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REVITALIZATION OF THE NATIONAL SILK INDUSTRY

SI/PHI/86/884/11-01

REPUBLIC OF THE PHILIPPINES

## Technical report:  Silk reeling*

Prepared for the Government of the Republic of the Philippines
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Joong-Hee Nahm
Expert in silk reeling

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United Nations Industrial Development Organization
Vienna

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## Explanatory Notes

Organization:

PTRI, Philippine Textile Research Institute (Manila)
DMMMSU, Don Mariano Marcos Memorial State University (Bacnotan, La Union)

Technical abbreviations and symbols:

D; denier, (size of fiber filament)

20/22 D: size of raw silk expressed the goal denier

M/T: metric ton

Cocoon Grade: A, B, C, D, or excellent, 1st, 2nd, 3rd

Raw silk grade: 6A, 5A, 4A, 3A, A, B, C, D

R and D : Research and Development

## TABLE OF CONTENTS

## Abstract

The aim of the project SI/PHI/86/884/11-01/J 13012 is to assist the silk reeling industry of the Republic of the Philippines.

The objective of the activity being reported is to increase the use of indigenous silk fiber by providing practical recommendations for revitalizing the national silk industry.

The silk reeling expert worked under the following terms and conditions:

- duration of the activity to be one month and 15 days;

- location of the activity to be in Manila, provided with travels within the country;

- Work in close cooperation with UNDP/Manila and PTRI;

- evaluation of cocoon quality for silk reeling;

- raw material production potential;

- actual state of major silk reeling facilities;

- productivity of raw silk;

- prepare an outline for silk reeling technologies to be applied in achieving the foregoing goals.

## I. Introduction.

According to the report of ALVAREZ. (1985)[1], sericulture in the Philippines began during the Pre-war era.

Nevertheless, the decline of sericulture was caused by lack of technical knowledge and inadequate financial support from the government.

After the outbreak of the second world war, the technology was lost and mulberry farms were planted to other agricultural crops.

Rehabilitation of silk industry started in the early 1960's under the Mountain Province Development Authority.

In 1973, the projects were transferred to the Philippine Textile Research Institute (PTRI) under the National Science and Development Board. Now Department of Science and Technology.

At present, PTRI has established viable projects on sericulture including silkworm breeding, egg production, cocoon production, cocoon grading, silk reeling, raw silk testing and silk products development and utilization.

The Philippines is endeavoring to promote the sericulture in the Northern and Southern parts of the mountanous regions and the country has invited foreign experts to help in the development of the silk industry.

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[1] Status of silk industry in the Philippines, by VIRMILA B. ALVAREZ. The ESCAP Workshop/Study. People's Republic of China. (1985).

Furthermore, technical people and other officials concerned with silk industry have visited Japan and Korea several times to learn and gain technical and advanced informations and development in sericulture.

If this group of people can develop and master the techniques of silkworm rearing and silk reeling, the prospect of the silk industry will be very bright.

Technical assistance from the more advanced countries in silk industry is indispensable to the development and promotion of the silk industry in the Philippines.

The period of assignment of the expert is between 16th Nov. and 30th of December 1987 and are described in detail as follows:

II. Recommendations:

1. The density of planting in mulberry farms must be increased to obtain more mulberry leaf yield; it is important to maximize the length of branches per unit area.

2. At present, most of the silkworms are reared by the shelf-rearing system. Studies regarding rearing technique advances indicated the advantage of shoot-rearing over the shelf-rearing system, because shoot-rearing is recommended.

3. After rural communities for cocoon production are organized, the cooperative rearing of young silkworm must be established and stabilized to enhance good harvest of cocoon crops. This system insures good nutrition control and efficient use of the rearing equipment.

4. In the Philippines, system for cocoon grading and pricing is
   controlled and dictated solely by the buyer.

   Henceforth, the price in the transaction of cocoons must
   be calculated from the price coefficient expressing the standard
   for the cocoon price and the percentage of raw silk in cocoons
   which is obtained from the result of cocoon testing.

5. In order to produce good quality cocoons, training and extension
   services must be provided and extended to the farmers.

6. Cocoon testing should be conducted yearly to examine the
   quantity and quality of raw silk obtained from cocoon production.

7. Rigid technical training and specialization on cocoon testing
   and raw silk inspection particularly must be made available
   to the staff of PTRI in Korea and Japan.

8. For the treatment of fresh cocoons, it is recommended to set
   the steam heating type drying machine in Misamis Oriental to
   produce high quality silk from the cocoons.

9. The testing equipment for raw silk is absolutely necessary for
   the prove inspection and grading the raw silk.

10. Filature water must be analyzed for the improvement of silk
    reeling results.

11. To guarantee the successful improvement of the project, and
    to give more information and recommendation for further
    improvement, an expert in silk reeling must be given training
    annually for at least one month every year.

