote its further development in the region.

The Chinese authorities reacted favourably to the suggestion that a workshop on the integrated silk processing industry should be organized in that country during the ESCAP organized workshop on small and medium-scale industries at selected sites in China in October/November 1978, which included the study of the silk processing industry in Wuxi.

The third session of the Intergovernmental Meeting on Agro- and Allied Industries held in Tokyo in October 1980, welcomed offer of the Government of China to offer its host facilities for the Organization of the Seminar and resolved that a workshop/seminar should be organized on the integrated silk processing industry to examine the findings and recommendations of the consultative mission, to provide a forum for exchange of experiences among the countries of the ESCAP region and to lay down specific guidelines for development of the industry including regional and sub-regional cooperation measures.

Accordingly, the ESCAP in cooperation with the Government of the Peoples Republic of China organized a Seminar on the
"Integrated Silk Processing Industry" which was held in Hangzhou of Zhejiang province from 26th to 29th September 1982 following visits to Beijing and Suzhou of Jiangsu Province from 16th September 1982.

The long term development objective was to provide additional employment opportunities in rural areas, facilitate income distribution and earn/save foreign exchange.

The development objective of the seminar was to
1. Strengthen the national planning and technological capability of the ESCAP developing countries in the development of sericulture and silk processing industry.
2. Examine and adapt the concept of institutional mechanism and organizational framework in China to suit individual country requirements.

The immediate objective of the project was to
1. Provide an opportunity to about 25 participants in the seminar to exchange experiences on the development of integrated silk processing industry.
2. Become acquainted with planning and development of the integrated silk processing industries.
3. Formulate guidelines for the further development of the industry.
4. Identify a technical cooperation programme.
5. Consider a regional cooperation mechanism.
This author was deputed by the United Nations Industrial Development Organization to participate in the Seminar on the Integrated Silk Processing Industry, Hangzhou 16-29 September '82 and assist the UNIDO delegate in deliberations of matters concerning sericulture technology of Industrial processing of silk. One of the requirements was production of a report.

From the Aide Memoire circulated to all participants before the seminar, a copy of which has been seen by the author at the time of report preparation, the agenda for the seminar was:

1. The experience of China in the planning and development of the integrated silk processing industry in the country.
2. The findings and recommendations of the report of the ESCAP consultative mission.
3. The technical assistance requirements of individual countries.
4. Regional strategy and mechanism to promote technical and economic cooperation among the countries.

In this report an attempt has been made to enumerate the observations on the "Integrated Silk Processing Industry" in China that was seen during the short sojourn and some recommendations as requested by the Chinese Delegation in
a meeting held with UNIDO representatives to the seminar on the 22nd September 1982 (Proceedings in the section - other activities)

Since the information on the technical assistance requirements of individual countries would be covered by the reports to be submitted by the ESCAP; and UNIDO Industrial Development Officer, this is not being duplicated here.

Notably missing in the proceedings of the seminar were the discussions on the findings and recommendations of the report of the ESCAP Consultative Mission, which were not held.

The seminar, however, provided an opportunity to exchange of some experiences among the representatives of the ESCAP region.
At the outset, the major departure in our understanding that the technology involved in silk production is simple demands a quotation from the opening speech rendered by Mr. Hou Zongshu, the Deputy General Manager, China Silk Corporation who views

Quote: "natural silk forms less than 0.2 per cent of the world production of textile fibers. This is why it is so precious and maintains high prestige. Silk has always been commended as the "Queen of Fibers" and valued highly. True, silk fabrics are precious, but they are very difficult and expensive to process and confront keen competition from other fibers. In recent years, notwithstanding great efforts made by many countries to promote the production of natural silk, it has not been an easy task to accomplish. This may be attributed to the fact that cocoon production involves the domains of both plants and animals requires mild climatic conditions appropriate for mulberry cultivation and silkworm rearing of improved varieties, and demands a very high level of technology in silkworm rearing. Unlike cotton, the production of which can be increased by merely cultivating the cotton plant well or synthetic fibers, the output of which can be raised by large scale industrialized production, silk has very critical requirements with regard to quality and variety. Therefore, since the production of silk is labour-consuming and costly, it would be very difficult for an industrialized country to develop the silk processing industry."
We believe our friends here have already acquired a deep understanding of this situation. For this reason, future development of the world silk processing industry and silk consumption can only be brought about by formulating a cooperation program on an international basis.

In view of the fact that Asia and the Pacific are the main silk producing regions, this seminar will play a significant role in the integrated silk processing industry in this region.

From the Chinese experiment in implementing sericulture and silk production projects in traditional and non-traditional areas proves that sericulture technology is not a simple one, easily transferable to any rural environment without much effort, provided the agroclimatic conditions and labour requirements are met.

This author having spent more than two decades in the field of silk production endorses the above point and emphasises the intricacies involved in the understanding of the high level of technology required in maintaining a balance between the plant insect interrelationship and the several processes contributing to the manufacture of the fabric before marketing.
Silk Industry in China – Past:

There are several evidences to prove that mulberry sericulture had its origins in China.

China has a long history and tradition of silk production. It dates back to 4600 years.

The development of the technology through different ages was as follows:

1100 B.C – 770 B.C – Western Zhou Dynasty
- Concepts of Mulberry planting, silkworm breeding, silk reeling and weaving were developed.

770 B.C – 221 B.C – Spring & Autumn Annals & Warring states period
- Perfection of production techniques in sericulture and silk fabric production.

226 B.C – 220 A.D – Qin & Han dynasties
- Development of brocade and jacquard weaving.
- Introduction of sericulture to Korea and Japan (195 A.D) in the east and Persia and Turkey in the west. Foreign trade and technical collaboration through the "silk Road".

220 B.C – 588 A.D – Three Kingdoms;
- Wei Jin, Northern and Southern Dynasties
- Improvements in the technology of silk weaving.
- Expansion of sericulture from Yellow river to Yangtze River basin.
588 A.D - 960 A.D - Sui, Tang and Five Dynasties.
- Improvements in colours and designs of silk fabrics.
- Nationwide spread of sericulture.
- Introduction of silk reeling and weaving to Europe (7th century) and Mediterranean countries.

960 A.D - 1368 A.D - Sung & Yuan Dynasties
- Silk export and consolidation of Jiangsu and Zejiang provinces as the silk centres.

1368 A.D - 1644 A.D - Ming Dynasty
- Development of Handicraft industry based on silk.
- Creation of special bureaus to supervise silk production.

1644 A.D - 1911 A.D - Qing Dynasty
- Establishment of silk weaving and Dyeing Bureau in Beijing, Jiangning, Suzhou and Hangzhou.
- Establishment of 770 loom silk factory in Hangzhou - manufacture of Leno, twill, brocades etc.,

The aforesaid briefly explains the rich legacy of silk and the role it played not only in the cultural heritage of China but also resulted in transfer of technology to other countries in the world.
Silk Industry in China - Present:

Traditionally, sericulture was practised in Huang He (Yellow River) Chang Jiang (Yangtze River) and Xi Jiang (Pearl River) valleys which were famous for the silk production. Now, sericulture is intensively practised in 25 out of 29 provinces. Geographically, it is spread all over the length and breadth of the country.

Sericulture is practised in the tropical and sub-tropical Guang Dong Province, temperate Jiangsu, Zhe Jiang and Sichuan provinces and colder Shang Dong province.

Thus the nature of sericulture and its crops, products, problems confronted in producing them are conditioned by the varying agro-climates in which it is practised. Mulberry varieties, silkworm races and the kind of cocoons and consequently the nature of silk produced differ from region to region.

Cocoon production, in China is done from March to November. Whereas the number of crops in Northern China are limited to two, the Jiangsu and Zhe Jiang provinces produce four to five crops, and Guangdong province of Southern China produces six to eight crops per year.

In terms of quality, the major cocoon production centres are in the following order:

1. Sichuan
2. Zhe Jiang
3. Jiangsu
4. Guang Jing
Sericulture and silk production which was traditionally practised as a rural based industry practised by the farmers, all under one roof, at their respective homesteads, has today diversified. All different aspects of silk production like seed (egg) production, reeling of silk, spinning, weaving, dyeing, printing, finishing etc., are now specialized activities leaving silkworm rearing along at the farmers stage. However, some amount of integration exists between the related activities of aforementioned specializations.

Along with the transfer of silk production technology to other parts of the world from China, trading in silk of Chinese origin flourished and provided the means for barter as well as earning the foreign exchange required. Even today, silk plays a major economic role.

Cocoon production in China which rose to almost 220,000 m.tons during 1930 dwindled to 30,000 m.tons by 1949 due to war and occupation of China. Since liberation, China has emerged as one of the major producers of cocoons as well as raw silk. During 1981, China claims to have 4 million ha under mulberry with a cocoon production of 5 million Tan or 75 million kg. or 75,000 m.tons of cocoons, which comes to an average of 562.5 kg. of fresh cocoons or 56.25 kg. of raw silk/ha (at an average of 10 kg. of fresh cocoons to produce 1 kg. raw silk) with a raw silk production of 26,000 m.tons. This shows that even though cocoon production is quite a lot all of it does not get converted to silk. This might be a good indicator for future expansion of the industry and increasing consumption.
Now, the world economic order as regards silk is conditioned by China. The Japanese Supremacy as a major exporter of silk was totally upset when China released its quality silk to the world market at prices so low that Japan had to change over to a raw silk and cocoon importing country.

According to the China Silk Corporation, China exported a little more than 6,000 m.tons of silk during 1981. It was less than 6,000 m.tons during 1980.

The total production of both finished and unfinished silk fabrics is estimated to be 800 million metres annually. Out of this only 1.2 million metres is pure silk. Half of this is exported as grey fabric to Europe who processed and finished these for re-export to other countries. China exports silk goods to 160 countries.

The sale price of dyed and printed fabric is RMB 10 to 12 and bleached fabric is RMB 6 to 8. At an average price of RMB 8 to 10 the value of silk fabric produced in China is RMB 6,400 to 8,000 million. The export prices for dyed and printed fabric is RMB 6 to 10 and gray fabric is RMB 5 to 7. Mostly, silk is exported as gray fabric. At an average price of RMB 5 to 8, the value of silk exported amounts to approximately RMB 6 to 10 million.

Thus the major part of the silk production is consumed domestically and only a small part is exported.
Silk is considered a luxury material in China. In order to make it amenable for the domestic use, a lot of mixed fabrics with rayon, acetate and other fibres are undertaken. The domestic market is approximately 500 million metres for all kind of fabrics.

