



# **SERICULTURE SCENARIO IN SAARC REGION**



**A re-emerging industry  
for poverty alleviation in  
SAARC Region**



**SAARC Agriculture Centre**



**International Sericultural Commission**

**Sericulture Scenario in SAARC region:  
A re-emerging industry for poverty alleviation  
in SAARC Region**

**Edited by**

Dr. Tayan Raj Gurung

Dr. S. M. Bokhtiar

Mr. Dileep Kumar. R.

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**SAARC Agriculture Centre**

Dhaka, Bangladesh

And



**International Sericultural Commission**

Bengaluru, India

**SAARC Agriculture Centre (SAC)**

BARC Complex, Farmgate, Dhaka-1215, Bangladesh

Phone: + 880-2-58153152; Fax: + 880-2-91245996

Web: www.sac.org.bd

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**Compiled by**

Dr. Tayan Raj Gurung, Senior Program Specialist (NRM)

**Edited by**

Dr. Tayan Raj Gurung, Senior Program Specialist (NRM), SAC

Dr. Shaikh Mohammad Bokhtiar, Director, SAC

Dileep Kumar. R., Secretary to Secretary General, International Sericultural Commission.

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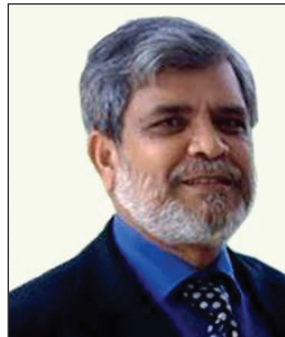
Email: natundhara2014@gmail.com

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## Preface

A predominantly agrarian region, SAARC Region is fast emerging as a major player in the global economy. The pathway of the economic progression is strongly supported by agricultural and industrial expansion. Among several agricultural based industries, the cottage industry “sericulture” which is rooted to traditions of most SAARC countries is gradually re-emerging as an important occupation and livelihood source. The sericulture and silk industry has been traditionally practiced in SAARC countries as an ideal occupation for rural development and inclusive growth. Since the Labour Force Participation Rate (LFPR) in sericulture is highest among all rural vocations, it is used as an ideal tool for employment



generation and poverty alleviation. Although the socio-economic and climatic condition in SAARC countries are ideally suited for the development of sericulture and silk industry, the industry is yet to set its foot firmly in many of the SAARC countries, except India due to various reasons. The successful model of tropical sericulture practice developed in India could be replicated in other SAARC countries as the climatic and socio-economic conditions are similar.

In order to take benefit of the successful sericultural model in India, the SAARC Agriculture Centre (SAC), Dhaka, Bangladesh under the authorization of the SAARC Secretariat joined with the International Sericultural Commission (ISC), Bengaluru, India to organize a Regional Consultative Meeting – “Sericulture scenario in SAARC Region – a re-emerging industry to poverty alleviation” during 25-28 August, 2015 at Mysore-India.

This book entitled “*Sericulture scenario in SAARC region – a re-emerging industry for poverty alleviation in SAARC Region*” is an attempt to bring a comprehensive overview of potentials and challenges in sericultural industries in the region. I would like to take this opportunity to express my sincere appreciation to all the focal point experts who succinctly reported the sericultural scenario in respective countries and showed their commitment for future actions. I am confident that this compilation will facilitate further research and development in sericulture in SAARC Region.

**Dr. S.M. Bokhtiar**

Director

SAARC Agriculture Centre

Dhaka, Bangladesh.

## Foreword

Ever since the shifting of the headquarters of International Sericultural Commission (ISC) from Lyon, France to Bangalore, India, it has been our dream to invite all the SAARC countries to utilize the platform of ISC as a tool for poverty alleviation in South Asian region. While sericulture and silk industry have emerged as profitable ventures in some parts of the sub-continent, it is not the case in the entire SAARC region. As the silk industry can be a viable employment provider in Indian rural areas, especially among the women, we felt that it would be a much easier task to replicate this success story to other countries of the region. The industry could have a greater scope of flourishing in rest of the region as the climatic and socio-economic conditions are favourable for practising sericulture. In this backdrop, the ISC had initiated a dialogue with SAARC during 2013, which has culminated in a Regional Consultative Meeting on Sericulture at Mysore during 24th to 28th August 2015.



I am pleased to note that the Regional Consultative Meeting on Sericulture has been a highly successful event as it witnessed an active participation of the 8 countries of SAARC and highly enriching and scholastic inputs provided by the best brains in the field. The meeting provided some critically important and useful recommendations for the orderly development of sericulture industry in the region. The decision of taking up a Sericulture Development Programme jointly by SAARC and ISC that emerged in the meeting would go a long way in addressing the Millennium Development Goals. I firmly believe that such joint initiatives would not only accelerate the pace of equitable development but also reinvent the cultural heritage shared by the people since time immemorial.

I am delighted to learn that SAC is bringing out a Reference Manual on the Consultative Meeting which principally covers the Country Reports on the status of sericulture in 8 SAARC countries, special papers by the experts and most importantly, the proceedings and recommendations of the Meeting. This is the first time that such an authentic document for silk industry is being published for the region. I believe that this Book would be an extremely useful reference manual for all those who are presently involved in the scheme of sericultural activities and all those who intend to be involved in the coming days. I congratulate SAARC Agriculture Centre for publishing this document which would certainly serve as a useful reference for the policy planners and technocrats.

The sincere and dedicated efforts put forth by Dr. Tayan Raj Gurung, SPS, SAC, Dr. S. M. Bokhtiar, Director, SAC, and Mr. Dileep Kumar. R., Secretary to Secretary General, ISC, for editing and publishing this book are laudable.

My best wishes for this wonderful initiative by SAARC and ISC.

A handwritten signature in blue ink, appearing to be 'Ishita Roy'.

**Ishita Roy**  
Secretary General

## Foreword

I am extremely delighted to know that the SAARC Agriculture Centre (SAC) is bringing out a publication on the Regional Consultative Meeting on Sericulture held at Mysore during 24th to 28th August 2015. It was my privilege to attend this important meeting and chair the proceedings of the sessions held on 26th August 2015. The most important and striking experience for me during the Meeting was the solidarity among the country representatives to work as a group to promote sericulture in SAARC countries. This comradeship eventually culminated in adopting a resolute resolution of taking up a Joint Sericulture Developmental Project for the SAARC region by SAC and International Sericultural Commission (ISC). As the representative of Government of India, it was one of the treasured moments for Central Silk Board to accept the responsibility of leading the sericulture developmental activities in the region.



The SAARC Regional Consultative Meeting was one of its kinds I attended for a long time. For the first time, we came across the historical perspective of the sericulture industry among the SAARC countries besides understanding its present status. The interactive sections provided an ideal opportunity to understand the strengths and weaknesses of the industry directly from the country representatives. While the Key Note paper provided the overall strategy needed for the industry in the region, the five special papers presented by senior level scientists and technocrats of Central Silk Board, outlined specific approaches needed across different disciplines of the industry. The group discussions were passionate and intense leading to path breaking recommendations for the development of sericulture and silk industry in the region.

It is heartening to note that the SAC has decided to document and publish the entire proceedings of the Consultative Meeting for the benefit of all stakeholders. The editorial team comprising of Dr. Tayan Raj Gurung, SPS, SAC, Dr. S. M. Bokhtiar, Director, SAC and Mr. Dileep Kumar. R., Secretary to Secretary General, ISC have done a commendable job in putting together the proceedings in a meticulous manner. I believe that this book would serve as a reference manual and guide for the future activities proposed to be taken up in the region.

The important initiatives, which are outlined in this publication, can contribute significantly to the Sustainable Developmental Goals (SDGs), now adopted by the United Nations. I appreciate ISC and SAC for this brilliant beginning.

Wishing all success for sericulture in SAARC countries.

A handwritten signature in blue ink, appearing to read 'Nagesh Prabhu'.