III.  Status of Silk Industry in the Philippines

1.  Trends of Production:

The basic policy of the Philippine Silk Industry is to meet the demands for domestic market by increasing the production of cocoons and raw silk.

The Philippines produce about 15-25 tons of cocoons. These cocoons are being exported to other countries and then the Philippines import silk fabrics from abroad. (Annex-1) (Annex-2)

The outline of silk industry in the Philippines is given in Table-1.

Table-1.  Estimated numbers of cocoon, raw silk and silk fabrics produced in the Philippines.

| | | Production | |
| Commodity : | Quantity : | Quality and others : | Source Reference |
|---|---|---|---|
| Cocoons : | 15-25 M/T/yr.: | Bivoltine C-grade  : | 2/ |
| Silk Yarns : | 205 kg./yr.  : | 20/22D    A-grade  : | 3/ |
| Silk Fabrics: | 108,000 yds/yr: | Jusi, Pongee, Shantung : Noil Silk, Spun twill silk | 4/ |

Information from PTRI:

Only PTRI has a silk reeling plant for semi commercial production of silk filament and Japanese standards for grading cocoons.

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2/Monthly Progress Report of PTRI.

3/Quantitative Flowchart of PTRI.

4/Summary of Properties Measured for local hybrid of PTRI, cocoon harvest from 1985 and 1986 to 1987.

In the Philippines, it is highly recommended to establish an integrated silk industry approach because of the limited cocoon market.

2.  **Cocoon Quality:**

According to the results of cocoon testing, the quality, especially percentage of raw silk is at a lower level.

The various characteristics of cocoons are shown in Table-2.

Table-2.  Qualities of Cocoons

| Items | : | Results | : Japanese results6/ | : Source Reference |
|---|---|---|---|---|
| Average cocoon weight (g) | : | 1.20 - 1.40 : | – | : 2/ |
| Cocoon shell percentage (%) | : | 18.8 - 25.0 : | – | : 2/ |
| Length of cocoon filament(m) | : | 1,162 - 1,290: | 1,186 | : 4/ |
| Cocoon reelability(5)5/ | : | 72 - 82 : | 72 | : 4/ |
| Size of cocoon filament(d)5/ | : | 2.51 - 2.64 : | 2.59 | : 4/ |
| Raw silk percentage(%) 5/ | : | 14.0 - 15.0 : | 18.10 | : 3/ |
| Double cocoon percentage(%) | : | 2.8 - 7.0 : | – | : 2/ |
| Percentage of rejected cocoons(%) | : | 2.8 - 3.0 : | 0.9 | : 2/ |

In the cocoon production, the development and application of appropriate technologies have not yet been given adequate attention. (Annex-3, Annex-4).

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5/Based on multi-ends.

6/Handbook of Silkworm Rearing (1972), Tokyo, Japan.

3. Silk Reeling:

This project is being conducted in the division of
silk development. They monitor the quality of cocoons
produced using the local hybrids of silkworm and encourage
cocoon producers to produce quality cocoons and silk yarns.

The project's existing silk reeling facilities also
provides services to private companies in processing their
cocoons into raw silk.

The current productivity of raw silk is given in
Table-3.

Table-3. The Actual Production of Raw Silk

| Year | : | 1982 | : | 1983 | : | 1984 | : | 1985 | : | 1986 |
|---|---|---|---|---|---|---|---|---|---|---|
| (a) kg/man/day[7/] | : | 0.22 | : | 0.27 | : | 0.35 | : | 0.38 | : | 0.46 |
| (b) kg/man/bath[7/] | : | 0.88 | : | 1.00 | : | 2.10 | : | 2.60 | : | 2.30 |
| Index : (a) | .: | 100 | : | 122 | : | 159 | : | 173 | : | 209 |
| : (b) | : | 100 | : | 113 | : | 238 | : | 259 | : | 261 |

Although silk reeling efficiency had improved in the
last 5 years, the productivity levels are much lower because
of the lower levels of both labor and reeling machines
being used.

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[7/] Information of PTRI.

## 4.  Raw Silk Inspection:

Inspections are checked through installed testing equipment, such as conditioning oven, evenness tester and cohesion tester.

The samples of raw silk have been sent to the Seoul National Silk Inspection House to examine the grades.

The details of the test results is given in (Annex-5).

## IV. Detailed Report

### 1. General Background Information:

Based on the solid background of researches and activities on sericulture, silk industry of the Philippines produced a remarkable growth for the last ten years. Studies show that the total export of raw silk for the year 1982 has increased from 500 to 1,200 kg.

During the same period of time, the project from the pilot demonstration farm to industrial production together with the private sectors and the farmers cooperators, has considerably stabilized cocoon production in the country.