Chinese sericulture is in the process of reorganization and the silk production is being modernized to meet the requirements of discriminative buyers abroad, and the demands of the export trade.

China is one of those countries where one could clearly see the distinction between sericulture which is an agricultural activity and industrial silk production which has been vertically integrated up to fabric production and hence the best venue for study of this industry.
Organization of Sericulture and Silk Production in China

Sericulture is one of the sideline activities in the overall agricultural production. In some tracts cocoon production forms a major source of cash returns. The organizational requirement differs from province to province depending upon this requirement. Sometimes a Vice-Chairman is exclusively for sericulture and silk industrial purposes.

Sericulture being an agricultural activity has benefitted a lot from the Chinese experiment in consolidation of land holdings, efficiency of land utilization, irrigation and drainage and restructuring of cropping pattern to enable food and fiber production taking the geographical and agroclimatic conditions, to meet requirements of a growing population of China. The aim seems to be self sufficiency in food and fiber production.

The land in China is owned by the State and is entrusted to the Commune having a certain number of households, who are further sub-divided into brigades and production teams who are wage earners and are involved in the actual production of cocoons or manufacturing of silk.

Remuneration invariably is in the form of cash which might sometimes be credited to bank accounts and sometimes authorization to purchase commodities and tools from the cooperatives. The inputs required for the agricultural production is provided to brigades and production teams.
The production targets are recommended by the Central Policy making body, which is headed by the Economic Committee consisting of Ministers from Light Industries, Textiles, Economic Affairs, Finance, Foreign Affairs, Agriculture etc., to which representative from all the major provinces are nominated. The Financial Committee approves the budgetary provisions. The State Council approves the targets for adoption and implementation.

The planning and implementation is done by the Production Teams and the Brigades by mobilizing the manpower required by it under the supervision of the Commune, which is the basic accounting unit at the provincial level.

The Provincial Bureau of Agriculture through the Division of the Local Products enforces the policy set by the state and ensures to see that targets are achieved by the different levels of production.

On the cocoon production side the silkworm Egg (seed) Corporation which is state owned plays a major role to ensure supply of quality eggs.

The National and Provincial Agricultural Institutes and the Agricultural Universities help in selection and maintenance of germ plasm determining the races suited to several agroclimatic regions and guides in extension.

Silkworm egg incubation is reported to be done at the commune level, young silkworm rearing at the set level and mature silkworm rearing and cocoon harvesting is conducted at the production team level.
Cocoons, thus collected, are sold to the China Silk Corporation, at a price decided by the State which differs according to the quality, which is uniform throughout the country. It is thus construed that quality evaluation facilities, as well as the driers are ought to be at the provincial or Commune level.

China Silk Corporation which took over all the export import functions concerning raw silk and silk fabrics hitherto handled by China National Textiles Import and Export Corporation (CHINATEX) and its branches dealing in silk products, is one of the state operated specialized enterprises, set up in March 1982 according to the decision of State Council. It integrates the silk industry with trade and has a status of a legal person.

Under the Chairmanship of one of the Vice-Chairman of the State Council and assisted by a Managing Director and a General Manager, the production, sales and marketing functions are supervised by Managers who look into the day to day affairs of economics, Finance, Statistics and Administration departments.

The China Silk Corporation is empowered to
1. Export of all silk products including garments, embroidered items, rayon, synthetics, blends and mixed fabrics.
2. Import of all yarn required for weaving as well as import of fabrics.
3. Wholesale domestic sale of the silk products
4. Purchase of cocoons.
5. Management of the industrial production units from filature to finishing.

6. Consignment processing, trade and joint ventures with foreign investors.

7. Economic Cooperation in technology of Sericulture and silk production with foreign countries and organizations.

It is hoped that the formation of the above organization would streamline some of the overlapping of competencies that exist in the organizational set up now, and gradually take control of the production and processing in future.
1. Seed Production

Silkworm seed production is usually conducted according to the directives of the Silkworm Seed (egg) Corporation of the Ministry of Agriculture. The kind of races to be reared for seed production is determined by the National and Provincial Sericultural Research Institutes under the Ministry of Agriculture and the Agricultural Universities. The targets for production are prescribed by the Ministry of Agriculture.

The team had an occasion to visit only one state owned Seed Production Centre known as Hu Shu Guang Seed (egg) Production Centre which was established in 1922. Thus it has 50 years experience in this field.

This facility is manned by 463 workers and staff out of which 6 are agricultural technologists, 25 - seed production technicians, 89 - workers for mulberry, 180 - workers for silkworm rearing, 26 - for administrative staff and 117 - supporting workers.

The Centre had 113 ha planted with mulberry which is capable of producing 7,500 kg / ha of leaves during spring and 8,200 kg / ha of leaves during autumn. Therefore, the total production of leaves is approximately 15,700 or 16,000 kg/ha per annum.

The activities are conducted in buildings with a floor space of 35,000 sq.mtr. and they are expanding to increase the capacity and adding some more equipment.
It has a cold storage facility capable of storing 3,50,000 sheets (1 sheet = 28 disease free layings = 5 grams or 2 sheets = 1 box of 23,000 eggs)

Three levels of seed production is undertaken, the grand parent ($P_2$) the parent ($P_1$) and the $F_1$ generation.

The production of silkworm eggs in the Centre is as follows:

$P_2$ - Grand Parent generation - 25,000 dfIs 5.95%

$P_1$ - Parent generation - 15,000 sheets (or 4,26,000 dfIs)

Hybrid $F_1$ generation - 3,50,000 sheets 4.29% (or 98,00,000 dfIs)

Silkworms are reared and good cocoons are retained for seed production and the excess cocoons are sent for reeling.

In addition to this activity, during off season when seed is not produced, this Centre is involved in making boxes for silkworm eggs, knit nets for silkworm rearing and produce ice in its cold storages. Pigs and Sheep are also raised and the excreta is utilized for production of farm yard manure.

This factory is only responsible for multiplication of $P_2$ and $P_1$ eggs and the four branches which are under its
supervision are responsible for the production of $F_1$ hybrid eggs which are sent to this Centre for cold storage, acid treatment and rearing upto 2nd stage. Disease free certification is carried out by the main Centre. Pebrine examination of individual moths is conducted at grandparent level and sample testing is done at the parent level.

The branches sometimes provide $F_1$ eggs to selected seed rearers for rearing at their level and providing cocoons for production of hybrid layings.

The production schedule is according to following steps:

1st - Planning and preparation for seed production
2nd - Disinfection and Sterilization - Buildings - Equipment
3rd - Hatching of eggs
4th - Brushing and rearing
5th - Mounting and Harvesting of cocoons
6th - Sorting, Pupa examination, Disease certification and shell content evaluation
7th - Sexing & seed production
8th - Seed preservation
9th - Disinfection, Sterilization and Consignment in cold storage.
The eggs are withdrawn from cold storage as and when required and are sent for distribution. But, before the eggs are sent for distribution they are examined for pebrine and viruses.

The eggs required for the $P_2$ and $P_1$ are produced during spring because the climatic and other conditions like the quality of leaf are good during the season. During autumn, Suzhou weather is hot as a consequence of which the quality of leaf is not as good as during spring. This centre rears hybrids during this season. At the time of the visit, the early autumn seeds were prepared and the late autumn harvest were due. Thus the seed production seems to be conducted during spring and early summer season.

Suzhou 3 ( ) X Suzhou 4 ( ) combination is popular in this area. Suzhou 3 belongs to the Chinese race and Suzhou 4 belongs to the Japanese race of silkworms.

Usually trays 80 cm x 1m accomodate 350 - 400 silkworms which are used in racks made of light wood frames using bamboos to serve as stands. There are about 550 - 600 eggs/laying. 60 layings make 1 box of 10 grams in weight. 2 sheets of eggs produce 30 to 40 kgs of cocoons. The sex ratio, Male & Female is 40:60.

The life cycle of the silkworm in spring and autumn is different. In spring when temperatures are low the duration hatching is delayed over 2 to 3 days and may go upto 11 days and during autumn when temperature goes high
the hatching takes place in 9-10 days thus reducing the life cycle 2 to 3 days. Thus whereas the larval life cycle takes 25-28 days during autumn, when temperature rises to a maximum it is brought down to 27°C by putting ice or switching on air coolers in the rooms. But, they have experienced difficulties accompanied by such practices due to increased humidity or lack of adequate humidity for which compensatory measures were required.

The silkworm eggs produced in the previous calendar silk year is used for next year. It is stored at a temperature of +2.5°C for 90 days. For immediate rearing the eggs are cold stored at 5°C for 40 days which is lowered to 2.5°C for the next 40 days after which HCl acid treatment is conducted at 1.092 specific gravity at 48°C for 5 to 6 mts. Incubation is conducted when the embryo reaches its second stage of development and artificial lighting for 6 hours duration (6 pm - 12 pm) is provided when it enters its 3rd stage.

Bush cultivation of mulberry is undertaken, 6,000 - 9,000 bushes are planted per ha. No information was provided as to what varieties of mulberry is cultivated. Leaf picking is still practised leaving the main branch with one or two leaves at the top left unpicked.

The cost of production/ha of mulberry was given as:

<table>
<thead>
<tr>
<th>Season</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>RMB 1,500</td>
</tr>
<tr>
<td>Autumn</td>
<td>RMB 1,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>RMB 2,500</strong> or US $1,315.80**</td>
</tr>
</tbody>
</table>
The direct cost of production of one sheet of eggs (28 dfls) is RMB 2.5 to 3.0 US $ 1.3 to 1.6. Including the administrative costs, it was £ 5 to £ 7.5 for 1 sheet. US $ 2.6 to 3.9. The cost of 1 box of eggs given as 2nd stage silkworms costs RMB 6 to 7.5. That is, they provide the eggs at cost price to the farmers. It was informed that this Centre sells 3,00,000 sheets/annum. Therefore, the receipts from this activity ranges from RMB 1.8 million to RMB 2.25 million.

The rejection rate of silkworm eggs due to disease is 3 to 5% whenever a laying is found to be diseased, the whole sheet will be burnt.

After visiting the egg production Centre and from what was shown, one could not make any conclusion of the level of technology or what equipments and processes are being used and followed respectively.
2. Mulberry Cultivation:

This was witnessed only in Yun Long Production Brigade of Chien Tong River Commune in Zenxiang Province and was introduced through projection of slides by the Zenxiang Agricultural Institute of Scientific Research.