**Dr. H. Nagesh Prabhu**  
Member Secretary, Central Silk Board &  
Secretary General (Elect) - ISC

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## Executive Summary

Silk as the Queen of textile fibre has always been in high demand for its strength, smoothness, healthy and environmental friendly fibre. Silk is witnessing a new era of global demand, which may rise in the next millennium. Asia is the home of sericulture and often referred as the starting point of the ancient Silk Road. It is recorded that domestication of silkworm originated somewhere at the foothills of Himalayas. While silk production in Asia has declined, it is currently produced by 60 countries in the world. In SAARC region, silk is produced in India, Bangladesh, Pakistan, Afghanistan, Nepal and Sri Lanka. The studies showed that silk is in high demand in all SAARC Countries. The major silk consumers of the world are; USA, Italy, Japan, India, France, China, United Kingdom, Switzerland, Germany, UAE, Korea, and Vietnam.

In India, sericulture has emerged as the most important cash crop with minimum investment, low gestation period, high employment potential and highly remunerative return. It is well suited to the agrarian economy. It involves simple technology, which is easy to understand and adopt. Sericulture has provided downstream employment and income generation in rural and semi-urban areas, high participation for low-income and socially under privileged groups. Sericulture is the activity of low investment and high output. Sericulture sector has the potential to provide employment at all levels (household, community and industrial). Indian models have displayed the successes in women empowerment, income generation, thus alleviation of poverty and socio-economic problems of the region.

Keeping in view of the emerging popularity of sericulture, the International Sericultural Commission (ISC) in 2012 invited SAARC to initiate a regional collaboration to revive the industry in the region. SAARC deputed a 2 member delegation from SAARC Agriculture Centre (SAC) to visit ISC in Bengaluru, India during 9<sup>th</sup> to 12<sup>th</sup> April, 2014. The visit culminated to two major actions, (i) development of a MoU of collaboration between SAARC and ISC on research and development in sericulture, and (ii) to organize a SAC-ISC Regional Consultation Meeting on sericulture for SAARC Countries. Accordingly, the SAC and ISC have jointly organized the SAARC Regional Consultation Meeting on sericulture at Mysore during 24<sup>th</sup> to 28<sup>th</sup> August 2015.

The Regional Study and Consultation Meeting was organized with the following objectives:

1. To document the scenario of silk production and consumption in the region and identify gaps and concerns plaguing the sector, and
2. To assess the potential of sericulture industry in SAARC region and devise suitable plans and strategies for its orderly development.



Under the guidance and support of SAC Governing Board Members, National Experts were identified (focal points) to prepare a comprehensive technical report on sericulture in their respective countries. All (8) Member States participated in preparing the country status papers. In addition, five eminent sericulture scientists from India were requested to prepare full paper on five specific topics. Accordingly, the Regional Consultative Meeting was conducted during 25-26 August 2015 at Hotel Regalis, Mysore, India. The meeting was followed by visit to the Central Sericultural Research and Training Institute (CSRTI), Mysore, the premier R&D Institute in India, Silkworm Seed Production Centre, Central Silk Technological Research Institute (CSTRI), Bangalore, farmer's fields, private sericulture facilities and government silk mills. The participants also visited the International Sericultural Commission and Central Silk Board in Bengaluru.

This compilation is a comprehensive collection of papers that provides an overview of sericulture in SAARC Region. The first section of the book presents a synthesis of all the country papers that helps in presenting a regional overview of the industry. The subsequent section presents respective country papers put in alphabetical order. The third group comprises a keynote paper and five invited special papers from scientists of Central Silk Board of India. The final section presents the proceeding of the Regional Consultation Meeting and recommendations.

Some of the most important recommendations are given below which necessitate immediate attention of SAC, ISC and the Country Representatives:.

- Formulate a Perspective Plan for the integrated development of silk industry for next 10 years (2016-2025) and Action Plan for next two years by 31<sup>st</sup> March 2016 for the SAARC Region,
- Initiate multilateral collaborative research project under the aegis of SAARC-ISC MoU for sharing seri-genetic resources and technologies among SAARC Member countries and promote sericulture as an environment friendly sustainable economic activity,
- Nepal, Bhutan, Pakistan, Srilanka, and Maldives to enroll International Sericulture Commission as Member Countries,
- Depute ISC Volunteer Experts to the SAARC countries and utilize their services for feasibility/project formulation/institutional study, and
- Plan and organize training on Sericulture and Silk Industry for the candidates nominated from SAARC countries at CSRTI, Mysore.

The meeting witnessed active participation from all the 8 country representatives, This occasion provided the delegates a unique opportunity to study the successful model of sericulture practiced in India for replicating in their respective countries. It was evident that the country representatives and experts realized that sericulture can be an alternative socio-economic-ecological enterprise in SAARC region that can facilitate rural employment, income generation and ecological management.

# **Sericulture Scenario in SAARC region: A re-emerging industry for poverty alleviation in SAARC Region**

## **Synthesis**

**Rajashekar Krishnan<sup>1</sup> and Tayan Raj Gurung<sup>2</sup>**

<sup>1</sup>Scientist, Central Sericultural Research & Training Institute, Central Silk Board, Government of India, Manandavadi Road, Srirampura Mysore 570008, Karnataka, India.

<sup>2</sup>Senior Program Specialist (NRM), SAARC Agriculture Centre, Dhaka, Bangladesh

### **Introduction**

The eight South Asian Association for Regional Cooperation (SAARC) nations comprise 3% of the world's area with over 21% of its total population. The economy of the region with a total population of over 1.70 billion is predominantly agrarian with about 22.65% of its population still below poverty line. The percentage of below poverty line population ranges from 8.90% in Sri Lanka to 31.5% in Bangladesh. The GDP growth rate among the member nations during 2014 ranged from a mere 3.2% in Afghanistan to an impressive 7.3% in India.

Driven by a strong economic expansion in many countries in the region, in the recent past, South Asia has become the fastest-growing region in the world. As of 2015, foreign exchange reserves of SAARC nations stand at US\$ 411 billion. The SAARC policies aim to promote welfare economics, collective self-reliance among the countries of South Asia, and to accelerate socio-cultural development in the region.

One of the major challenges faced by the nations in the region is to provide sustainable livelihood means for the population in the rural and semi-urban areas, where there is abundant traditional knowledge and skills required for agro-based and traditional avocations. The ever increasing exodus of young productive population from the rural areas to the urban centers has contributed to several socio-economic and ecological disasters in addition to non-availability of productive manpower for agro-based rural enterprises. The situation warrants immediate action to identify economic activities/rural enterprises suitable for specific regions, draw up programmes that are aimed at providing employment and adequate remuneration to the rural and semi-urban poor. At the same time, it is also important that the activities envisaged to be propagated are environment friendly and acceptable to the socio-religious sensibilities of the target group.

In this background, it is proven that sericulture and silk industry serve as an effective tool to substantially alleviate poverty in the region. The belief that sericulture can be a long term sustainable rural enterprise is eminently supported by the progress achieved by some member countries like India, growing domestic and global demand for silk products, availability of relatively inexpensive labour, congenial agro-climatic zones for sericulture, socio-religious importance for silk products in the region etc. In addition, the recent advances made in the area of development of appropriate technologies and replicable models of extension and management, can be adopted all over the region with or without modifications, further strengthen the case for choosing sericulture and silk industry as an effective tool for poverty alleviation in SAARC region.

### **Historical perspective**

Though there are claims that silk was made in India as early as 4000 B.C., historians credit its discovery to China during 2640 B.C. In the SAARC region, sericulture probably took its first steps in India on the fertile tract between the Ganga and Brahmaputra rivers during 400 A.D., courtesy a Chinese princess married to an Indian prince who is believed to have smuggled seeds of mulberry and silkworm hidden in her headgear.