At present, PTRI has established a reeling plant to produce local silk. Serious researches and activities were considered in utilizing raw silk to produce Philippine Silk Products.

The expert proposed the following fields for further expansion of silk products in the country.

### 2. Detailed reports on survey visits:

(1) Project visited: Silkworm Breeding and Egg Production Project, in La Trinidad, Benguet Province.

The expert was accompanied by Miss Cecilia B. Arriola of PTRI.

People contacted : Mr. Paul M. Bacuso, Sc. Research Specialist I

Mr. John P. Saley, Farmer of Balinsak, Kapangan, Benguet

Mr. Bell Belangoy, Farmer of Lomon, Kapangan, Benguet

Mr. Napoleon C. Tan, Local Government
Officer, Department of Local Gcv't.
Kapangan, Benguet

Background:   In the past, most of the silkworm varieties were

brought from Japan, Taiwan and Korea.  This project

can supply silkworm eggs for the cocoon producers.

The facilities were established in 1976 and

13 people make the study on silkworm breeding.

As a result of their endeavors, tropical silk-

worm varieties have improved tremendously.  At present,

however, this station can accomodate only 1,120 boxes

of silkworm eggs per year.

The cooperative rearing of young silkworm is

also well supported by farmers in the area.

The current cocoon harvest per box is 20-40kg.

and silkworms are reared 6 times per year.

Item discussed:  The people concern the cooperative rearing of

young silkworm to be expanded into the rural

communities for cocoon production.

Proposal       :  The lower level in cocoon productivity in the

Philippines may be increased by adopting some of

the recent advances in silkworm eggs production in

the developed countries such as Japan and korea.

And it is strictly recommended that the foundation

stock of eggs (parent eggs of F1 hybrid) must be

examined to produce silkworm eggs which is not infec-

ted by Pebrine.

(2) Project visited: Cocoon Production, Training and Extension Project in Kalingagan, Villanueva, Misamis Oriental. December 3, 1987.

The expert was accompanied by Miss Cecilia B. Arriola of PTRI.

People Contacted : Mrs. Zita L. Sanchez, Science Research Specialist I, Kalingagan, Villanueva, Misamis Oriental.

Background : This project is a typical large scale producer with 14 employees. It works since 1976.

There are 2 hectares of mulberry field and one silkworm rearing house.

Activity and Production : The technical employees extend technical services and consultation to farmer cooperators and private sector in the area.

By requests, short-termed training courses are also conducted and made available to nearby provinces.

The production value of cocoons per box is about 20-25 kg in the latest rearing of silkworm.

The farmers have a deep interest in the diseased silkworms and on the new conditions of cocooning mountage.

Issues discussed: Mrs. Sanchez enumerated the current problems

as follows:

a) High percentage of silkworm mortality

and stained cocoons.

b) The treatment and processing of fresh

cocoons.

Actually, it was observed that there was

a high number of stained cocoons and double

cocoons.

Likewise, the fresh cocoons have been

treated under unsuitable conditions from a

cottage heating system.

Proposals : The expert gave one reference literature on

the silkworm diseases and proposed to set

up the steam-heated cocoon dryer.

(3) Project Visited: FAO project on Sericulture in DMMMSU,

Bacnotan, La Union, November 27, 1987

People contacted: Bienvenido P. Agpaoa: Ph.D. President, DMMMSU

La Union .

Virgilio M. Libunao:  Director, Sericulture

Research and Development Center.

Mr. Nestor Ballesteros:  Agricultural Machinery

Researcher.

Activities : In this project visited by the expert, the

practical services for silkworm rearing are

provided and extended to farmer cooperators.

Fabrics are produced tentatively with the

use of the handloom.

Future Plans        :    (a) Extension of mulberry fields.

                         (b) Institution of a pilot silk reeling plant.

Item discussed      :    In this project, they are attempting to
                         select the good characteristics of silkworm
                         pupae using the reeling of a cocoon in alive
                         for breeding purposes.

Proposal            :    The expert presented and described the fresh
                         cocoon reeling method with the use of
                         potassium hydroxide solution.

(4)  Cocoon Processing and Raw Silk Testing in Bicutan, Tagig,
     Metro Manila.

Contacted counterparts:  Mrs. Salvacion Jusi-Cruz:  Project Leader
                         Ms. Cecilia B. Arriola:  Researcher

Background          :    The reeling plant and raw silk testing facilities
                         were established at the PTRI in 1978.[8]
                         The major equipment for cocoon processing
                         are the following:

                         1.  Multi-end silk reeling machine has a
                         capacity of producing 8-12 kg. raw silk/8 hrs.
                         operation.