Yun Long Brigade which has a population of 3,478 in 750 house holds divided into 16 production teams is one of the 7 brigades of Chien Ton River Commune of 24,000 people. Yun Long has 2,763 mu or 184.1 ha of arable land with 1,040 mu or 69.3 ha planted with mulberry. 400 mu or 26.66 ha is young mulberry and 640mu or 42.7 or established mulberry plantation.

Almost more than 60% of the Zenxiang area has been planted with the following 4 varieties of mulberry.

1. Tong Xiang Qing
2. Hu San 197
3. Tuan T
4. He Ye Bai

According to the Agricultural Institute the present production of leaf is reported to be 3,000 kg/mu or 45,000 kg/ha for HU SAN variety planted in different patterns of 500 - 1000 middlings / mu or 7,500 - 15,000 middlings / ha. But in the field only 1000 to 1,500 kg. of leaf is produced / mu or 15,000 to 17,500 kg/ha.

The Agricultural Institute demonstrated through slides that they are undertaking bottom pruning, but this has not been witnessed in the field. The team saw mulberry nurseries along side most of the grown middling plantations in the area of operation.
of the brigade. Plastic film techniques to prevent growth of weeds in nurseries as demonstrated by the Agricultural Institute was also not seen in the field.

In addition to wheat, mulberry, they grow rape seed, early and late rice, jute, vegetables & fruits. Both flood and drought resistant varieties have been planted in the brigade area because this area experiences more rainfall in spring and drought during autumn. Mulberries are pruning at a height of 80 cm at a distance of 1.3 m x 0.7 m.

Chemical Fertilizer was provided to mulberry N:P:K: 5:3:4 2 kg. of pure nitrogen yielding 100 kg. of leaf. According to the statistics provided by the Brigade a quantity of 120 Chins / mu/annum or 60 kg. / mu or Chins /mu / annum 30 kg/mu 450 kg/ha/annum of Farm yard manure (pig and sheep) 250 tonnes / mu / annum. 12,500 /mu /annum or 187.5 m.tons/ha/annum of river of tank silt. 20 ton or 1000 kg / mu - 15,000 kg/ha/annum of green manure is given to the mulberries.

The mulberry is picked to feel silkworms reared during different seasons. Yun long Brigade uses 5067 Chins of leaf/mu/ annum 2533.5 kg. of leaf /mu/annum or 38,002.5 kg/ha/annum or approximately 38,000 kg/ha. It is used to feed silkworms in the following proportion:
Spring - 2112 Chins (41.7%)
Summer - 418 Chins (8.12%)
Early Autumn - 1014 Chins (20.00%)
Middle Autumn - 1221 Chins (24.1%)
Late Autumn - 302 Chins (6.0%)

5067

This shows that there are two major crops in this area, spring and autumn, with small residual rearing in summer and late autumn.

The Brigade irrigates mulberry once in 10 to 15 days when continuous drought prevails.

Plant protection measures involves use of insecticides and pesticides. Hairy caterpillar, mulberry borers and *Theophras mandarina* were abundantly seen to occur all over the plantation. Dipterex was supposedly used but there was no trace of its action on any of the pests. Most probably the insecticides and pesticides are not being used for the fear of contamination to the silkworm.

Both leaf picking and shoot harvesting is popular.
3. Silk Worm Rearing & Cocoon Production:

This activity was witnessed in Yun Long Brigade. At the time of the visit, a few silkworms left from the early autumn were still spinning cocoons.

This brigade uses:

TONG FI x HUA 02
SUZhou 16 x SUZhou 18

Altogether 3,246 sheets, 1 sheet containing 1 box of eggs 23,000 - 24,000 eggs and 1057 trays of grown silkworms were utilized during 1981 as given below. It produced a total of 2368 Tans or approximately 2370 Tans or 118.5 m.tons of cocoons.

<table>
<thead>
<tr>
<th>Season</th>
<th>Sheets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>985</td>
</tr>
<tr>
<td>Summer</td>
<td>239</td>
</tr>
<tr>
<td>Early Autumn</td>
<td>716</td>
</tr>
<tr>
<td>Mid Autumn</td>
<td>1046</td>
</tr>
<tr>
<td>Late Autumn</td>
<td>260</td>
</tr>
</tbody>
</table>

3246 sheets

Silk worms eggs were obtained from the silkworm seed egg corporation of the Agricultural Bureau.

The Zhejiang Agriculture Research Institute claims to have released two combinations.

1. TONG 34 x TONG 603 for summer and autumn rearing which is popular with 70% of the farmers of the area
2. TONG 306 x HUA 10
A new combination TONG 34 x SW 12 has been found to yield 10% more than the other varieties under laboratory conditions, but has not yet been released to the field.

Weight of fresh cocoons harvested at the research station weighed 1.8 - 1.9 grms with a shell wt. of 0.36 grms and shell percentage of 19%. The filament length is 1,000 m. in the laboratory which under field conditions showed a consistent 800 - 900 m. Leaf: cocoon ratio is reported to be 1:14.

The time required for hatching to coconooning at the brigade was as follows:

<table>
<thead>
<tr>
<th>Season</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer &amp; Autumn</td>
<td>22 - 24</td>
</tr>
<tr>
<td>Spring</td>
<td>26 - 27</td>
</tr>
</tbody>
</table>

Usually young silkworms hatching from 4 to 5 sheets of eggs are reared by one person but as the silkworms mature only 2 sheets can be reared by a single person.

Silkworm rearing is conducted in big halls which are centrally heated with tunnels uniformly distributed under the floor all over the breadth of the room. Charcoal powder cakes are used in the heating devices to evaporate water kept in receptacles and thereby increasing the humidity when required. The rearing trays are made of bamboo and are round in shape. Some rectangular trays with rounded edges were also seen. The stands are improvised wooden frames with bamboo sticks to serve as shelves. These trays and stands are washed and disinfected before and after every silkworm rearing and dried in the sun. Lime powder was used in trays probably to control excess humidity in trays.
Usually one chin of silk worms requires 16.19 chins of leaf for spring rearing and 15 chins of leaf during autumn rearing.

The spinning silkworms are put on straw mountages to enable spinning. Bamboo and straw mountages were also seen in trays. It is reported that plastic wire mesh is also being used as mountages.

Calculating from the number of sheets the brigade reared, and amount of cocoons harvested it looks as if 22.25 kgs. to 36.5 kg of cocoons are produced per box of eggs (23,000 - 24,000 eggs).

During 1981 the brigade produced 2370 Tans or 35,500 kg. of fresh cocoons utilizing 3246 sheets of eggs.

<table>
<thead>
<tr>
<th>Season</th>
<th>Sheets</th>
<th>Coconns (Tans)</th>
<th>Kg.</th>
<th>Kg/sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>-</td>
<td>985</td>
<td>893</td>
<td>13,470</td>
</tr>
<tr>
<td>Summer</td>
<td>-</td>
<td>239</td>
<td>191</td>
<td>2,865</td>
</tr>
<tr>
<td>Early Autumn</td>
<td>-</td>
<td>716</td>
<td>438</td>
<td>6,570</td>
</tr>
<tr>
<td>Mid Autumn</td>
<td>-</td>
<td>1,046</td>
<td>691</td>
<td>10,365</td>
</tr>
<tr>
<td>Late Autumn</td>
<td>-</td>
<td>200</td>
<td>150</td>
<td>2,250</td>
</tr>
<tr>
<td></td>
<td><strong>3,246</strong></td>
<td><strong>2,368</strong></td>
<td><strong>35,520</strong></td>
<td><strong>53.38/5 = 10.6</strong></td>
</tr>
</tbody>
</table>

Another figure given is that the Brigade utilized 3.19 boxes/mu or 19.2 boxes / ha cocoon production is 422.4 kg / ha.

Fresh cocoons are sold to the provincial branch of the China Silk Corporation at the rate of RMB 200/ 50 kg. of superior quality cocoons and RMB 150/50 kg. of lower quality of cocoons. The standards used for prescribing the quality could not be ascertained.
The rearers receive a bonus when the actual production exceeds the targeted amount of cocoons to be produced.

Muscardine and flacherie were reported to be common diseases. They disinfect the silkworm rearing rooms by burning with some resins of Chinese plant origin as a preventive measure against muscardine. Mashed garlic is mixed with water and this extract is used for disinfection against flacherie. 1% bleaching powder \((\text{CaOCl} \ (\text{Cl}))\) and 2-3% Formalin also used for disinfection of rearing equipments and the rearing room. In addition, washed rearing equipment is dried in the sun. The seed production centre as well as the silkworm rearing areas are reported to be free from Pebrine.

The brigades which collect the harvested cocoons from different production teams sell their produce to the respective Provincial Silk Corporation.

According to the quality of the Cocoons the price ranges from RMB 150 / 70 kg. of low quality fresh cocoons to RMB 200 / 50 kg. for high quality fresh cocoons. The quality is adjudged by the number of fresh cocoons per unit weight. 1 kg. of Spring cocoon contains 480 cocoons and during autumn it is 560 cocoons.

Cocoon storing which was done in 20 kg cloth bags was seen in Suzhou No.1. Silk reeling Mill was quite satisfactory. The rejection rate was as high as 10%. Double cocoons occur below 1%. Scope exists for improving the cocoon sorting and grading which was noted in all the mills. This had a direct effect on the reeling which was conducted.
4. Raw Silk Reeling:

This activity was noticed both in a factory as well as at the brigade level. Except for silk reeling factory No.1, Suzhou all of the others were vertically integrated with weaving. The machines used were made in 1944. Other automatic equipment imported in 1956 from Japan; some of them are locally produced now. The capacities of the following mills were as given below.

<table>
<thead>
<tr>
<th>Workers No.</th>
<th>Outputs m.tons</th>
<th>Auto ends</th>
<th>Multi ends</th>
<th>Grades of raw materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Suzhou No.1 Silk Reeling mill</td>
<td>310</td>
<td>2000</td>
<td>7000</td>
<td>3A (9,200)</td>
</tr>
<tr>
<td>2. Hangzhou Silk Combine</td>
<td>300</td>
<td>10,000</td>
<td></td>
<td>2A - 3A (semi-automatic)</td>
</tr>
<tr>
<td>3. Yun Long Brigade</td>
<td>208</td>
<td>20</td>
<td>800</td>
<td>No grade</td>
</tr>
</tbody>
</table>

Silk reeling was noted at the automatic, Semi-automatic and the multi-end level. At the Suzhou silk factory there were 9,200 ends for reeling 7,200 of which were multi-ends and 2,000 ends automatic. Whereas at the Hangzhou silk combine there were 10,000 semi-automatic reeling machines. In the automatic machines cocoons were being delivered to the reeling end by travelling buckets carrying cocoons from which cocoons were cast automatically at each end when there was a drop in the number of cocoons being reeled per end. In addition to the automatic casting most of the automatic
silk reeling machines were equipped with denier control device. Brushing was done separately. Despite these measures built in an automatic machine, there was a need for the silk reeler to control the filaments and mend ends. Therefore, a reeler could attend to 50 ends at a time. Brushing was done at one end of the automatic silk reeling machine and cocoon with picked ends were supplied through the rotating buckets.