Sericulture thrived in India in the regions of Bengal, Jammu and Kashmir prior to taking roots in the southern peninsular India during 1780s, owing to the efforts of the then ruler of Mysuru, Tippu Sultan. The industry grew under the auspices of rulers and visionaries of the then Mysore and Madras provinces and technical guidance of experts from countries like Italy and Japan. With the World War I gripping the world, silk production increased to 136 Mt during 1945, from a mere 4.10 Mt in 1937. The industry saw a major slump soon after the war when the demand for silk also dropped. Presently, the industry is a major employment provider in India, a country that produces all four commercially important types of silk *viz.* Mulberry, Tasar, Muga and Eri, contributing to over 17% of the global silk production.

Bangladesh, which shares its boundaries with Bengal, a traditional sericulture state in India, has as long a history and cultural heritage as Indian sericulture. After becoming an independent nation, massive efforts to establish sericulture started in 1978 with the establishment of Bangladesh Sericulture Board. Sericulture was introduced in Pakistan during the 1950s in the Northwest Frontier Province, Baluchistan and later in Sindh during 1976. The industry has not grown to its potential in spite of systematic monitoring and evaluation by a full fledged Directorate established by the government of Punjab way back in 2008. In Nepal, concerted efforts to promote sericulture were made during the 1970s with the assistance of Korea. This phase was followed by programmes assisted by JICA and UNDP during the 1990s. The country produces 4 MT of silk as against an

annual demand of 250 MT. The other member of SAARC with a history of silk production going back to 17<sup>th</sup> century is the island nation of Sri Lanka. The country has seen an era of systematic planning during the 1900s when a special unit for sericulture development was established under the Department of Cottage Industries and again efforts to revive the industry during 1976 by the Silk and Allied Products Development Authority [SAPDA]. In the ensuing years, activities like establishment of mulberry and silkworm germplasm, breeding, human resources development to manage the industry, commissioning of post cocoon processing units, experimentation in by-product utilization were taken up, which resulted increase in productivity of cocoons from 26 kg/box to 40 kg/box, area under mulberry from 975 to 5225 acres, and production of raw silk and twisted yarn touched a high of 12640 kg and 10986 kg, respectively during 1988-92. Weaving activity also thrived under SAPDA which had more than 30 handlooms. The industry collapsed in the later years due to various socio-political reasons in spite of great potential that exists in the region. Sericulture is not practiced in Bhutan although attempts were made in eastern Bhutan during the eighties, which lead to development of silk weaving in the region. But the nation has a very rich tradition in manufacturing textile products that are unique and in great demand. The requirement of silk is met entirely through imports from producer countries including India.

### **Current status of sericulture industry**

#### **Types of silkworm**

The SAARC nations are home to all four commercially known silkworms viz., *Bombyx mori* L., that feeds on mulberry (*Morus spp.*); *Antheraea mylitta* Dury and *Antheraea proylei* J. the Tasar silkworms feeding on *Terminalia*, *Shorea* and *Quercus spp.*; *Antheraea assamensis* a species endemic to India called the Muga that feeds on *Machilus bombycina* and *Philosamia ricini* the Eri silkworm feeding primarily on *Ricinus communis*. Apart from these, Sri Lanka also has *Antheraea cingalesa* and *Cricula ceylonica* that are endemic to the island nation.

#### **Production scale and volume**

The raw silk production in the region is more or less dependent on India, which produced 26480 MT of raw silk in 2013-14 followed by Bangladesh and Nepal with contributing 44 and 1.76 MT during the corresponding year. India produced 28708 MT of raw silk during 2014-15, which consisted of 21390 MT of Mulberry, 2434 MT Tasar, 4726 MT Eri and 158 MT of Muga silks. While India recorded a compounded annual growth rate of 5.69% during the last ten years, the production in Bangladesh and Nepal have been stagnating for the last five years. The reasons behind the steady growth in India include advancements in production technologies that raised raw silk production per hectare to 97.30 kg,

effective management practices, development of processes and machines for post cocoon processing and federation of practitioners through participatory extension mechanism and incentivize investments at farmer's level to neutralize high input costs.

**Production of raw silk during the past ten years (MT.)**

Year	India		Bangladesh	Nepal
	Mulberry	Vanya*	Mulberry	Mulberry
2005-06	15445	1860	NA	1.4
2006-07	16525	1950	NA	4.1
2007-08	16245	2075	NA	4.31
2008-09	15610	2760	NA	1.36
2009-10	16322	3368	40	1.19
2010-11	16360	4050	38	1.09
2011-12	18272	4788	42	1.31
2012-13	18715	4964	43	1.57
2013-14	19476	7004	44	1.76
2014-15	21390	7318	NA	NA

\* *Non-mulberry silks*

**Raw silk import and export**

All the SAARC nations are importers of silk and silk goods. Although India is a major silk producing nation, it also is the biggest importer. India imported 3489 MT of raw silk valued at US\$15.23 million during 2014-15, primarily from China. The demand-supply gap is narrowing down over the years due to increase in domestic silk production, especially bivoltine silk. It is expected that the country would become self-sufficient in raw silk production by 2020. The average import of raw silk in other countries are relatively small with Pakistan importing 354 MT followed by Nepal 250 MT and Sri Lanka about 12 MT. Bangladesh imported 393.73 MT of silk and silk products during 2013-14. Bhutan's imports of silk products are valued at US\$1.70 million.

The SAARC nations are not among the major exporters of raw silk. All member countries produce far below the domestic demand for silk. At the same time the silk products from the region are in great demand especially in the Europe, USA, Saudi Arabia, UAE, Hong Kong and Singapore, largely owing to the exquisite

designs, colour combination and craftsmanship of the artisans of the region combined with the ability to cater to markets that demand small volumes. Weaving is as much a part of culture and tradition in most of the SAARC countries. Silk products from India, Bangladesh, Sri Lanka and Bhutan have created their own niche markets. The value of silk goods exported from Bangladesh was US\$ 0.41 million, mostly to the UAE. The value of textile exports from Bhutan exceeds US\$ 0.47 million and that of silk goods from Sri Lanka is around US\$ 0.30 million. The total value of silk and silk goods exported from India during 2014-15 was US\$ 456.45 million, which included 6 MT of raw silk. The major items of export were fabrics, made-ups and ready made garments, which accounted for about 95% of the total value of exports during 2014-15.

### **Employment in sericulture**

Sericulture is a labour intensive enterprise that generates about 16 person-year of employment for every hectare of plantation. This includes the manpower involved in cultivation of food plants, cocoon production, reeling up to production of finished products. A glance at the percentage of manpower involved in the three stages of the production process *i.e.*, cocoon production-71.98%, Reeling-5.07%, weaving and processing-22.95%, eminently supports the fact that the enterprise largely belongs in the rural and semi-rural areas where majority of the population of the SAARC region dwell. The industry also plays a major role in women empowerment and distribution of equity from rich to poor. This is supported by the fact that the industry provided employment to 8.28 million persons in India during 2014-15. An overwhelming 90% of the employment is generated in the rural areas and the contribution of women is about 54%. In Bangladesh, where nearly 80% of the population live in rural areas, about 0.65 million are involved in industry, with the women contribution is 75% of this work force.

### **Scenario of silk consumption**

The SAARC countries are traditionally silk consuming nations, where silk plays an inseparable part of the socio-religious lives of many ethnic community of the region. India leads the consumption among the members with an annual consumption of over 32,000 MT raw silk (2014-15), and over 85% of the silk goods manufactured in the country. The per capita purchase of pure silk goods has grown at a rate of 5.30% from a 0.14 m. during 2006 to 0.18 m. in 2012. The second highest consumer is Bangladesh with an annual consumption of over 300 MTs of raw silk, while it produces little over 41 MT. In case of Sri Lanka, the available data on raw silk imports (12264 MT during 2011), the fact that the 3 major ethnic communities in the country representing over 90% of the total population use silk and that the value of silk and silk goods imported during 2011 was valued at US\$ 0.96 million all indicate towards high level of consumption

and near total dependence on overseas producers. The scenario in Nepal that consumes over 250 MT of raw silk annually while producing 4 MTs; Pakistan and Bhutan that solely depend on imports is not very different.

The above facts clearly indicate the presence of a huge consumer base in the region and the potential for expansion of the industry for the collective benefit of the member nations.