                         2.  Cabinet type cocoon dryer (75 kg/8hrs)

                         3.  Cocoon boiling machine (240 kg. dried
                         cocoons/8 hrs.)

                         4.  Silk reeling machine (120 skeins/8 hrs.)

                         5.  Silk booking machine.

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[8] Cocoon/Silk Processing at Philippine Textile Research Institute,
by Salvacion J. Cruz, ESCAP Workshop/Study Tour, People's
Republic of China. 1985.

Problems discussed: We discussed mainly testing and grading
of cocoons. Because the quality testing
of cocoon is incomplete and not being
done regularly.

In the Philippines, the different kinds
of yarns are produced like: machine
reeled silk, hand spun silk and douppion
silk.

However, cocoon produced by the private
companies are exported for lack of
economical silk reeling support.

No local standards have been set up to
measure the quality and grade of cocoons
and raw silk.

Proposals : Acquisition of proper testing equipment
to complete the series of tests for
determining the grade and classes of
silk yarns must be considered. (Annex-6)

The expert provided and described the
necessary technologies for testing and
grading of cocoons (Annex-7) and raw silk
inspection.

(5) Silk Products Development and Utilization Project:

Background : This project aims to improve and develop
the availability of quality silk for
domestic market instead of importing raw
silk from other countries.

Activity        : One of the activities is the utilization

of waste cocoons by means of degumming

and recycling of the waste and blended

spun silk yarn produced from waste cocoons

which would still be of good potential for

domestic apparels or other items.

Proposals       : In the manufacture of hand spun silk, the

process of cocoon degumming and cocoon

opening must be developed to produce Pegnee

which will be suited for spinning purposes.

Annex-1

## SUPPLY AND DEMAND FOR DRY COCOONS
### (Exportation)

| YEAR | Qty. (kg.) | FOB Price (₱) | FOB Price ($) | Price per kg. ($) |
|------|-----------|---------------|---------------|-------------------|
| 1981 | 15,148 | – | 151,878 | 10.03 |
| 1982 | 26,083 | 2,736,624 | 321,691 | 12.33 |
| 1983 | 11,761 | 925,280 | 85,971 | 7.31 |
| 1984 | 22,749 | 2,855,131 | 171,621 | 7.54 |
| 1985 | 4,500 | 408,626 | 22,500 | 5.0 |
| 1986 | 13,189 | 2,857,968 | 140,566 | 10.66 |
| Average | 15,572 | 1,956,726 | 149,038 | 8.81 |

In 1985:  January – November

## SUPPLY AND DEMAND FOR RAW SILK
### (Importation)

| YEAR | Qty. (kg.) | FOB Price (₱) | FOB Price ($) | Price per kg. ($) |
|------|-----------|---------------|---------------|-------------------|
| 1982 | 500 | 141,953 | 16,859 | 33.72 |
| 1983 | 2,780 | 890,283 | 74,240 | 26.70 |
| 1984 | 1,923 | 995,104 | 52,487 | 27.29 |
| 1985 | 725 | 248,906 | 13,326 | 18.38 |
| 1986 | 1,199 | 476,966 | 23,865 | 19.90 |
| Average | 1,425 | 550,642 | 36,155 | 25.20 |

SOURCE:  Foreign Trade Statistics of the Philippines

Annex-2

## SUPPLY AND DEMAND FOR SILK FABRICS
### (Exportation)

| YEAR | QTY.(sq.m.) | FOB Price (P) | FOB Price ($) | Price per/sq.m.($) |
|------|-------------|---------------|---------------|---------------------|
| 1982 | 59,088 | 4,704,144 | 554,813 | 9.39 |
| 1983 | 90,556 | 6,800,808 | 602,907 | 6.66 |
| 1984 | 91,351 | 11,117,971 | 634,982 | 6.95 |
| 1985 | 103,790 | 12,544,934 | 678,382 | 6.54 |
| 1986 | 70,666 | 9,116,663 | 448,243 | 6.34 |
| Average | 83,090 | 8,856,922 | 583,865 | 7.18 |

### (Importation)

| YEAR | QTY.(sq.m.) | FOB Price (P) | FOB Price ($) | Price per/sq.m.($) |
|------|-------------|---------------|---------------|---------------------|
| 1982 | 2,378 | 28,397 | 3,411 | 1.43 |
| 1983 | 3,145 | 77,754 | 7,147 | 2,27 |
| 1984 | 4,348 | 465,993 | 27,702 | 6.37 |
| 1985 | 6,107 | 646,715 | 34,634 | 5.67 |
| 1986 | 16,901 | 1,390,410 | 67,048 | 3.97 |
| Average | 6,576 | 521,853 | 27,988 | 3.94 |