In the semi automatic the cocoons were only delivered but the casting was manual. In the multi-end, the cocoon delivery as well as reeling was manual. In most factories the number of cocoons per end were constant at 7 to 8%.

In the semi automatic machine 20 ends per basin/reeler existed and the cocoons were delivered to the basin through the travelling bucket system. No denier control devices were noticed. One reeler reeled 40 ends.

In the multi-end machine the silk reeler has to brush, pick the end and cast all by oneself, thereby making it more labour intensive. It had a brushing device as a part of each reeling basin and contained 6 other compartments to accommodate the reelable and the unreelable cocoons as well as the casting ends. The multi-end silk reeler was seated on a chair which was rocking on rails to enable swift reeling.

The normal working hours for reeling was 8 hours per shift with half-an-hour rest per shift.
The illumination to enable reeling was just above the head of the reeler. Automatic indicators existed for the steam utilized and ensure constant supply of electricity located at one end of the machine. 1.3 to 1.4 kg/cm² of steam was being utilized for 400 ends.

Most of the motor drive shafts had conical belt drums to change the revolutions which are not found familiarly in the silk reeling establishments now-a-days which use interchangeable gears. This shows the antiquity of the machines.

Cooking of cocoons was mechanized utilizing conveyor bucket system. The temperatures maintained in the different sections of steaping, steam cooking and finishing part maintained temperatures at 60°C - 90°C - 45°C respectively. In the silk combine, the cooking part maintained 58°C - 75°C - 45°C. In some places the steam supply pipes were not insulated thereby losing heat. The cooking machines were quite large having 104 baskets capable of containing 70 - 90 grms of dry cocoons / basket. The cooking time was 13 - 15 minutes depending upon the quality of cocoons.

The Suzhou No.1 silk reeling produces 20/22 d and 19/21 denier silk whereas at the Hangshou silk combine they reel mostly 20/22d but are also involved in the production of 26/28 d and 28/30 d raw silk.

Whereas in Suzhou Silk Reeling factory the hybrids of Suzhou 6 and Suzhou 7 varieties produced in the neighbourhood
was reeled the Hangshou silk combine reeled cocoons belonging to Han 7, Han 8, Tung Fi, Gua He varieties and single hybrids of the letter two races.

Reeled silk was invariably soaked under vacuum utilizing a softening agent known as F101 which is manufactured in Shanghai, China. The formula was not known. The equipment for soaking was locally designed.

The raw silk percentage for dry spring cocoons was reported to be 40% and for the autumn 30%. During spring 250 kg. of dry cocoons are utilized to produce 100 kg. of raw silk whereas during autumn 300 kg. of dry cocoons are required.

The productivity figures provided by the factories differed mostly in detail.

In the Suzhou silk reeling factory and reeling section of Hangshou silk combine it was mentioned that the 20 end multi-end machine was capable of producing 150-160 g/hr, during spring whereas the summer and autumn cocoons could yield only 100 g/hr for 20 ends. The automatic silk reeling machines showed a 25% higher productivity than the multi-end machines. Assuming that the machine works only 7 hours per shift efficiently, the production per person on 20 end multi-end machine is 1 kg to 1.14 kg per shift per 20 ends.

Re-reeling of raw silk to standard reeling of 1.5m in circumference revolving at 150 rpm was being conducted, promptly. Raw silk from spring cocoons are usually used for weaving pure silk fabrics.
While in the first mill the floor shop maintenance was relatively better but at the combine the maintenance was not up to the mark.

The steam supply for reeling was 1.3 to 1.4 kg/cm. The bath temperature was not more than 30°C as verified with a temperature indicator.

The ends were breaking frequently, thereby creating more number of idle, unattended ends reducing productivity. Low reeling bath temperatures are known to reduce frequency of groping ends, the percentage or reelability which directly affect efficiency of reeling. Of course the temperature should be modified according to the reelability of the cocoon. Increasing the quantity of steam supply to meet the maintenance of bath temperature in the range of 35-40°C may be very essential to increase the efficiency of reeling. If necessary, this should be raised to 2.3 to 3.5 kg/cm².

Another very interesting phenomenon noted was that good quality cooked cocoons were supplied to the multiend reeling basins whereas relatively inferior quality cooked cocoons were being supplied to the automatic and semi-automatic machines. This might be the reason for reeling efficiency of 90 ends/worker on an automatic machine, whereas a Japanese worker looks after 200-400 ends depending upon the quality of cocoons. Further, a worker looking after the semi automatic machine, (which is nothing but a multiend machine for all purposes with a denier control device and automatic cooked cocoon supply) looks after 40 ends whereas a worker attending
to an automatic machine looks after only 50 ends. This negates the relative advantage of investing a larger sum of money on automatic machines. According to convention, good quality cocoons are provided to the automatic machines and inferior quality cocoons to the multi-end machine. Skill wise, usually more skilled technicians are employed on the multi-end machines.

The wages paid per worker per shift, which was mentioned to be linked to productivity was more for workers employed on automatic machines than on multi-end machines which looks a little strange. Provided the quality of silk is as per specification the worker on the multi-end machine requires to be rewarded than the worker on the automatic machine.

There could be three reasons for which, quality cocoons are used on multi-end basis and inferior cocoons on automatic machines.

1. Production of superior grade silk on all the machines may be one of the major criterion.

2. There could be socio-political considerations demanding some ease of operation to jobs demanding skill and labour intensiveness.

3. Availability of a large labour force at moderate remuneration might have prompted this decision to employ a larger number of workers with least skill on automatic machines.

4. The quality of cocoons available and some of the processing including sorting, grading and cooking might have been responsible for this - supervision might have to be improved.
The Suzhou Silk Reeling factory which was established in 1924 employs 1801 staff has 54% direct workers, offers incentives for better quality and quantity of silk produced. The incentive system is also based upon 14 criteria of which the intrinsic properties like size deviation, evenness, neatness and cleanliness are the most important. These are determined in the inhouse testing facilities according to Chinese National standards.

Silk produced in the Suzhou No.1 Silk Reeling Factory is examined by the Commodity Inspection Bureau who issue certificates to that effect, both for domestic and export purposes as required according to the National Standards.

By products like douppion silk reeling and the waste preparation is not undertaken in most of these factories visited, except at the factories Yun Long Brigade where both these functions were being undertaken. Waste processing was up to the mark in the latter factory.

The cost of processing of 100 kg. of raw silk is RMB 1000 or US $ 526.3 or it costs US $ 52.63 for processing 1 kg. of raw silk.

Raw silk of 3A grade silk is sold to Japan at the US $ 32-35/kg and to Europe and USA at the US $ 30-35/kg. and "C", "D" and "E" grade silk to India is sold at US $ 22/kg. With the above cost of processing, it is not known as to how China is able to
offer raw silk of 3A grade and above at the above prices. Even assuming that there are recoveries due to sale of by-products the cost of processing is still on the higher side. Since this consultant was given to understand that China is desirous of making all these processes profit oriented and economic, it may be worthwhile to conduct a detailed investigation leading to cutting down of costs to a minimum in order to make these factories self supporting if not to earn a profit. Alternatively, silk reeling might have to be vertically integrated with silk weaving for earning a profit. Still then the cost of processing has to be brought down drastically.

Floss and the reelers wastes are processed further for spinning purposes, pupae are utilized as animal feed after extraction of oil and reeling water is used for fertilizing the fields.

Thus whereas silk reeling activity is an independent specialized activity which was noted in Suzhou, more vertical integration with weaving was noted in Hangzhou silk combine.
4. Design:

Designing plays a very important role in the marketing of the textile products.

The team witnessed this activity in greater detail at

1. The Suzhou Silk Designing Factory and casually at other factories like Suzhou Silk Printing Factory which employs manual and mechanical screen, rotary screen printing.

2. Hangzhou Silk Brocade Factory which has 60 years experience in weaving of coloured and black and white silk weaving which is later printed has an inhouse designing facility.

3. The Suzhou Embroidery Institute founded in 1957 and which specializes in production of gifts, souvenirs and other items by employing traditional Chinese embroidery had its own designing activity to suit its own specialized requirements.

The weaving mills in Jiangsu province were serviced by Suzhou Silk Trial Production Factory, a centralized design facility located in Suzhou which was established in 1957. From 1963, it is known as Suzhou Silk Designing Factory. More than 50% of silk fabrics manufactured in Suzhou are designed in this factory.

This factory employs 400 workers, 42% of whom are women. The staff includes 40 engineers and technicians.
In addition to developing designs which are prescribed by the Central Marketing Establishment to meet both for domestic and export needs, this centre has facilities for training factory hands as well as technicians intending to learn design and card punching. Extension work is also undertaken by its staff.

More than 500 patterns are produced per annum and released for Commercial production. The technical information is packaged and disseminated through design factory personnel who actually demonstrate the production of new designs, assigned by the Central Marketing Agency, to the different weaving establishments reproducing these designs and train technicians in the factory to punch cards and setting the looms for weaving of very complicated designs.

In addition, the factory produces cards meant for use in Jacquard looms for weaving cotton, silk and woolen products and organize training programmes in 10 different other provinces within the country.

There are five divisions at the Centre.

1. Designing - Production of different varieties which includes market study raw material planning, equipment and product development.

2. Patterning

3. Colour matching - as required by consumers and end users which includes Engineering.

4. Graphic Design

5. Jacquard Punching
The designs produced by this factory are exhibited at the Canton Fair held twice in a year from which they are able to obtain feedback upon the customer preference.

A visit to the Suzhou Zhan Ya Silk Weaving Mill and Dong Wu Silk Weaving Factory in Suzhou which benefit from the extension services provided by the Design Factory at Suzhou goes to prove that the transliteration of designs produced at this centre on the looms of the mills are well achieved.