### **Constraints in sericulture**

In spite of the characteristics of the industry like low gestation, low investment, rural employment generation, frequent remunerations, optimal utilization of family labour, women empowerment etc., the industry has not seen expected growth in the region except in India. The following are some of the major constraints that have limited the growth of the industry to a great extent.

Barring India and to some extent countries like Bangladesh and Nepal, there seems to be a lack of institutional network to support the industry in most of the member countries. The existing organizational capacities in the countries are inadequate to address the needs of the industry.

The other major constraints are:

- Inadequate development of post-cocoon sector that creates the demand pull,
- Lack of region and season specific food plant varieties and silkworm races,
- Inadequate extension and human resources development capabilities,
- Low levels of literacy among target groups,
- Lack of independent R & D capabilities to address regional issues,
- Lack of timely input delivery mechanisms,
- Non-participation of private sector/cooperatives/NGOs in the activity for lack of incentives,
- Lack of National level policy for sericulture and mission mode approach in some member countries,
- Lack of regulatory mechanisms to protect the domestic industry from effects of inexpensive imports of silk goods,
- Low adoption levels of technologies due to unorganized nature of the industry leading to under utilization of resources, yield gaps and inconsistencies in output quality,
- Rapid urbanization and industrialization in traditional sericulture regions, and
- Social and religious sensibilities that deters some religious communities from practicing sericulture.

It is also a fact that remedies for most of the above maladies can be found within the SAARC region.

### **Potentials of sericulture**

The SAARC region is endowed with rich culture and tradition in textile manufacturing and produces textiles that are unique to the region. Silk for ages has been an inseparable part of the lives of the population and the demand for silk has not been met domestically. The demand supply gap is being filled through imports from countries like China and Korea.

There is a great potential for promoting sericulture as a means of poverty alleviation in the region because:

- The region is characterized by agro-climatic conditions congenial for production of both mulberry and non-mulberry silks. The region also has silkworms that are endemic-a potential that is waiting to be commercially exploited,
- Traditional knowledge and skills are available,
- Majority of the population in the region live in the rural areas, where unemployment and poverty are rampant,
- Availability of inexpensive labour and opportunities for participation of family labour, especially women,
- Agro based, eco-friendly nature of the industry, which fits aptly into the framework of socio economic development programmes, and
- Availability of appropriate technologies, extension and management models, training facilities and R&D support within the SAARC group.

### **Conclusions**

There is no country in the SAARC group that has a history sans silk. The region has a large consumer base for silk, tradition and culture, knowledge and skills in production, strong domestic demand pull and growing global markets. The experience of India where sericulture has emerged as a highly employment generating occupation and the emphasis laid by the governments of other member nations on sericulture in the past are reasons enough to take immediate action to revitalize the sector and benefit from its potential to serve as a tool for rural development and poverty alleviation.

The region has the required environmental conditions for cocoon production, abundant genetic resources in respect of food plants and silkworms that can be commercially exploited, technologies for production, crop protection, replicable extension management models, R&D and training facilities available within the



group and large rural agrarian population offering inexpensive manpower that is required for keeping the cost of production at competitive levels.

In addition to the above, sericulture eminently addresses the issues of environmental protection and women empowerment.

It is time that the governments of the SAARC nations made concerted efforts to facilitate re-emergence of sericulture as an effective tool for poverty alleviation through greater regional cooperation. An appropriate in-depth analysis of the present status of the industry needs to be done to identify the strengths and weaknesses of the industry. It is essential to identify the needs of each member country in respect of genetic resources, training and extension support, institutional strength, replicable models for effective extension and management, support to post-cocoon sector in terms of improvement of traditional machinery or development of new machines to enhance productivity and quality, intra-regional exchange of artisans/designers for product diversification etc., and suggest priority areas in which collaboration among the member nations is required.

With the environmental conditions, human resources, technology, management skills, R&D, and human resources development capabilities are easily available within the group, it is a win-win situation for the SAARC nations to adopt sericulture and silk industry as an effective tool for rural development and poverty alleviation, especially when the domestic and overseas demand for silk is growing.

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# **Sericulture scenario in Afghanistan-a re-emerging industry for poverty alleviation in Afghanistan**

**Mohammad Sarwar Anwari**

General Manager, Sericultural Project, Directorate of Livestock and Animal Health,  
Ministry of Agriculture, Irrigation and Livestock, Kabul, Afghanistan

## **Introduction**

Afghanistan is a landlocked country in south and central Asia, with a population of about 27 million, it has area of 652000 km<sup>2</sup>, making it the 42<sup>nd</sup> most populated and 41<sup>st</sup> largest nation in the world. It is bordered by Pakistan in the south and east, Iran in the west, Turkmenistan, Uzbekistan and Tajikistan in the north, and China in the northeast. Afghanistan has an arid and semi – arid continental climate with cold winters and hot summers. The climate varies substantially from one region to another due to dramatic changes in topography. The wet season generally runs from winter through early spring, but the country on the whole is dry, falling within the desert or desert steppe climate classification.

Degradation of environment quality and loss of resources present one of the big challenges in the development of Afghanistan. Between 1990- 2000 Afghanistan lost an average of 29400 hectares of forest per year, to an average annual deforestation rate of 2.25 % which further increased to 2.92% per annum between 2000-2005. Forest now occupies less than 2 % of country's total area. Rangelands are being converted to rain-fed wheat production which is highly effected climate.

Afghanistan is geographically and ecologically diverse with four broad eco-regions, namely, temperate coniferous forests in the east, temperate grasslands and shrub-lands, Savannas and shrub-lands with minor occurrence in the northern region, grasslands and shrub-lands in the northern, southern and western parts of the mountainous regions and deserts and xeric shrub-lands in the southwest (UNEP 2008: Biodiversity profile of Afghanistan).

A few centuries ago deciduous and evergreen forests covered 5% of Afghanistan's current land area, including one million hectares of oak and two million hectares of pine and cedar growing mostly in the eastern part of the country. Open woodland dominated by pistachios, almonds and junipers occupied a third of the land areas. Today most of the original forests have gone. By the middle of 20<sup>th</sup> century, the total forest cover of Afghanistan was estimated at 3.1 – 3.4 million hectares. Forests now occupy less than 1.0-1.3 million hectares (2 % of country's total area), (SOE 2008).

The largest areas of forest are located in the eastern provinces, at present the forests occupy 1.7 million hectares and rangelands occupy about 30 million hectares, representing roughly 45% of the country's territory.

### **Sericulture**

Sericulture has long history and it is a traditional industry in Afghanistan. In the rural areas of the country for the women it is very valuable business that even illiterate women can obtain money from this way. Ultimately, it has positive influence on gender equity. 2500 years ago when the Malica Kotan married the King of Coarsen (its center was Balk province) she brought silk worm from china to Afghanistan and started rearing them.

The Sericulture department was officially established under the structure of Ministry of Agriculture, Irrigation and Livestock in 1954. Two Chinese experts (Dr. Kei and Mr. Shaa) were hired to develop sericulture industry in center and provinces of the country. From 1954 to 1962 sericulture stations were established at Gulbagh and Tapa Tajbik. Both station's breeding stocks were from Japan silk warm breed. Till 1963 this industry was extended to Badakhshan, Harat, Balkh, Kunduz, Baghalan, Jowzjan, and Parwann 1966 the 3 years school of Sericulture was established for the first time in our country. Two Japanese experts (Mr. Kakoo, Mr. Toda) were the teachers and 43 students (technical staff) were graduated from the school.

### **Darulaman Sericulture farm:**

This farm was inaugurated in 1972 and funded with budget of £100,000 from China and AFN 200 million from government budget in 1967. This farm was established in 35 hectares land with four blocks of silk warm raising, one cold storage, one laboratory, one carpenter room, admin block etc. Production capacity of this farm was 20,000 commercial 12gr egg boxes and 1000 egg papers for the mother stock and breeding purpose. 80,000 to 90,000 mulberry trees were utilized to feed the silk warms in the farm. Three deep well with water pump were used for Irrigation of that mulberry trees. 20 Chinese experts were working in this farm 10 people for construction, 10 people for the technical affairs and training of local staff.