SOURCE:    Foreign Trade Statistics of the
Philippines

Annex-3

### COCOON PROPERTIES MEASURED FOR LOCAL HYBRID COCOONS in 1986

| Varieties | Length of cocoon filament (m) | Weight of cocoon filament (cg) | Size of cocoon filament (d) | Cocoon reel-ability(%) | Reeling time (hrs/min.) |
|---|---|---|---|---|---|
| Taihei x choan | 1056 | 30.0 | 2.5 | 78 | 3:10 |
| N144 x C144 | 1039 | 32.6 | 2.8 | 78 | 3:05 |
| B2 x D | 856 | 20.0 | 2.1 | 78 | 2:40 |
| J101 x C101 | 1180 | 32.0 | 2.4 | 89 | 2:55 |
| C101 x J101 | 1319 | 34.0 | 2.3 | 82 | 3:00 |
| J102 x C102 | 1096 | 34.0 | 2.8 | 89 | 2:40 |
| C102 x J102 | 1013 | 30.0 | 2.7 | 85 | 2:40 |
| Range (mean) | 1079 | 30.4 | 2.5 | 83 | 2:70 |

Weight of dried cocoons:   350(g)

Annex-4

## YEARLY CHANGE OF THE QUALITIES OF COCOONS

| Variety | Year | Length of cocoon filament (m) | Weight of cocoon filament (cg) | Size of cocoon filament (d) | Cocoon reel-ability (%) | Reeling time (hrs./min.) |
|---|---|---|---|---|---|---|
| N144 x C144 | 1982 | 1,333 | 39.41 | 2.66 | 67 | 2:30 |
| | 1983 | 1,181 | 35.90 | 2.74 | 68 | 2:30 |
| | 1984 | 1,084 | 31.28 | 2.60 | 85 | 2:45 |
| | 1985 | 1,124 | 28.50 | 2.30 | 76 | 3:15 |
| | 1986 | 1,087 | 33.00 | 2.70 | 78 | 3:15 |
| | Average | 1,162 | 33.62 | 2.6 | 74.8 | 2:50 |
| Taihei x choan | 1983 | 1,983 | 36.69 | 2.56 | 88 | 3:15 |
| | 1984 | 1,364 | 40.21 | 2.65 | 70 | 3:10 |
| | 1985 | 1,253 | 38.00 | 2.73 | 85 | 3:05 |
| | 1986 | 1,250 | 37.00 | 2.60 | 70 | 3:10 |
| | Average | 1,290 | 37.98 | 2.64 | 78 | 3:10 |
| J102 x C102 | 1983 | 1,307 | 35:47 | 2.47 | 80 | 1:43 |
| | 1984 | 1,211 | 32.57 | 2.40 | 87 | 2:40 |
| | 1985 | 1,257 | 30.70 | 2.20 | 69 | 2:30 |
| | 1986 | 1,096 | 34.00 | 2.80 | 89 | 2:40 |
| | 1987 | 1,078 | 32.00 | 2.70 | 85 | 2:40 |
| | Average | 1,192 | 32.95 | 2.51 | 82 | 2:25 |

Weight of dried cocoons:   350(g)

Annex-5

## THE RESULTS OF RAW SILK TESTED

| Items | No. | Sample-1 | Sample-2 | Sample-3 | Sample-4 | Sample-5 | Remarks |
|---|---|---|---|---|---|---|---|
| Denier test (d) | average of denier | 18.03 | 17.84 | 17.85 | 18.15 | 17.58 | No. of skein: 35 (112.5m) |
| | denier deviation | 1.83 | 1.63 | 1.35 | 1.31 | 2.00 | |
| | maximum deviation | 3.3 | 2.8 | 2.1 | 2.2 | 3.7 | |
| Evenness test (%) | average of evenness | 93.60 | 90.80 | 90.90 | 91.10 | 92.50 | |
| | low evenness | 90.00 | 85.00 | 82.50 | 85.25 | 87.50 | No. of panel: 18 |
| Cleanness test (%) | | 95.00 | 98.80 | 91.80 | 98.30 | 96.10 | |
| | | large split:1 | small split:3 | large split:3 | small split:3 | large split:1 | |
| | | small split:4 | large loop:1 | small split:3 | | small split:3 | |
| | | slug:1 | | large loop:1 | | | |
| Neatness test | average neatness | 98.80 | 96.00 | 97.80 | 97.90 | 98.40 | |
| | low neatness | 94.95 | 92.10 | 93.80 | 95.00 | 94.50 | |
| Tenacity (g/d) | | 3.96 | 4.02 | 3.85 | 3.89 | 3.99 | |
| Elongation (%) | | 20.6 | 21.3 | 21.4 | 20.6 | 20.7 | |