The nature of designs noted in the different establishments differed according to the purpose for which they are meant for example, for use as apparel (formal or fashion, men or women's dresses), furnishing, upholstery, decorative or wall hanging purposes etc. They utilized a vast range of subjects, colours and motifs.

Most of the designs were artistically inspired. Whereas floral designs dominated woven products, paintings by famous Chinese landscape and animal painters were adopted for brocade and embroidery design meant for decorative purposes.

China with its long tradition of art and aesthetic sense has achieved very high levels in drawing and pattern making and has the necessary acumen for reproduction of minutest details in colour designing.

However, there was a general feeling that very dark shades of the basic colours were showing out a very strong contrast. This may be one of the reasons why most of the silk fabric is required to be exported in the grey state rather than dyed or finished.
Silk fiber has a great affinity for dye, the range of colours and shades found in silks produced in China could be far more than that is produced at present. The present trend specially for silks is pastel shades and colours which would be acceptable for any customer irrespective of nationality and background.

Therefore, there is a dear need for improvement in development of shades acceptable to discriminative buyers. Considerable craftsmanship and art is required at present to produce level results and to produce shades of colour to match specified standards. More creative colours could be produced by computerised shade matching instead of the present practice of trial and error, which is not very reproducible.

It should be remembered that the prime consideration in the choice of textile materials is the purpose for which they are intended but colour has been termed the best salesman.

Since the Design Factory is also producing designs for fabrics made out of cotton, wool, man-made fibres as well as their blends with silks, the kind of attention required for designing exclusively for silk might be getting diluted thus making it unsuitable. Sometimes, it was difficult to choose design wise or colour wise exclusive piece or a combination of both of silk fabrics from the range available at the show rooms or stock rooms attached to the weaving factories in
in Suzhou, whereas the situation was a little better in Hangzhou. However, in some factories exquisitely designed silk fabrics meant for export were being woven.

The team noted patterns which are inadequate for Jacquard and may be more economically achieved on the dobby. The long stretches of yarn wasted on the backside of the Jacquard woven fabric possibly could be saved. Dobby designs could also be utilized for production of silk scarves, lining, tie fabrics etc., which would increase the range of products currently manufactured and result in increase in the consumption of silk.

Similarly, the Jacquard punching could be much more simplified by adoption of more modern methods of production. The same could be said of fabric construction and loom efficiency.

The UNIDO team noted that the blouses and ready made shirts made only of silk could still be improved by imparting better training to cutters and pattern makers and scope exists for improving the stitching undertaken.

Last but not least, the designers should be exposed to more creative designing as done in other countries by spending considerable period of time in some of the important places in Italy, USA, Switzerland, France and UK etc., and should be kept regularly in touch with the market requirements.

Simultaneously, famous designers should be invited to visit China so that an interaction could take place between the local designers and the foreign design creators who could
possibly have an insight into the designs which are typically Chinese which could be selected for adoption and forecast about the colours or designs that could be in fashion two years ahead.

Designing need not necessarily be exclusively for export. The domestic market should also benefit from good designing effort.

The foreign interior decoration, dress design, Textile (fabric) design and Architectural magazines, when subscribed, could be a good source of information for the colours and shades which are current in the countries of their origin. These could be also adopted for the domestic market with some modification, which will improve sale of silk domestically.

The Chinese authorities desired to have some UNIDO assistance for development in this field of specialization.
5. Preparatory Processes

Raw silk is harsh and stiff on account of the gum. Generally raw silk undergoes several preparatory processes before weaving unless the fabric woven out of the undegummed silk is meant for dyeing in piece. The greater part of raw silk is degummed and dyed.

In China, both undegummed and degummed silk is processed and woven. Piece dyeing, as well as rope dyeing is undertaken.

This preparatory processes which involves throwing, warp and weft preparation and looming was noted in the following factories

1. Zhen Ya Silk Weaving Mill, Suzhou
2. Dong Wu Silk Weaving Factory, Suzhou
3. Hangzhou Silk Combine, Hangzhou
4. Hangzhou Brocade Factory, Hangzhou
5. Yun Long Silk Brigade, Chien Tong River Commune.

All the above processes are noted as a part of the overall exercise of weaving under one roof, never as decentralized, specialized and independent activities as noted in some of the South East Asian Countries, specially India.

The composition and the numbers of equipments used in all these establishments differed. For example Zhen Ya Silk Weaving Mill, Suzhou employs 630 looms of which 240 are Jacquard looms. They have 24 doubling machines, 100 winding frames and 182 twisting machines and 24 warping machines.
80% of its production is for production of crepes (01, 02, 03, 51), Satin and Jacquard fabrics. The Dong Wu Silk Weaving Factory which has 700 looms producing 50 varieties of fabrics using acetate, rayon blended with silk for which it has 40 doubling machines and 200 twisting machines. For crepes some of the establishments were using twists of 26 turns per cm and 23 turns per cm. The twists ranged up to 9,000 tpm.

In both the above mills as well as in other establishments visited, the yarn preparatory processes were very uncontrolled each in a different way. This might be because of addition of newer equipments while the old machines and still serviceable and are thus being used.

There was a lot of idle capacity. This could happen in such mills where a number of different fibres are processed and a varied number of different kinds of fabrics are being produced. Silk forms a very small activity in some whereas in some others it becomes a major activity. Thus a case may be made out for a specialized mill dealing with silk and its blends or mixed fabrics only.

The machine maintenance and repair was exceptionally good in most of the establishments.

Thrown singles, trams, crepes, organizers were prepared in each one of the establishments.
Pigment colour like natural white (2 or 5S), sky blue (2 or 5Z), Rose (3 or 6S), Sulphur (4 or 7Z) were being utilized for deleniating the number of threads and the twists utilized in the case of high twist threads. This is generally applied along with sizing materials.

The yarn preparation was meant for weaving fabric construction of plain weaves like shantungs, flat crepes, georgettes, crepe de chine, taffetta, pongee, chinon etc., twills, satins; and fancy weaves like Jacquards, brocades, damasks, pile construction like velvet etc.,

While there was no major differences in the details connected with preparatory processes in other countries, material handling in some of the establishment were moving not in a very logical fashion and the shop floor maintenance needed improvement.
6. Weaving

This activity was noted in five factories:

1. Zhen Ya Silk Weaving Mill, Suzhou
2. Dong Wu Silk Weaving Factory, Suzhou
3. Silk Combine, Hangzhou
4. Silk Brocade Factory, Hangzhou
5. Yun Long Production Brigade, Chien Tong River Commune.

Zhen Ya Silk Weaving Mill, Suzhou which was established in 1917 with almost 60 year experience behind it. It employs 3,100 workers out of which 65% of whom are women. This mill produces 30,000 metres per day with almost 30 varieties of fabrics with the following composition.

1. Pure Rayon
2. Polyester
3. Pure Silk Fabrics

The total amount of pure silk fabrics amount to 20% crepe silk, satin and Jacquards are produced.

There are five main sections, two for preparation and three others employing 630 looms, 240 of which are Jacquard looms and 150 of which have widths upto 1.6 mtr. Except these wide width looms all the rest produced narrow width fabrics of 1.1 mtr. on ordinary looms. Almost 70% of the products are meant for export. This mill works all three shifts and workers report for work for six days and rest for two days. Each day almost 7½ hours work was involved.
The mill is being modernized to produce more varieties at a higher speed and having larger packages. They are trying to acquire heat setting devices and scouring, bleaching and dyeing equipment. In this factory the material handling and moving was not very logical.

One loom produces 2.5 m per hour. Each worker attending 3 to 8 looms depending upon the complexity of the weave. No sizing is reported to be utilized for silk. Noise control measures have not been undertaken.

Dong Wu Silk Weaving Factory, Suzhou which is almost 60 years old employing 3000 staff members 50% of whom are women. It has 700 looms producing 50 varieties of fabrics. The majority of products are made of pure silk. However, pure rayon and rayon, different mixed fabrics of silk and rayon also were produced and most of the products are for export. China National Textiles Import Export Corporation (CHINATEX) (now, China Silk Corporation) determines the designs, provides the factory with orders, and determines the delivery conditions. Finishing is carried out in other factories.

The materials are meant for dresses, upholstery and others for minor nationalities.

The workers wages are 60 to 80 yuan per month and a single worker can maintain 2 to 5 Jacquard looms and
consume 2 m.tons of silk per day. Noise control measures have been undertaken under the guidance of a specialized agency created for that purpose.

At the Hangshou Silk Combine which was started in 1956 and completed in 1958 covering 31,000 sq.m. out of which 12,000 sq.m has been built. It has 1,800 staff, 60% of whom are women. They have three work-shops consisting of weaving, reeling, printing and dyeing. The two weaving work-shops contains 680 looms which includes 200 jacquard looms. The total output is only 9.6 million metres per annum. Most of the products are pure silk. The Jacquard loom produces mixed fabrics, whereas the other 400 looms manufacture pure silks. The produce, crepe-de-chine and Georgettes. Most of all these fabrics (95%) are exported.

The Hangshou Silk Brocade Factory, Hangshou which belongs to the Ministry of Light Industries was established in 1922 with 60 years of experience in weaving. It has 3000 employees and has 380 silk looms. This factory is under expansion. It produces almost 1,000 different designs of fabrics 50% of which is exported. It has colour silk weaving, black and white weaving which is printed later. In recent years the production is being increased as the demand for these products is increasing. This factory has won the national medal for best quality. It has four sections.
1. Designing
2. Raw material preparation,
3. Weaving &
4. Quality Control.

The various deniers of yarn that are utilized is 1/150d and 1/120d. According to one of the production cards which were verified they were weaving 1.40 m width fabrics with 13,440 ends, and picks of 122d, 108 ± 2 per minute, 61.5/cm capable of producing two metres per hour ± 0.4 metre per hour. They utilize more than 20,000 cards for a very complicated design.

In this factory the young workers earn about 50 to 60 RMB/day and exceptionally good workers who look after designing, weaving, machine maintenance earn 100 RMB. Retirement age is 55 and the workers receive 75% of wages as pension.

The Yun long Production Brigade Factory is vertically integrated from cocoon production to weaving. They have about 10 sets of power looms and produces mostly twills. One significant departure from others is that they had dobby attachments to the looms.

Thus it can be seen that silk weaving is conducted on larges assortments of both wide width and narrow width, domestically manufactured as well as imported looms (Tsudakoma) with automatic shuttle change as well as
manually changed shuttle looms with Jacquard attachments in almost all the above factories.