### **Present possibilities:**

Farm	Area (Hectares)	Mulberry tree
Zendajan sericulture farm	400	300,000
Urdu khan sericulture farm	24	80,000
Jawzjan sericulture farm	15	1500
Balkh Dehdadi sericulture farm	20	40,000
Kunduz sericulture farm	6	3000

**Project Goal:**

- transferring new technology in the field of sericulture in the country.
- promotion of silk production level in the country.
- encouragement of private sector to invest on such industries.
- struggling against narcotic cultivation.
- develop and extend of silk warm industry all over the country.
- making business for the jobless people in the country.

**Activities:**

- Survey and design of projects in 5 provinces.
- Rehabilitation of silkworm farms in Herat, Jawzjan, Balk, Baglan, Kunduz provinces.
- Rehabilitation of Darulaman sericulture laboratory, Cold storage, Carpenter room, with new equipment and machinery. And also new machinery for mulberry tree farm and tractors and 100 papers of mother stocks.
- Preparing of improved breeds of Mulberry trees for 5 provinces & improved eggs.
- Preparing the update and new technology equipment to 5 provinces.
- Providing fellowship & scholarship to technical staff of center and provinces
- Changing of 3 diesel water pumps of Darlaman sericulture farm to electrical and solar system and also changing of irrigation system to the new method.

# **Sericulture scenario in Bangladesh-a re-emerging industry for poverty alleviation in Bangladesh**

**Md. Saidur Rahman**

Bangladesh Sericulture Development Board, Rajshahi, Bangladesh  
E-mail: msrahman57@yahoo.com

## **Abstract**

Sericulture of Bangladesh has the long history and cultural heritage as Indian sericulture especially with West Bengal. In 1947 when India was divided Bangladesh (The then East Pakistan) received very small sericultural resource. For massive extension of sericulture and establishment of sericulture industry in the country Bangladesh Sericulture Board was established in 1978 which was renamed as Bangladesh Sericulture Development Board in 2013. The Governing body of the Board is chaired by the Honorable Minister, Ministry of Textiles and Jute with 14 members from different associate ministries and sericultural professions. Besides the government sector, private sectors and NGO's are also working in sericulture. Tree plantation is the common practice in the extension area and 505 hectare of land is under mulberry plantation. Annual cocoon production is 418.00 MT and raw silk production 41.60 MT. Employment generation through deferent fragment of sericulture is 0.65 million, out of which 75% is women. Annual import is 393.73 Ton and export is US\$ 133,884. Maximization of cocoon production in Jaistha (May-June) and Bhadury (August-September) season, extension and adoption of technology in field and establishment of stable marketing system are the major challenges for extension and establishment sericulture industry in the country. Suitable agro-climatic condition, existence of unemployment, availability of low cost labor, having sericultural infrastructure and existence of demand both in domestic and international market are the major potentialities for exploration of sericulture in the country.

## **ortnIduction**

Sericultural activities of different dimension are well fitted to employment generation, poverty reduction and women empowerment especially for rural area having agricultural base and tradition. Bangladesh has a well agricultural base and long tradition of agriculture. Sericulture history of Bangladesh also has a long history and cultural heritage and it shares the same cultural heritage with the Indian sericulture especially with West Bengal. Once there was a well known reputation of "Bengal Silk" for its unique nature and lusture and also considered

as the socio-economic backbone of the Bengal. During that period a quantum of 250 MT of silk yarn was exported from the undivided Bengal to different European countries (Quasim, 1990. In 1947 when India was divided Bangladesh) The then East Pakistan (received two nurseries and small silk growing areas. During 1961 ten new nurseries and 20 extension centers, 1 silk industries and 1 research and training institute was established under the supervision of the then East Pakistan Small Industries Corporation (EPSIC) at present Bangladesh Small Industries Corporation (BSIC nI 1978) Bangladesh Sericulture Board was created with the objective to gear up the sericultural activities in the country for poverty reduction, employment generation and women empowerment bringing all the functional component of sericulture under one umbrella. The Board was reformed and renamed as the Bangladesh Sericulture Development Board to coordinate effectively and strengthen the sericultural activities in the country.

Vision, Mission, Objective and Role in Socio-economic development of the Board are as follows:

- Vision : To promote and expand sericulture throughout the country with a view to reduce the acute poverty of the hardcore rural people of Bangladesh.
- Mission : Introduction of HYV mulberry and silkworm variety for rapid expansion & promotion of sericulture, sophistication in technology for reeling silk yarn, throwing, twisting, weaving, dyeing, printing and finishing of fabrics through training, awareness build-up, motivation and supervision.
- Objective : To promote, expand and development of sericulture and silk industry in the country and to look after the persons engaged in this sector.

Role in socio-economic development:

- Employment generation
- Women empowerment
- Poverty reduction

Governing Body of the Board:

Bangladesh Sericulture Development Board is the apex body of sericulture in Bangladesh to look after the development of sericulture in the country. The Governing Body of the Board consists of 14 members taking representative from National Assembly, associate different ministries, University and representatives from different sericultural professions as follows:

Chairman	:	Honorable Minister, Ministry of Textiles and Jute
Senior Vice Chairman	:	Honorable MP, Nominated by Honorable Speaker of National Assembly
Vice Chairman	:	Secretary, Ministry of Textiles and Jute
Member	:	<ol style="list-style-type: none"> <li>1. Commissioner, Rajshahi Division.</li> <li>2. 01 Representative from Ministry of Textiles and Jute</li> <li>3. 01 Representative from Ministry of Finance</li> <li>4. 01 Representative from Ministry of Agriculture</li> <li>5. 01 Representative from Ministry of Ministry of Industries</li> <li>6. Director General of Bangladesh Sericulture Development Board.</li> <li>7. 02 Representatives from Rajshahi University (01 from Botany Department and 01 From Department of Zoology)</li> <li>8. 03 Representatives from Sericultural Professions.</li> </ol>

#### **Functional Structure of the Board:**

The functional Structure of Board consists of four divisions namely -Finance & Planning, Extension & Motivation, Production & Marketing and Research and Training and each division is headed by a Director. Administration and Management is headed by a Secretary and Audit and MIS is under the direct control of Director General .Research and Training division, Production & Marketing division and Extension & Motivation division is the techno-functional component of Board.

Research & Training division is responsible for providing R & D support and generation of skill manpower for sericulture sector. It has two sub-stations namely -Germplasm Maintenance Centre (GMC) situated in the northern part of the country and Regional Sericulture Research Center (RSRC) situated in Eastern Part (Hilly Area) in the country.

Production and marketing division is associated with post cocoon activities and marketing. Under production & Marketing division there are 12 reeling center's situated at different cocoon producing areas of the country.

Extension & Motivation division is responsible for extension of sericulture and field production. This division has a wide extension network in the country. It has 05 Regional Sericulture Extension Office, 07 District Sericulture Extension Office, 41 Upazilla Sericulture Extension Office and 160 Sericulture Extension Sub center throughout the country. Besides these extension networks there are 10 nurseries, 01 P3 station, 07 Mini farms and 26 chawki research center.