**Annex-6**

## THE EQUIPMENTS FOR RAW SILK TESTING

| Items | Specifications | Purpose : Remarks |
|---|---|---|
| 1. Winding Tester | frame: winding speed: 110,140 165 m/min. <br> swift: 530 g <br> bobbin: head dia – 60mm <br> barrel dia – 38mm <br> head length – 85mm <br> weight – 105 g | To determine the number of breaks which occur in raw silk yarn in the winding operation. |
| 2. Sizing Reel | 400 revolution equal 450 m dial showing the number of revolutions automatic stop motion | To measure the size deviation of denier skeins |
| 3. Precision Balance | capacity ; 160 g <br> sensitivity: 0.001 g | To weigh the denier skeins |
| 4. Denier Balance (quadrant) | revolution; 100, 200, 300, 400 rev. <br> sensitivity: 0.5 denier | To measure the denier of individual skeins. |
| 5. Conditioning oven | with forced ventilation <br> temp.: max. 140ºC <br> accuracy; 1 centigram | For weighing of moisture and to determine the average size at conditioned weight. |
| 6. Serigraph | full speed: 15 cm <br> upper and lower clamps: 10cm <br> automatic recording system | For tenacity and elongation tests |
| 7. Autograph | capacity: 100 kg <br> load cells: 1kg, 100g, 50g, 10 g <br> stretching speed: changeable | For the test of physical properties of silk yarn |
| 8. Cohesion Tester | duplan system <br> friction action at 20 different places <br> tension: 180 g | To determine the degree of agglutination of cocoon filaments forming raw silk |
| 9. Cocoon Floss Remover | motor driven system <br> harvesting of cocoon and floss removing work done simultaneously | For cocoon harvesting |
| 10. Microscope | magnification: 2000x | For observation of silk fiber structure |

Annexes-7
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## Cocoon Testing
_____

Cocoon testing means the procedure under which the characteristics of cocoons are tested concerning their consumptive value and are graded according to results of tests.

In developed countries, the silk industry law provides that the transactions of cocoons are to be conducted according to the results of tests performed by the cocoon testing station.

1. Methods of cocoon testing.

   (1) Length of cocoon filament
   _____

The length of cocoon filament obtained from a cocoon is expressed in meters. It is calculated as follows :

$$\text{Length of cocoon filament(m)} = \frac{\text{Length of raw silk(m) x No.of cocoon filament per/thread}}{\text{No.of total reeled cocoon.}}$$

where,

- Length of raw silk is checked by meter gauge
- No. of cocoon filament per thread = 8
- No. of total reeled coccon = No. of cocoon sample  .No.of unreeled

        cocoon + No.of converted carryover cocoon)

- The cocoon number converted to whole cocoon length

  = 1.00p x 0.80H + 0.37M + 0.11L

            P : unreeled new coccon

            H : cocoon reeled only outside layer

            M : cococn reeled to middle layer

            L : coccon reeled to inner side layer

The reeling work is not performed to the last cocoon, but the remaining cocoons are reelable if they use other conditions. These are called carryover cocoons.

That is why, these cocoons should be converted into whole cocoon length or weight and the converted number must be deducted from the sample cocoons to obtain extra raw silk percentage of actual sample.

The converted number is referred to as "carryover cocoon" and is calculated by multiplying the number of cocoons from its thick layer, middle layer and thin layer with the converted indexes.

For example :

- No.of sample cocoons ——— 300
- Length of raw silk ———— 38,100 (m)
- No. of unreeled new cocoons —— P (1)
- No. of carryover cocoons ——— H (29) M(14) L(6)
- No. of total reeled cocoons ——— 300-(1+29) = 270
- Length of cocoon filament (m)

$$= \frac{38,100(m) \times 8}{270} = 1,129 \ (m)$$

## (2) Cocoon Reelability

The number of times the cocoon filaments have been broken during reeling of the cocoons and the reciprocal of the average filament feeding times per cocoon is expressed in percentage.

Percentage of cocoon reelability is calculated as follows :

$$\text{Cocoon reelability(\%)} = \frac{\text{No. of total reeled cocoon}}{\text{No. of feeding filament of cocoon}} \times 100$$

where, No.of total reeled cocoon = Sample cocoon – (No.of unreeled cocoon + No. of converted carryover cocoon)

No. of feeding filament of cocoon = no.of total feeding filament + No.of carryover cocoon – No.of converted carryover cocoon.