It was evident from this visit that once yarn processing is well looked after, the weaving process is more mechanical needing the least skill and human interference except for mending broken ends, or start, stop or restart the machines and some maintenance. Even complicated designs can be produced by a trained worker under the guidance of an expert supervisor, provided cards are punched and the loom is set to weave.

However, the logic behind using silk for the warp and rayon and other man-made fibres like polyester for the weft is not understood. If at all the silk effect has to be given, the rayon or polyester could be used for the warp and the pure silk on the weft so that the body bulk and appearance would be that of silk. Of course, cost is a factor which might have prompted this decision. It might be worthwhile studying the relative merits of these options and should the cost be compensated by the customer, the second alternative may be adopted in the interests of consumption of silk and inclusion of more silk in the fabric.

What impressed the visiting team most was the full utilization of most of the looms in a majority of the factories running 3 shifts a day and the exquisite woven fabrics produced out of them. Secondly, the absence of
ceiling lights in most of the weaving establishments and provision of a 40 W illumination right on the loom which can be drawn towards or away from the weaver. The light is just enough to examine the defects and was very soothing to the eye without causing much fatigue. There were devices to verify whether the composition of the cloth is according to specification as weaving is done, and scissors to mend ends and extra lengths.

The measurement of lengths and quality control did not differ in detail except that the silk fabric thus measured examined came into direct contact with dust on the bare floor both at the time of measuring and quality control. The reasoning may be that the silk will be subjected to further processing where this dirt would be removed. However, for obvious reason fabric coming into contact with dirt could be avoided.
7. Scouring, Dyeing, Printing and Finishing:

This activity was witnessed in

1. Silk Finishing & Dyeing Factory
   Suzhou
2. Silk Printing Factory, Suzhou

The Silk Finishing and Dyeing Factory, Suzhou has been established almost 50 years back. According to information provided this factory seems to have developed a series of processes. The factory is under expansion and modifications of most of the known processes has been undertaken and different technologies have been tried by this factory.

The main objective of this factory is to reduce costs and manpower on the bleaching, dyeing and finishing without compromising on the quality. Mechanization is being sought as a solution to achieve these ends.

The following four categories of fabrics are processed at this factory.

1. Silk - Crepes, Satins and plain weave. They either dye or bleach these products.

2. Rayon - Georgettes, Satins, serges etc., and other fabrics. All fabrics made out of rayon only are dyed.
3. Mixed Fabrics -
   Silk + Rayon ; Silk + Cotton
   Silk + Cotton + Rayon

4. Other man made fabrics as may be received.

All the above are meant for export to 40 countries. The processes undertaken by this factory differ according to the material composition, weave and end use.

The treatments given to pure silk are as follows:

1. Opening the fabrics and folding
2. Scouring & Degumming.

This is undertaken to remove excess sericin on the silk without damaging the fibroin content. Scouring is generally conducted in stainless steel on nickel basins by using soap and soda ash.

3. The dyeing process differs according to the construction of the cloth.

3.1. Open width dyeing is conducted in jiggers for Satin, Plain Weave and Habutai

3.2. Rope dyeing on winches is conducted for crepes.

4. Finishing : In this process drying and tentering is undertaken.
Plain weave fabrics are passed over simple steam heated cylinders in order to obtain lustre and hand. After drying a PERMA treatment is given. Crepes, however, undergo the single cylinder process and tentering process whereafter a PERMA treatment is given.

However, for rayon fabrics and specially for Chiffons for which Suzhou is famous, scouring, desizing, dyeing and finishing is undertaken.

In an answer to one of the questions as to whether the management is aware of a continuous degumming and dyeing process developed by an Italian firm (Mezzera) using a Swiss patented chemical P400, the reply was in the affirmative.

It was also elaborated that the factory had imported the most recent model of the "Mezzera" called as VEM-25. Their experience is that this process can only be more efficiently used for white fabrics made out of polyster fibre and not so efficiently for silk. This processing also required very big lots. Since silk is produced in small lots and in several different varieties this process seems not so economical. Now this factory uses a chemical known as KINOSA from Japan as a substitute for p-400, (which is used in "Mezzera" process).

Mezzera introduced three machines for silk finishing. Model TM3 for degumming and simultaneous bleaching or dyeing.
of silk yarns in hank form model VMB for continuous degumming and simultaneous bleaching of open width silk fabrics and the Mezzera flux to perform rope dyeing of degummed fabrics.

Model VBM is meant for mills of high volume for carrying out continuous degumming and bleaching of open width fabrics. This factory seems to have gone in for the largest model. Hence this difficulty of processing silk on these machines. Secondly, it is not only the machine but the chemical (P;400) which has to be imported regularly, which is a recurring expenditure.

Both imported and locally manufactured, direct, reactive and acid dyes are used for dyeing silk at 90°C. The factory was not aware of as to whether the dyestuff used by them is resistant to urea formaldehyde or formaldehyde sulfoxylate, which are used in crease resistance and reduction process of bleaching respectively. Common salt (NaCl) is used in the dyeing process. It was given to understand that it is not a practice to use even such water soluble substances like starch glue sugar or gelatin in the dyeing and finishing of fabrics.

However, the management confessed that plain fabrics require crease resistance treatments. But, as of today they do not apply any resins - because they are afraid that such
treatment would reduce the strength of the fabric and
deteriorates the "hand and feel". Thus they like to retain
the intrinsic properties of silk in preference to treating
silk to meet the competition faced from synthetic fabrics
in easy case. It was informed from the Thai experience
that the use of Polyurethane for crease resistance was
better than urea formaldehyde process which does not
diminish the handle or strength of silk.

The processing technology in this sector is developed
but still requires improvement. In order to strengthen this
activity, the Chinese authorities desired to have contacts
with other institutions involved in similar activities
or elsewhere in France, Switzerland /Italy and wondered whether
UNIDO could arrange such contacts for transfer of technology.

Scouring is usually conducted by using 3% (?) industrial
soap (10 gms/1 ltr. for 1 kg. of silk) at bath temperature of
98°C and $pH$ of 9.8 (9.5 to 10) for a period of 2 hours. Most
of the processes utilized soft water at $10^0$ hardness (10 ppm).
Two bath process starting with a partially exhausted liquor
and finishing with a fresh solution was followed. Rinsing
was adequate.

It was construed that no bleaching agent was added
because it was replied that they do not use any optical white,
and the whiteness is a "natural one", due to the adoption of
a time proven process as described above.
The amount of sericin left over is reported to be 1-2% with an overall loss of weight in the fabric up to 22 - 23%. This treatment depends upon the fabric construction and as a general rule white fabrics are degummed less.

The process control was done manually and variations are likely to occur depending upon the experience of the labour attending to this process. It was generally felt that consistency could not be maintained by adoption of such a process, but under the present circumstances there is no other alternative. However, the steeping and transfer of the silk from bath to bath was done by a remote controlled process.

It was informed that weighting was not undertaken to compensate for the loss in weight of degumming as it deteriorates the quality of the fabrics.

Further, it was also expressed by the visiting team that such low percentages of sericin left over in the fabric would be causing crease effects on white fabrics. It was agreed by the management that all plain fabrics required a treatment of crease resistance.

The scroop of silk was also improved by rubbing silk in acid and drying without rinsing.

Silk printing was witnessed at the silk printing factory at Suzhou. This factory established in 1959 as about 23 years of experience in this field. It employs 1,000 workers with an annual production of 10 millions metres. Three main categories of fabrics, 15% silk, 50-60% polyester and the rest mixed fabrics are processed by this plant.
About 1.5 million metres of silk and 6 million metres of synthetics material and the rest are mixed fabrics which are processed here. Silk, Synthetics, cotton, Rayon and blended fabrics are processed for export.

This factory was awarded the gold medal for excellence in printing on the subject "Pavillion in Lake".

The activities are undertaken in 4 sections:
1. Preparatory - Design & Screen Preparation
2. Printing
3. Finishing of Fabrics
4. Inspection and Packaging

Three kinds of printing processes are undertaken
1. Manual Screen Printing including discharge printing
2. Mechanical Screen printing
3. Rotary Screen printing.

98 - 99% of silk is manually printed. Mechanical screen printing is also being tried. Special machines have been developed for that purpose. 98% of the fabrics are discharge printed and only 2% of the fabrics utilize other processes. No block printing is tried.

Screens of different meshes are utilized polyester screen of finer meshes 8-10 unto 20 meshes is preferred over silk screens because of the good abrasiveness properties. 60 screens person/shift / 8 hours are produced. 4 workers work in the lab and 30 other workers reproduce the prints on 7 tables each 63 m long with heating facilities.
On an average 5 colours are produced for manual printing and less than 10 colours for rotary printing. The latter process was utilized when a maximum number of colours are to be reproduced.

Both locally manufactured and imported printing colours and dyes are utilized but no vegetable dyes are tried. For pure silk acid dyes along with sodium chloride (NaCl) is used, direct dyes for rayon and reactive dyes are used for discharge printing.

The goods are steamed after printing to enable thorough fixation of colours, washed, soaped, rinsed.

Both dark and light shades of prints meeting the state seems standard of fastness of 3 is undertaken. This to be low when compared to international standards.

At the Silk Combine at Hangzhou the printing and dyeing section processes 31 million metres. 20% are printed fabrics, 25% bleached fabrics and 55% dyed fabrics. 100 varieties of printed and dyed fabrics are produced in this establishment.

The processing undertaken at the Silk Combine did not differ very much in detail from that undertaken at other establishments.

Thus in conclusion silk in this section underwent "boiling off" process with involves a more or less complete degumming (25-30% of gum removal) exposing fibroin to severe damage in further processing. The degumming process must be confined to
rather narrow limits of alkalinity, time and temperature to prevent chafing of the filaments and exfoliation which causes lousiness effects.

Bleaching was not conducted in order to preserve the intrinsic properties of silk and probably to reduce the costs of processing. When entirely degummed the silk fabric needs little bleaching. If the fibre or fabric is still not white sulphurous acid or sodium peroxide is used.

The prime consideration in the choice of textile materials is the purpose for which they are intended but colour has been termed the best salesman. Thus colouring by staining and painting which is external and dyeing by penetration of dyestuff into the fibre has been attempted. Painting on silk was not noted during this trip.

Many dyes for silk have little affinity for cotton and since all fibres do not possess the same affinity even when same dyes are used, dyeing of mixed fibres give resist-effects, tone-tone effects, cross dyed effects of considerable ingenuity.

The desirability of these might be exploited as long as the fashion world demands such combinations while developing some better dyes like metal complex dyes and techniques of dyeing.