### **Strength of sericulture in Bangladesh:**

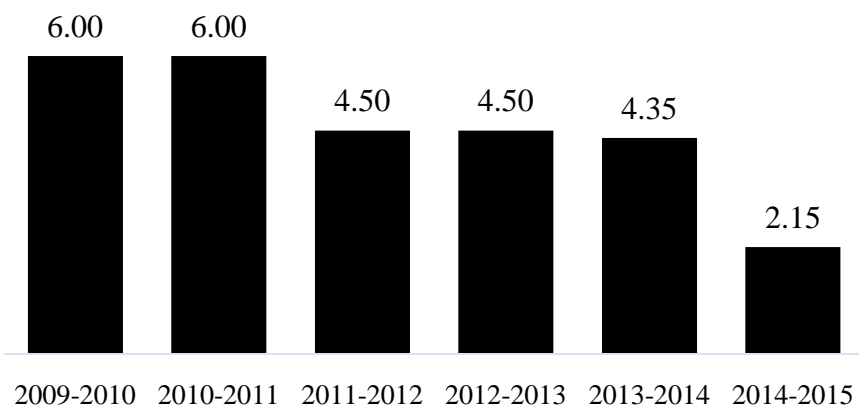
As sericulture holds the merit of employment generation through its different steps of activities the government has taken sericulture as one of the potential sector for employment generation, poverty reduction and women empowerment. Important positive sides of sericulture in the context of Bangladesh are given below:

- Suitable agro-climatic condition;
- Existence of unemployment and poverty;
- Availability of labour and land specially in hilly area;
- Having 10 sericulture nurseries, 07 Mini Farm covering with nearly 175 hectare of land and with silkworm rearing establishment;
- Existence well research establishment and of wide extension network system.
- Existence of large scale demand-supply gap of raw silk in the country.
- Increasing demand of silk materials in the country and also in the international market.

### **Good Practices for development of sericulture in Bangladesh:**

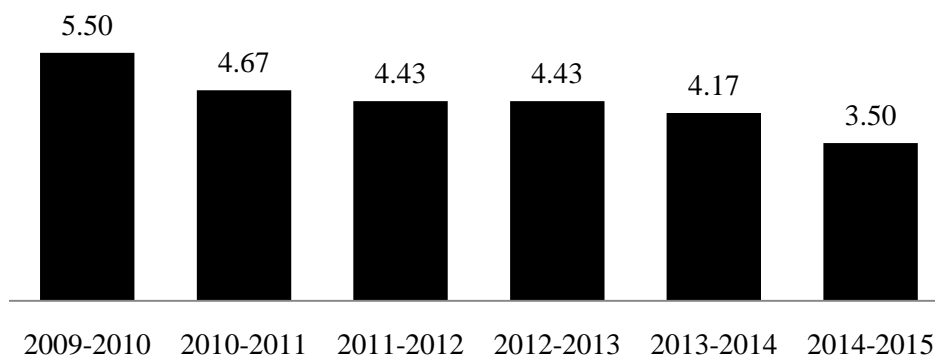
For flourishing boosting up the sericulture in the country through expedition of extension activities some good practices have been taken by the Board. This are-

- Development project : After the establishment of the Board 17 development projects have been completed during the period of 1978-79 to 2014-2015 with the amount of Tk. 15,371.79 Lac. Five ongoing Development projects are implementing during the period of 2009-2017 with the amount of Tk.751,200.
- Provided training : As the sericulture requires high technique especially for silkworm rearing and post-cocoon activities, training has been provided to 7,798 personnel during the period of 2009-2015.
- Supply of saplings : Practice of mulberry cultivation in Bangladesh is mainly through tree plantation. During the 2009-2015 years 275,000 saplings has been supplied to the farmers with very much subsidized price.



**Figure 1. Number of seedling supplied ('000)**

- Supply of silkworm eggs: As the sericulture farmers in the country are not economically sound disease free silkworm eggs is also supplied to farmers at subsidies price. During 2009-2015 years 267,000 disease free silkworm eggs is supplied to the farmers.



**Figure 2. Supply of silkworm during 2009-2015**

- New Approach for development of sericulture: For more close observation and providing intensive and effective technical supervision at the aim to make the sericulture extension more fruitful in the country recently some new approaches has been taken .These are
  - A) Reshom Polli establishment: Concept of the establishment of Reshompolliis to establish a Polli (village) of 75 farmers. Each farmer should have 200 mulberry trees. Thirty eight such types Reshompolli will be established in the country. By this time 25 have been completed.

- B) Block system mulberry plantation: In a block there are 5 farmers. Each farmer should have 200 mulberry trees. The Board is planning to develop 300 such type blocks will be established in the country and by this time 52 has been completed.
- C) Coordination of sericulture activities with One House One Farm project (OHOF) : One House One Farm project is the poverty alleviation project through family farming and e-financial inclusion .In Bangladesh nearly 25 % of people living below the poverty line. The aim of this project is to improve the livelihood of these people and bring the poverty at '0' level by 2021. Theme of the project is; Village co-operative formation → Participatory fund mobilization → Investment → Farm development → Loan repay. Target area of this project is 40,527 words under 4,503 Union and 485 Upazilla and 64 Districts of the country. The government directed to link the sericulture activities with OHOF project. In the first step involvement of Village Development Organization (VDO) members of 25 Upazilla under greater Rajshahi division is under process.
- D) Extension of sericulture in Hilly region: Hill tracts region, the eastern part of the country is the potential zone for extension of sericulture due its suitable climatic condition and availability land for mulberry cultivation. As the people depends only on the local traditional agricultural practice that is called "Jhum Cultivation" So unemployment is another positive side for sericulture extension in that area. Considering the above advantages Bangladesh Sericulture Development Board launches a pragmatic programme and extensive extension network for massive sericulture extension at aim to generate employment for the people living in the hilly area and to enhance cocoon as well as raw silk production in the country.

### **Development of sericulture in the country**

#### **A) Development in research:**

Initiation of sericulture practice in Bangladesh was started with low yielding mulberry variety as well as silkworm races. The institute has developed a number of new technologies. Significant achievements of the research institute are given below:

- Sixty eight mulberry varieties and ninety five silkworm races have been collected and are maintaining in the germplasm bank.
- Nine high yielding mulberry varieties has been developed. Due to development of high yielding mulberry varieties leaf yield has been improved to 30-40 MT/ha/yr in place of 12-18 MT/ha/yr.
- Twenty eight silkworm races have been developed. Due to development high yielding silkworm races cocoon production has been improved to 60-70 kg/100dfls in place of 20-25 kg/100dfls.

- Renditta has been improved to 10-12 in place of 18-20.
- Indigenously made reeling and other post cocoon appliances have been improved.

The developed technologies are being transferring to the field through extension division. Though the unit production has been increased but the yield gap is noticeable. This is due to poor management of technologies as the farmers are not technically as well as economically sound and also for adverse climatic effect especially in Jaistha (May-June) and Bhadury (August-September) season.

**B) Area under mulberry plantation:**

Practice of mulberry cultivation in Bangladesh is in the form of bush, high bush, low cut and tree. But at farmers level mainly tree plantation system is practicing using road side, embankment, boundary of cultivated land and also in surrounding of home that is called "homestead sericulture". Bangladesh Sericulture Development Board has 10 Sericulture nurseries and 07 mini sericulture farm which occupying about 175 Hectare of land under mulberry cultivation. These nurseries are using for maintenance of silkworm mother stock, seed multiplication and also for supplying saplings and disease free laying (DFLS). Besides the land under nursery, there are about 1.40 million of mulberry tree at farmers level in extension area which covers about 280 Hectare of land. Some reputed NGO's working in Bangladesh are also playing significant role for development of sericulture and silk industry in the country. About 50 Hectare of land under different NGO's are using for mulberry cultivation in farming system to rear silkworm for cocoon production. Therefore, there is a total of 505 hectare of land under mulberry plantation in Bangladesh.