For example :

- No. of sample cocoon —————————— 300
- No. of feeding filament of cocoon ——— 417
- No. of unreeled cocoon —————————— P(1)
- No. of carryover cocoon —————————— H(29) M(14) L(6)

No.of total reeled cocoon and No.of feeding filament of cocoon are corrected as follows :

No. of total reeled cocoon = 300 - (1 + 29) = 270

No. of converted feeding filament of cocoon = 417+49-29=437

$$\text{Cocoon reelability (\%)} = \frac{270}{437} \times 100 = 62(\%)$$

## (3) Raw Silk Percentage

The conditioned weight of raw silk obtained from the reelable cocoons is divided by the total weight of cocoons submitted for testing. The result is expressed in percentage. Raw Silk percentage is calculated as follows :

$$\text{Raw Silk Percentage(\%)} = \frac{\text{Conditioned silk weight(g)+carryover silk yield(g)}}{\text{Weight of cocoons(g)}} \times 100$$

where; Converted carryover silk yield = weight of a cocoon filament(g) x No. of carryover cocoons to be converted to whole one.

$$\text{Weight of a cocoon filament} = \frac{\text{Conditioned silk weight(g)}}{\text{No. of reeled cocoons}}$$

No. of reeled cocoons = No. of sample cocoons - (No.of converted unreelable cocoon + No. of converted carryover cocoons.

The Cocoon number converted to whole cocoon weight = 1.00P+0.8H+0.28M+0.06H

Where :

P = No. of new cooked unreeled cocoons.

H = No. of thick layer carryovered cocoons.

M = No. of Middle layer carryovered cocoons.

L = No. of thin layer carryovered cocoons.

The calculation of raw silk yield for the weight of cocoons includes carryover cocoons to be converted into raw silk yield and the converted raw silk yield is added to that wound on the reels.

Raw silk from carryover cocoons is calculated from the weight of cocoon filament multiplied by the number of carryovers cocoons.

The index is applied to the converted carryover and unreelable cocoons to the whole number of cocoons.

The index is expresied in two ways as follows;
(1) length system and    (2) weight system. The size of cocoon filaments vary with the portions of cocoon shells.

For example :
────────────

- Weight of sample cocoons        ──────────────────        300
- Conditioned raw silk weight ·   ──────────────        100(g)
- Weight of sample cocoon         ──────────────        600(g)
- Unreeled new cocoon             ──────────────        P(1)
- Carryover cocoons          ─────────────── H(29) M(14) L(6)
                                             ────── ───────────
                                                      27

- No. of reeled cocoons   =   300 − (1 + 27) = 272
- Weight of a cocoon filament   =   100 ÷ 272   =   0.37(g)
- Converted carryover silk yield   =   0.37 x 28   =   10.36 (g)
- Raw Silk Percentage (%)   =   $\dfrac{100(g) + 10.36(g)}{600\ (g)}$   x 100   = 18.39(%)

## 2. Grading of Cocoons :

The results from the test cf cocoon filament length and cocoon reelability are given marks cr points according to the Cocoon Grading Table-1 and Table-2 respectively.

The sum of both marks is called as Grading Marks and compared with the Final Grade of Cocoon Classification (Table-3).

Table-1    Grading Table of Cocoon Filament Length (m)

| Length of cocoon filament(m) | below 890 | 891–960 | 961 1030 | 1031–1100 | 1101–1170 | 1171–1240 | 1241–1310 | 1311–1380 | 1381–1450 | 1451–over |
|---|---|---|---|---|---|---|---|---|---|---|
| Mark | 38.0 | 38.5 | 39.0 | 39.0 | 40.0 | 40.5 | 41.0 | 41.5 | 42.0 | 42.5 |

Table-2   Grading Table of Cocoon Reelability (%)

| Reelability(%) | Below43 | 44–50 | 51–57 | 58–63 | 64–68 | 69–73 | 74–78 | 79–82 | 83–86 | 86 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mark | 41.0 | 47.5 | 48.0 | 48.5 | 49.0 | 49.5 | 50.0 | 50.5 | 51.0 | 51.5 |

Table-3   Final Grading Table cf Cocoon Classification

| Grade | Excellent | First | Second | Third | Fourth |
|---|---|---|---|---|---|
| Result | cver 91.5 | 90.5–91.0 | 89.0–90.0 | 88.0–88.5 | below 87.5 |

The obtained results above are as follows :

Table-4   Cocoon Testing Results

| Item | Results |
|---|---|
| Cocoon filament length (m) | 1,129(m) |
| Cocoon reelability percentage(%) | 62(%) |
| Raw silk percentage (%) | 18.39(%) |

Since cocoon classifications are based on filament length and reelability percentage of cocoons, the grading mark is obtained from the result by adding up the mark of cocoon filament lenght and reelability percentage using Table-1 and Table-2.

The grade equivalent based on the marks follows :

Table-5    Result of Cocoon Grading

| Item | Marks |
|------|-------|
| Cocoon filament length (m)    (1) | 40.0 |
| Cocoon reelability percentage(%) (2) | 48.5 |
| Grading result   (1) + (2) | 88.5 |
| Cocoon grade | Third |

## 3. Price of Cocoon

In the transaction of cocoons, the price is calculated from the coefficient of cocoon price expressing the standard cocoon price and raw silk percentage of cocoons obtained from the results of cocoon testing.