Common salt (NaCl) was used in the dyeing process. Sodium Chloride has in the past, on many occasions been the
the cause of serious damage to silk during processing.

Salt might not produce any effects when in solution but can produce tendering during prolonged storage when dried into the fiber. Even when good rinsing is done it does not get completely washed. Sodium Chloride in solution hydrolyses into Sodium hydroxide (Na OH) and Hydrochloric acid (Hcl) In the presence of Soda ash (Na₂ Co₃) the alkalinity is increased. Cold concentrated alkalis have little effect when the contact with silk is of short duration and rinsing follows immediately. Prolonged action of cold concentrated sodium hydroxide causes the fibroin to be dissolved. Hot mildly alkaline solutions dissolve fibroin rapidly. Lousy silk is formed more readily in the presence of alkali. Hydro Chloric acid which is formed due to hydrolysis further gets oxidized to Chlorine, which reacts with protein thereby spoiling quality of silk. In order to prevent this damage glaubers salt is always used in processing of silk.

The modern tendency is towards insistence on colours which are of pastel (light) shade, fast to light, washing, rubbing and bleaching. This makes a great demand on the craftsmanship, to produce level results and to produce shades of colours which match certain specified standard. This could be obviated by computerising this process which will ensure reproducibility to a larger extent than at present.

The chief printing processes applied to silk are the direct print, resist and discharge styles. The block printing, screen printing and roller machine printing are adopted.
However, it was reported that in China, block printing is not undertaken and screen printing is the most popularly practised while a little mechanical screen and roller machine printing on silk was also performed. Because silk and its blends with some selected fibers did not absorb the thickened printing pastes the outlines looked smeared. Hence, manual or mechanical screen printing is the best answer. However, in the interest of handicraft development, China which has a long tradition in wood block printing could also try block printing and resist printing like batic printing of fabrics.

In China, direct, reactive and acid dyes are used for dyeing. Acid dyestuffs are noted for brilliant shades or good fastness to rubbing and moderate fastness to washing. Direct dyes are not very brilliant, yet their fastness to light is better, less liable to bleed than acid dyes. Discharge styles on silk forms an important branch of these printed fabrics.

Finishing is the sequence of operations other than scouring, bleaching and dyeing after the fabric leaves the loom or the knitting machine. This is done to improve the appearance and serviceability.

Fabrics of high quality, like silk require little finishing because of its intrinsic appeal of richness, softness and lustre. However, even these would require damping, smoothing, ironing or pressing to make them look neat and presentable. Silk is dried to be smooth, even and free from distortions in open width. These methods are common to rayon and silk which
may be one of the reasons why both these fibres are clubbed together in China. It was not quite clear whether any gum or starch is used to stiffen the fabric; and glucose or sodium sulphate are used for fullness. However, there are other elaborate processes to make silk look more attractive, remove defects or impart some property which is not normally processed by silk which is undertaken.

The simpler finishing processes like the effects of moisture heat and pressure are tried in China. The treatments which are both physical and mechanical range from drying on a series of steam heated cylinders or a stenter frame while stretching the fabric to desired width during the drying process. Soft effects are obtained by mechanical flexing.

It was informed that weighting was not undertaken. Silk fabrics, if woven in the gum, are somewhat stiff and yellow. When this gum is removed preparatory to the finishing and dyeing process from one fifth to one fourth of the weight of the silk is lost. Silk manufacturers sometimes use certain metallic salts like stannic chloride (SnCl₄·5H₂O) in the processing of silk for weighting unless the material has to be dyed black. In this case iron salts are used. An amount of Stannic chloride not exceeding 10% seems to have no injurious effect on silk fabrics and may tend to increase the breaking strength. However, an excessive amount of tin weighting is injurious to the fiber, although it has little effect upon the luster. Ikuzo Sakaguchi
of the Faculty of Textile Science and Technology, Shinshu University, 386 Japan who has been working on the weighting of silk who says that "Silk weighted with tin is supposed to be heavier in feel and has higher draping quality than non weighted silk, and yet it does not lose its excellent character."

Metal weighting is usually permanent. The realization that excessive weighting of silk was injurious the trade had made the International Silk Association to adopt maximum standards of silk weighting. A lot of research work has been done to determine the effect of weighting on the washability and durability of silk. However, many manufacturers produce silk without weighting. They are known as "Pure Dye" (not more than 10% of any substance during finishing) or "non weighted silk".

Now only very few fabrics are weighted and thus a lot of developments have been done on the permanent finishes that give the cloth the desired body that are in no way injurious to its service qualities. Some of the new finishes render the fabrics crease resistant or water repellent also.

China has a great scope to develop the silk processing field.
8. Silk Art Work:

This was noticed in the Embroidery Institute located at Suzhou.

This is a regional institute founded in 1957 and is under the direct supervision of the Suzhou Provincial Arts and Handicrafts Corporation, of the Department of Light Industries.

The main objective of this institute is to develop traditional Chinese embroidery and train Designers, Embroiderers and Hand Weaving enthusiasts to produce gifts, souvenirs and such other items.

The history of embroidery which is more than 250 years old and which was meant to decorate pillow covers and bed sheets has been refined into a handicraft. After the establishment of the institute, 42 different types of embroidery stitches have been developed and with the quality of the refined techniques developed at the institute one could embroider simultaneously two different aspects of the same subject, on both sides of a fabric. The Tiger Hill of Suzhou has been embroidered on both sides of a fabric such that one side depicts autumn and the other side spring. By using of different stitches, the mirror image of a cat seated on a pillow has been depicted, which is really a marvel.

Silk, cotton and art silk are utilized for embroidery purpose and most of it is woven on handlooms to produce a compact cloth for use in this fine handicraft art work.
Similarly, for embroidery purposes all kinds of colours and yarns are used to obtain the desired result.

Vegetable and Chemical dyes are utilized to produce 1000 coloured yarns in the factory. Silk yarns which are thus dyed are isolated into their finer components to utilize for embroidery.

There are 3 such other Embroidery Institutes located in the following provinces.


The time spent was just adequate enough to acquaint with the activity; and it would be interesting to know about the nature of the hand weaving and the kind of vegetable dyes utilized for dyeing silk and compare notes. However, it has been an experience to be exposed to the art of embroidery which has reached its ultimate perfection in China.
9. Research:

Zhejiang Agricultural Research Institute, Hangzhou, established in 1950 is a provincial research institute where one of the activities undertaken is sericulture research to meet the provincial needs.

The sericulture section has 51 scientific and research workers 29 of whom are high and middle school graduates. 70% of the staff are college graduates. It has a farm of 170 mu.

The sericulture activity is conducted in the following three sections.

1. Breeding of silkworms
2. Cultivation of mulberry
3. Silkworm rearing & diseases of silkworm

Thus the laboratories deal with

1. Physiology and bio-chemistry of mulberry
2. Physiology and bio-chemistry of silkworms
3. Diseases of mulberry and silkworms.

The main objectives of the institute constitute development of mulberry cultivation and silkworm rearing with a particular emphasis on

1. The quantity of cocoons harvested / mu of mulberry
2. The quantity of yarn / unit of cocoons

Extension and training is imparted to farmers to enable them achieve these objectives.

It was explained that in 1979 - the HU SAN variety of mulberry yielded 3,000 kg/mu, 1 mu has 500 to 1000 mulberry plants. The silkworm races suited to the province are experimented at the Institute. The institute has bred 2 pairs of breeds.
1. TONG 34 X TONG 603
   for use in summer and autumn. Almost 70% of the farmers utilize this breed.

2. TONG 34 x SU 12

   The leaf cocoon ration was 1:14 and 11 gm of eggs yielding 35 kg. of cocoons. It was reported that fresh cocoons weighed 1.8 to 1.9 gms with an average shell weight of 0.36 gms showing a shell percentage of 19 and a filament length of 1,000 m. However, these cocoons collected from the field yield only 800 - 900 m. of the filament.

   The reelability varied from 12 - 30%

   The activities which were explained with the help of slides included

   1. Use of plastic film to reduce weed growth in the nurseries.
   2. Different mulberry varieties, planting distances and methods of training.
   3. Machines used in the pruning and disinfestation.

   Some of the research problems undertaken are:

   1. Nematode infections like root knot etc.,
   2. Analysis of the chlorophyll to determine the nutritional value of mulberry leaves.
   3. Spraying of 4th and 5th stage silkworms with several concentrations of urea to produce better shell percentage.
4. Use of high temperature (37°C - 24 hrs) for control of virus replication.

5. Use of chemicals like formaline and bleaching powder for prevention of silkworm diseases.

The visit was too brief to really get deep into the level of work done and it would have been more relevant and pertinent if the team was shown some institutions involved in the silk technological development also to get an insight into the organization of research on the processing of silk in China.
10. Other activities:

10.1. During the course of the Seminar, the Chinese delegation led by Mr. Dai Wei Zhong, Deputy Director, Department of Textiles, Ministry of Foreign Affairs sought two meetings with the UNIDO Industrial Development Officer and UNIDO Silk Consultant on 22nd September 1982 and again on 28th September 1982 respectively.

During the first meeting amongst other subjects of UNIDO competence like other textiles matters and Ramie Project etc., discussed, the major topic of discussion was silk processing in China. The Chinese authorities made a special mention of the report of the consultative Mission on the Integrated Silk Processing in 13 countries of the Asia and the Pacific (ESCAP/UNIDO) coauthored by the UNIDO Silk Consultant. The report received very high appreciation.

On 28th September 1982, Mr. Hou Shou, Manager, assisted by Mr. Li You Zhou, Chief, Market Research of China Silk Corporation and Mr. Zhu Xing, Senior Engineer of the Ministry of Textile Industry, explained at length the present state of the silk processing and laid the need for upgrading the post reeling operations of degumming bleaching, dyeing, designing, printing and finishing of silk to enhance the export of better quality finished goods instead of the grey fabrics and sought urgent assistance from UNIDO in this matter.

The major immediate objective outlined was to provide technical and consultancy services and provide on the project training as well as abroad, of a sizeable number of technologists.
and to strengthen one of the promising institutions in a silk processing wise intensive areas to locate the National Silk Processing Development Project.

In reply, the UNIDO Industrial Development Officer explained the procedures concerning such requests and informed that any action could be considered on the merits of a request forwarded through the Ministry of Economic Relations and Foreign Trade.

10.2. Visit to Hangzhou coincided with the visit of one of the largest customers of Chinese raw silk and fabrics from the United States, who was also incidentally put up at the same guest house. He was the guest of the Hangzhou branch of the China Silk Corporation.