**C) Cocoon & raw silk production:**

Bangladesh has past experience of non mulberry silk cultivation. But among the four kind of natural silk at present only mulberry silk is practicing in the country. Due to its tropical climatic nature traditionally Bangladesh is the multivoltine zone and exploitation of multivoltine silkworm breed is the common practice in the field. But at present improved multivoltine crossed breed silkworm is using in the field to improved the field productivity. At present Bangladesh is producing about 418.00 MT of green cocoon & 41.60 MT raw silk annually (Sericulture in Bangladesh, 2014). The trend of cocoon & raw silk production during last five years is summarized as follows :

**Table 1. Silk production in Bangladesh during 2009-2014**

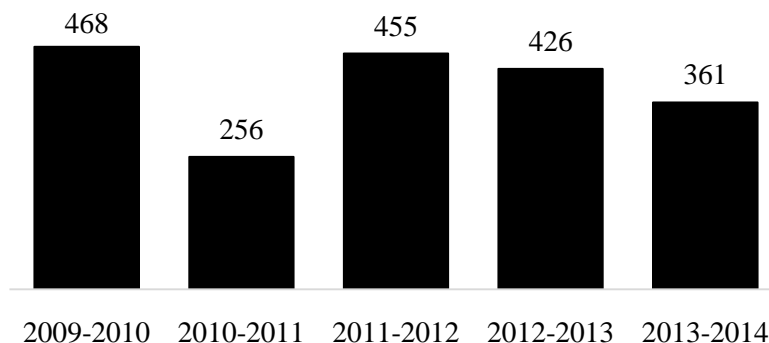
Fiscal year	Cocoon Production (MT)	Raw Silk Production ( MT)
2009-2010	400.00	40.00
2010-2011	390.00	38.00
2011-2012	430.00	42.50
2012-2013	430.00	43.00
2013-2014	448.00	44.50
Average	418.00	41.60

**D) Employment generation:**

Bangladesh is densely populated country and nearly 80% of total population is living in the rural area. Practice of sericulture is rightly fitted for development of socio-economic condition in the country especially in the rural area through employment generation by engaging in different activities of sericulture. At present about 0.65 million people are involved in different dimensional activities of sericulture like mulberry cultivation, silkworm rearing, reeling, production and marketing. Out of 0.65 million employment generations more than 75% i.e. nearly 0.49 million women are engaged in silk sector.

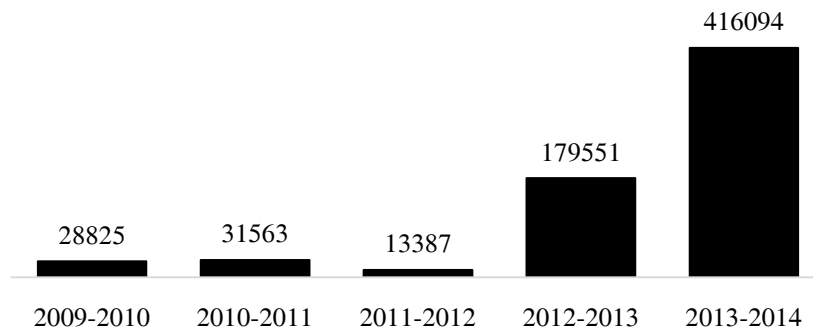
**Silk import and export**

National demand of raw silk is 300 MT/year. But annual production in the country is 41.60 MT. Rest amount needs to import to feed the silk industry in the country. Average annual import is 393.73 Ton (Including woven fabrics). Export of silk is not encouraging. Annual average export is only US\$133,884. The Trend both in export and import is not in a regular fashion but it is fluctuating due instability of demand both in domestic and foreign market.



Source: National Board of Revenue, Bangladesh

**Figure 3. Silk import in 5 years (Tons)**



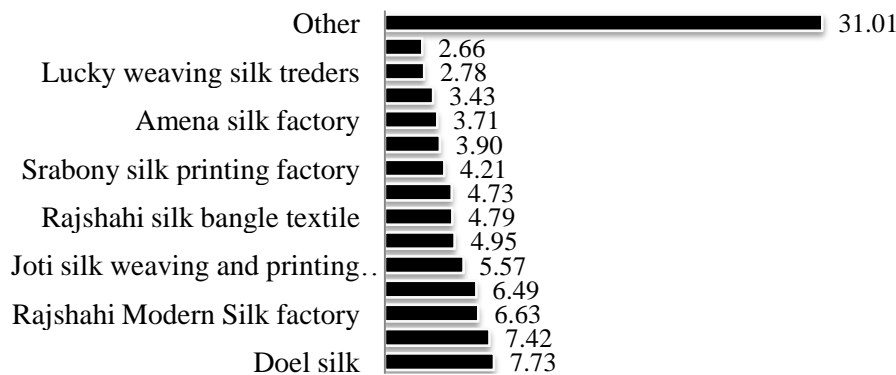
Source: Export Promotion Bureau, Bangladesh

**Figure 4. Silk export in 5 years (US\$)**

### **Involvement of Private Sector and NGO in Sericulture**

#### **Private Sector**

At present total production side that means silk industry is in the private sector. Silk industry plays a vital role in our national economy. Many people get employment opportunity through these silk industries. It has good will but growth and market share is not satisfactory to the national and global context. This is mainly due to old technology, poor advertising, limited showroom, shortage of raw materials, inadequate capital. But it has some positive sides like growth of sales and market share, low cost labour, increasing demand, good geographical location, employment generation (Md. Nazrul Islam et al, 2010). According to silk policy'2005 total demand of silk fabric is 7.00 million meter. According to annual report of Silk Industry Owner's Association, 2012 thirty two private silk industries working in the country produce 2.43 million meter silk cloth and their annual sales is Taka 8,361,100.



**Figure 5. Market Share % of 32 silk factories**

NGO : BRAC, the leading NGO in the country is still working in sericulture. 1,000 women are engaged in silkworm rearing and 4,000 women in silk spinning. Nowgaon Education Development Association (NEDA) and Socheton is working in sericulture in coordination with Bangladesh Sericulture Development Board.

#### **Silkworm races using in the field :**

Traditionally Bangladesh is the multivoltine zone due its tropical climatic nature . Initiation of sericulture in Bangladesh was through using multivoltine silkworm race called 'Nistari (Indigenous)' and using of these races in field was continued for a long time. For improving the field production, improved silkworm race was developed and introduced from 1980s. Due to exploitation of these improved silkworm races cocoon production was increased to 40-46 kg/100dfls from 20-25 kg/100dfls. These improved silkworm race are mentioned as below-

**Table 2. Production of Improved silkworm races**

<b>Sl. No.</b>	<b>Name of the improved silkworm race</b>	<b>Production level/100dfls (Kg)</b>
1.	Bipul	45.00
2.	FT-B	45.00
3.	HTHHRB-3	44.00
4.	BSR-95/14	46.00

At present hybrid eggs are using in the field for high as well as stable cocoon production and as result cocoon production is increased to 60-70 kg/100dfls. Details of hybrid combination with its production level are mentioned below:

**Table 3. Productivity of hybrid silkworm races**

<b>Sl. No.</b>	<b>Hybrid combination</b>	<b>Production level/100dfls (kg)</b>
<b>For May-June and August-September season:</b>		
1.	(Nistari × FT-B) × HTHHRB-3	
2.	(N) I (K × FT-B) × HTHHRB-3	50-58
3.	(Nistari × BSR-95/14) × HTHHRB-3	
<b>For October-November and February-March season:</b>		
4.	BN (M) × BB (Multivoltine) (Bivoltine)	60-70

### **Potentiality of sericulture extension in Bangladesh**

- Soil and climatic condition is suitable for sericulture in Bangladesh. Due to this suitability at least four crops can be harvested in a year;
- Existence of unemployment and availability of low cost labour in respect of other country;
- Scope of exploitation of women's force in different dimensional activities of sericulture and women empowerment;
- Segment of employment generation in sericulture is comparatively more than the other agriculture crops and at present farmers are showing more interest in cash crop;
- Northern part of the country, the Greater Dinajpur, Rangpur district may be the potential growth zone of sericulture due to availability of land for mulberry cultivation and existence of unemployment in that area;
- Hilly region, the eastern part of the country is the another most potential zone for extension of sericulture due to its suitable climatic condition for sericulture, availability of land for mulberry cultivation and existence of unemployment;
- Annual requirement of raw silk in the country is 300 MT. At present it produces only 41.60 MT. A large amount of total requirement is required to import. Due to large demand-supply gap there is a wide scope of sericulture extension in the country;
- Due to rapid industrialization and high labour cost, sericulturally advanced country is gradually leaving sericultural practices specially in mulberry cultivation and silkworm rearing. But the demand of silk is still existing in the world market. In this present scenario world silk production, Bangladesh has a bright potentiality for extension of sericulture as it has unemployment problem and availability of labour.