The coefficient of cocoon price is calculated on the basis of raw silk percentage which is 10% raw silk yield from cocoons.

The formula is as follows :

$$\text{Coefficient of cocoon price (10kg of cocoons)} = \frac{\left[\begin{array}{c}\text{(Raw silk price +by-} \\ \text{product income )}\end{array}\right] - \left[\begin{array}{c}\text{(Cost of manufacturing \& managing)} \\ \text{( + profit + others)}\end{array}\right]}{\text{Weight of raw silk (60 kg/bale)}}$$

The coefficient of cocoon price CCP, stands based on the 2nd grade of cocoon. If the CCP varies from 3.7% is added or deducted from the standard.

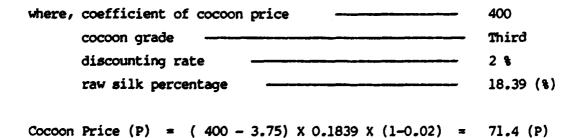| Grade | Excellent | First | Second | Third | Fourth |
|---|---|---|---|---|---|
| CCP amend (%) | + 7.5 | + 3.75 | 0 | -3.75 | -7.5 |

CCP : Coefficient Cocoon Price.

The raw silk percentage of cocoons tested by the cocoon testing station and the raw silk percentage actually produced at the industrial silk reeling are both taken into consideration.

Furthermore, raw silk percentage is customarily somewhat lowered from the actical percentage as allowances for losses.

This percentage of raw silk is called the transaction raw silk percentage of cocoons.

An example of calculation for cocoon price :

$$\text{Cocoon pric/kg} = \left[\begin{array}{c}\text{Coefficient of}\\ \text{cocoon price}\end{array}\right] + \left[\begin{array}{c}\text{Amended}\\ \text{coefficient}\\ \text{cocoon price}\end{array}\right] \times \left[\begin{array}{c}\text{Raw silk}\\ \text{percentage}\end{array}\right] \times \left[\begin{array}{c}\text{1-discount-}\\ \text{ing rate}\end{array}\right]$$

where, coefficient of cocoon price ——————— 400

       cocoon grade ————————————— Third

       discounting rate ———————————— 2 %

       raw silk percentage ———————————— 18.39 (%)

Cocoon Price (P) = ( 400 - 3.75) X 0.1839 X (1-0.02) = 71.4 (P)

## VI.   Conclusions and Consequences

1.   ·   The problems of the silk industry in the Philippines have
their origin in the following deficiencies :
   - Limited supply of raw materials because the lack of stimulating
     factors for production.

   - Shortage of skilled technicians for the processing of high
     quality products.

   - Scarcity of unreliable financing facilities.


2.      The economic feasibility and the potentials for commercial
production of the silk industry may be realized by providing
adequate and satisfactory conditions to achieve the following :
   - Demonstrate that rural silk reeling can give higher
     incomes to cocoon producers.

   - Provide adequate and necessary facilities for increasing the
     output and quality of raw silk.

   - Carry out R and D to increase efficiency in plant machinery for
     silk reeling.

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VIII. WORK SCHEC LE FOR DR.J. NAHM

UNDP Korean Expert on Silk Reeling

| Date | Place | Remarks |
|------|-------|---------|
| Nov. 16, 1987 | UNDP, Makati | Briefing |
| Nov. 17 | PTRI, Bicutan | Orientation |
| Nov. 18-20 | PTRI, Bicutan | Discussion |
| Nov. 21-22 | Saturday, Sunday | |
| Nov. 23-25 | PTRI, Bicutan | Discussion |
| Nov. 26-28 | DMMMSU, Bacnotan, La Union | Visit FAO Project on Sericulture |
| Nov. 29-30 | Holiday | |
| Dec. 1 | PTRI, Bicutan | Discussion |
| Dec. 2-4 | PTRI, Cagayan de Oro City | Visit to Cocoon Production Training and Extension Project, Misamis Oriental |
| Dec. 5-6 | Saturday, Sunday | |
| Dec. 7-8 | PTRI, Bicutan | Discussion |
| Dec. 9-12 | La Trinidad, Benguet | Visit to Silkworm Breeding and Egg Production Center |
| Dec. 13 | Sunday | |
| Dec. 14-18 | PTRI, Bicutan | Discussion |
| Dec. 19-20 | Saturday, Sunday | |
| Dec. 21-23 | PTRI, Bicutan | Preparation of Report |
| Dec. 24-25 | Holiday | |
| Dec. 26-27 | Saturday, Sunday | |
| Dec. 28-29 | PTRI, Bicutan | Finalization of Report |
| Dec. 30, 1987 | Departure | |