On 24th September '82, an unscheduled meeting involving the manufacturer Mr. Bob Scalamandre of Scalamandre Silk Inc., New York, Mr. Minke of UNIDO, Mr. Li You-Zhou of the China Silk Corporation was convened by the author after dinner that evening to hear the manufacturer's impressions and his suggestions for improvement of Silk of Chinese origin. The proceedings are as follows.

This manufacturer who weaves wide width fabrics mostly meant for interior decoration and a supplier to all prestigious institutions like the White House informs that this factory is involved in production of Damask and Satin tapestries which are in great demand in the US. His factory has 28 different types of looms (70 in number) each type utilizing upto 16 shafts and are capable of weaving different kinds of weaves.
The quality of yarn required by him belong to 22 d doubled yarn. He has been importing US $15,000 worth of material at a time. He informs that commercial brands like "Golden Double Deer" and "Golden Sleever" of 4A and 5A grade supplied by Wuxi are upto the mark.

He outlined certain problems faced by him as regards the yarn supplied by other suppliers through the China Silk Corporation.

1. Quality of yarn does not stand up to specification quoted. Specially in the organize, the yarn is sometimes tied to other skeins thereby making it difficult to find the ends.

2. The lacing with cotton thread is sometimes tied at 3, 4 or 6 places which causes difficulties in further processing. Sometimes the yarns are so tightly tied that the dye penetration is not uniform.

3. Even though the quality of weaving of the piece goods is generally good, there have been inconsistencies between lot to lot and lack of uniformity in colours and shades.

4. The dyeing process has lately improved, but the fastness standards should be raised to at least 5 if not to 8 in order to achieve international standards.

5. The dyestuff and other chemicals used in processing have also shown improvement but scope exists to utilize Lanolin and such other dyes to improve fastness.
6. The dyeing and finishing needs some sophistication for production of better dyed yarns and fabric.

7. China does not produce enough wide width fabrics for home furnishings which has a stable market in the USA.

8. The present designs are too traditional and need improvement.

In order to enhance the present market of Chinese fabrics he recommends

1. To try manufacture of wide width (55") Chinese Tasar x Douppione fabrics which will find a ready market. The loom width should be 64".

2. He feels that at present not enough advertising is being done for silk in America which could have a greater impact on its promotion. He advised that the China Silk Corporation should explore combined effort on this core in close cooperation with cotton Incorporated, Wool Bureau and the Silk Bureau in the USA.

3. Since the product is new to the market, he advises China to select the target market (or markets) and start approaching this problem of promotion more systematically. Depending upon the market (or markets) identified out of the low
income bracket, middle income bracket and the high income bracket, he felt strategies should be laid depending upon the geographical location whether it is North East, South East, Mid West or West. It is very difficult, to outline the strategy offhand, but some consistent effort should be undertaken.

If felt necessary he feels that his Company could render such assistance and advice as required.

4. He even advises that young aspirants should be sent to higher education in weaving, design in the United States. After completion of Scholastic career, those students who wish to specialize should spend considerable period of time with designers. He suggest exchange programmes.

5. In order to develop the present designing capabilities he suggests that the textile designing institutions as well as the textile institutions to subscribe to such textile design, dress design, interior design, architectural design and trade magazines in US as well as other countries to which export is intended for knowing about the current trends in colours, shades and designs.

Adoption of most of these constructive suggestions would help improve the marketability of silk.
Conclusions

During the short sojourn in China, the participants to the Integrated Silk Processing Seminar had an occasion to witness two levels of production.

The first half of the visit was to more specialized homogeneous activities in mills visited in Suzhou; and the vertical integration of different sectors, including both agricultural and industrial, or of related fields of the industry, during the visits to mills in Hangzhou.

For example, throwing and weaving; similarly printing, dyeing and finishing, were clubbed together in the more specialized mills, but a vertical integration was observed in the Silk Combine at Hangzhou and extended vertical integration between both agricultural and industrial sectors at the Yun Long Brigade, Chien Tong River Commune. In addition, one agricultural activity each, viz., silkworm seed (egg) production in Suzhou, and silkworm rearing and cocoon production in Yun Long was observed.

During the meagre time at the disposal and notwithstanding the painstaking interpretation (not only from Chinese to English and vice versa but also from Chinese to Chinese had to be resorted to at times), the Chinese hosts have been able to cover a large spectrum of the industry. The arrangements were excellent and need a special mention. However, it was felt that some basic information concerning the factories visited could have been prepared beforehand and handed out just before the visits. This could have saved time for discussions and obtaining some more useful information.
The following account gives a short summary of the several observations made.

Sericulture and silk production in China has been rural based and employs large masses of labour. A larger percentage (more than 50%) of those employed in almost all the establishments were women.

The technology utilized was not very simple. It is very labour and technology intensive, and demanded sizeable investments in order to produce quality goods of an acceptable standard, specially to meet export standards, at a price which could be afforded by the higher middle income in the society.

At the outset it has to be pointed out that the present conclusions have been arrived at after computation of figures provided during the several visits.

China produced, Mulberry, Tassar, and some Eri cocoons to serve as raw materials for its silk production.

During 1981, China produced 311,000 m. tons of cocoons including Tassar and Eri, and 37,400 m. tons of raw silk which includes both Tassar and Eri silk.

The Mulberry cocoon production is 75,000 m. tons and the raw silk was 26,000 m. tons.

Therefore, 236,000 m. tons of Tassar and Eri cocoons and 11,400 m. tons of Tassar and Eri silk yarn was produced.

Thus, China is not only a major Mulberry silk producer but also a major Non-mulberry silk like Tassar and Eri silk, the production of which was not witnessed during this visit. The only other major producer of Non-mulberry silk in the region,
India, produces 448 m.tons of silk of Non-mulberry origin.

Any further reference to silk in this report would mean and Mulberry silk/not Tassar or Eri.

The raw silk production in China is done in more than 600 mills and Hangzhou itself has more than 28. Thus, a large industrial base exists in China for production of silk which sustains a larger cocoon production.

The production of coons or raw silk exceeded the consumption in China.

The word "Silk" is very broadly being used for fabrics in China even when one of the components is silk and the other component manmade or regenerated fibre. A visit to the weaving mills in Suzhou and Hangzhou revealed that polyester, rayon etc are being used in different combinations with silk, probably with an aim to reduce the cost of the fabric to meet the domestic demand.

The domestic demand for all kind of fabrics, pure silk or mixed or blended etc. would be 500 million metres.

China produces more than 800 million metres of silk fabric which might be valued at approximately RMB 6,400 to 8,000 million or US$ 3,400 to 4,000 million, out of which pure silk is only 1.2 million metres; out of which only 0.6 million metres are exported. This would have brought in a revenue of RMB 4 to 5 million or US$ 2 to 2.6 million.

However, China exported 8,00 m.tons of raw silk which might be valued at US$ 200 million (calculated at an average price of US$ 25/kg. for all varieties sold).
This shows that the raw silk of Chinese origin is much more acceptable internationally than the woven or finished products. Further, it might also be relevant to find out as to how far quality or the cost at which the silk is offered or the quantums that could be offered at any point of time or which of these combinations, play a decisive role in the purchase of raw silk of Chinese origin; and why sucha trickle of the silk fabrics in a grey form are exported, so as to lay emphasis on the development of the industry.

Silk processing technology in China has a long tradition and thus adopts time proven methods. Now China is attempting to modernize which explains coexistence of old and new machinery as well as processing methods. Despite the age of the machinery a lot of care was bestowed on the proper maintenance and prompt repair of them which improved efficiency. Machinery development to suit each factories own needs was also noticed.

China produced gradeless to "6A" grade raw silk. The major exportable grades are"4A", "3A" and some "2A" grade of 20/22 d category. The "5A" and "6A" grades are not available in quantities enough for export. However some "C","D", "E" grade raw silk is exported to other developing countries in Southeast Asia, including India. There seems to be great demand for"4A"to "6A" grades silk and future modernization of raw silk processing should be oriented towards this.

From the processing costs given to the visiting participants it cannot be said that silk reeling is a very economic and profit yielding proposition. It was not quite clear whether this was
compensated in the subsequent value added weaving operation.

This might then require upgrading the present cocoon production, specially the mounting of silkworms to produce better quality cocoons with avoidable defects. The investments required to acquire rotary mounting frames etc., would be worthwhile. Availability of good quality cocoons will improve the grade of silk that could be produced in reeling. Similarly, there is also a need for the improvement of the genetic endowment of the silkworm races. Cocoons weighing more than 2 gms with length of filament longer than the present 1,000 m in length and shell percentage of more than 19% should be produced. The National and Provincial Research Institutes could possibly achieve this with a little more orientation in this direction.

However, from the cocoon production data provided, the Chinese farmer in the Brigade utilized 3.19 boxes/mu or 19.2 boxes/ha, with an average pr action of 422.4 kg/ha., or 22 kg of fresh cocoons/box. This would work out to 42 kg of raw silk/ha. Just to provide a comparison, and to evaluate the level of technology some Japanese statistics are being quoted. A Japanese sericulture family having an average of 0.73 ha./family; utilizing 13.7 boxes of eggs produced 440 kg of cocoons/ family. The national average is 700 kg of fresh cocoons/ha utilizing 21 boxes of eggs/ha, which works out to 32 to 33 kg of fresh cocoons/box. There are farmers who produce more than 1000 kg/ha. Thus, raw silk production in Japan is 90 to 120 kg/ha which is quite high.

Thus the technological capability to produce 32 kg of fresh cocoons instead of the present 22 kg/box, 700 kg of fresh cocoons
instead of the present 420 kg/ha (preferably 1,000 kg/ha) and raw silk production of 90 kg/ha from the present 42 kg would need a long and sustained effort, which China can because agro-climatically it enjoys the same, if not better climate than Japan.

China, which has achieved its objective of being the largest silk producing country, should now shift its emphasis from production of quantity to quality goods and products.

Modernization of the silk industry needs not only capital investment, but also better technology and aegis to transfer it to the field. The number of the transfer agents and their content has to be improved by not only providing them on-the-job training but also acquaint them with the developments in countries which are famous for their respective technologies.

From what was gathered on personal interviews, there is a great scope to augment further information and improve documentation and retrieval. Even though, the officials on several occasions were very eager to provide information, it was not readily available. Cost analysis and net savings with respect to turnovers and expenditure etc., were available with some institutio