### **Constraints**

- Poor management of technology in field due to farmers are not technically as well as financially sound;
- Lack of stable marketing system for silk goods, specially for cocoon;
- Scattered mulberry plantation in extension area following tree plantation;
- Supply of eggs to farmers instead of chawki silkworm;
- Problem in technology innovation and dissemination;
- Lack in the development of post cocoon side that means industrial side;
- Lack in skill manpower.



**Challenges:**

Total demand of raw silk in the country is about 300 Metric Ton. Out of total demand at present country produces 41.60 MT. Rest amount has to import to fulfill the national demands. In this situation the major challenges are -

- Improvement of leaf and cocoon productivity in the field level;
- Maximization of mulberry leaf production in adverse climatic condition due to climate change;
- Prevention of mulberry disease and pest especially for powdery mildew, thrips and tukra in adverse climatic condition due climate change;
- Maximization of cocoon production in adverse climatic condition especially in Jaistha (May-June) and Bhadury (August-September) season;
- Prevention of silkworm diseases especially for Bacterial, Viral and Fungal diseases in adverse climatic condition;
- Improvement of rendita to 6-8;
- Ensure raw silk production at international grade;
- Strengthens of extension, technology dissemination and adoption process to increase the productivity level and minimization of yield gap;
- Establishment of stable and sound production and marketing system.
- Reducing import of raw silk.

**Ways to overcome the challenges:**

To meet the national demand and to minimize yield gap, improvement is to be needed in following fields-

- Improvement in technical information including research paper, research methodology and other relevant materials;
- Improvement of genetic materials both for mulberry and silkworm race;
- Improvement both in mulberry cultivation and silkworm rearing technology in the context of changing climate condition;
- Development of advanced post cocoon machineries and technologies for production of quality raw silk;
- Improvement for strengthening of extension management system and technology dissemination and adoption process;
- Improvement in production and marketing process for establishing a stable production and marketing system;
- Enhancement of technical skill of officer/Field Staff through providing training and higher degree in the field of sericulture;

- Mechanization in sericultural management practice;
- Diversification of sericulture.

### **Conclusion**

The soil and climatic condition of Bangladesh is suitable for practicing of sericulture. Availability of land especially in hilly region, labour, unemployment and existence of wide agricultural tradition are also the major advantages for exploiting sericulture in the country. The present world scenario of sericulture is also a positive side for massive extension of sericulture in the country having problem of unemployment and poverty especially in the rural area like Bangladesh. Due to socio-economic condition, unemployment, huge demand - supply gap of raw silk in the country and present world scenario of sericulture, there is a bright prospect of sericulture in Bangladesh.

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# **Sericulture scenario in Bhutan region – a re-emerging industry for poverty alleviation in Bhutan**

**Dawa Penjor**

Program Director, National Mushroom Centre, Department of Agriculture  
Ministry of Agriculture and Forests, Royal Government of Bhutan, dawa63@gmail.com

## **Abstract**

Weaving is an ancient art in Bhutan and the textile industry has become an integral part of Bhutanese life and culture. Bhutan does not have a silk production industry as such at the moment but weaving is one of the most important contributors for employment in women and income generator in many rural settings. Bhutanese textiles are very intricate and take long time to weave but it is a pride for the Bhutanese and a must for important occasions and a family heirloom.

## **Introduction**

Historical perspectives of silk industry in the country

Presently Bhutan does not have a silk production industry as such although attempts were made to rear silk worms in eastern Bhutan in the eighties in addition to traditional rearing of insects around the home. This is how some of the weaving communities using silk developed in places like Radhi and Bidung. The silk industry as it exist is constituted by the products (textiles) that are developed from the silk threads imported from neighboring countries, mainly India. Many Bhutanese women depend on weaving to earn income and to sustain their families. Other activity where silk is used are for production of cultural and religious products, wall decorations, adornment for religious paintings (Thangka), images made from pieces of silk cloth sewn together. Silk cloth pieces are also imported to produce dress, scarves and shirts, traditional shoes, etc. In olden times silk has been collected from the forest for use by weavers but now almost all the silk is imported. The silk cloth pieces used for developing products like dress for men and jacket for women beside the products cited are also imported from neighboring countries.

Textiles are the products of centuries of individual creativity and transmitted skills in fibre preparation, dyeing, weaving, cutting, stitching and embroidery. The entire process of weaving from the preparation of yarn, the dyeing and final weaving to produce designs ranges from the most simple to the most intricate.

### *Thagzo: Weaving & Dyeing: The art of weaving in Bhutan*

Developing of textile products is an ancient art in Bhutan and the weaving has become an integral part of Bhutanese life and culture. Traditionally coming from a rural and rustic setting, a uniquely rich tradition of weaving has evolved and flowered over time as a home or cottage industry. The skills are handed down from generation to generation, mother to daughter, from family to family. Weaving in Bhutan is today an art form that is representative of the very heart and souls of the country and as such the art of weaving is widely practiced. This occupation has now become main form of employment for the jobless women in Bhutan. With the beginning of development under the five year plan in the early sixties predominantly men were able to receive education and gain employment. The number of schools was low and they were located far away from their villages and it comparatively was easier for the boys to stay away from home. The need for the girls to help the parents to help at home was also greater. As a tradition in Bhutan, land and wealth is normally passed on to the daughter of the family and as such girls usually stayed at home. These men found work outside their homes but by and large married women from the rural villages and took them to live with them wherever they were employed. For most of these women, weaving became the main form of employment away from their villages especially if they came from the eastern part of the country. Actually in the villages the farmers wove only when they were free from agricultural work. It was the royal weavers, thama, in the royal loom houses who were the professionals. Some of the aristocratic and landed households also had professional weavers. When Thimphu became the capital city many of these weavers were brought along. The widespread use of textiles took it beyond the realm of clothing to the realms of rituals and symbolism, as a form of wealth and commodities for trade and taxation.

Although it has become a tradition now to consider women to be weavers it is said that men were the predominant weavers in the western Bhutan till the first half of the century. There, it was considered a men's job to weave and they actually weaved plain white cotton pieces.

Bhutanese textiles represent a rich and complex repository of a unique art form. They are recognised for their abundance of colour, sophistication and variation of patterns, and the intricate dyeing and weaving techniques. The significance of Bhutan's textiles is attributed to many factors such as: its intricate patterns in textile art (unique in the world), skills and methods adopted in their creation, noteworthy role in religious, official and social events represented by "glyphs and symbols of ancient knowledge" and their deep sacred connotation.

The history of Bhutanese textiles became more evident in the last century. As textile production moved beyond the confines of clothing to artistic expression of

individuals and communities, patronage from the Royal household was vital. Although the founders of the Wangchuck dynasty are from Bumthang, their ancestral home is in Lhuentse district, which is historically recognised as the home of the most celebrated weavers in the country. The role and influence of royal women in sustaining and furthering the weaving tradition must be acknowledged. Penlop (Governor) of Trongsa in Central Bhutan, Jigme Namgyal built the Wangdichholing palace in 1857 and the loom houses (thagchem) accommodating 30 to 40 weavers, were built around the same time near the palace and existed until the mid 1900s.



**Figure 6. An assortment of silk textiles**

The sister of the Second King of Bhutan, Azhi Wangmo, is credited to have introduced the horizontal loom from Tibet in the 1930s. Currently Her Majesty the Queen Azhi Sangay Choedon Wangchuck has supported textile development and continues to extend royal patronage to the textile industry. Her Majesty's interest and intervention has revitalized Bhutanese textiles, given the industry and impetus within the country and brought world attention to Bhutanese textiles. The Bhutan Textile Museum in Thimphu was conceived and established by Her Majesty in 2001 under her patronage.

Today Bhutanese textiles have reached new heights of dynamism and respect; they are valued not only for their economic viability, but also as a symbol of Bhutan's artistic heritage that commands world attention and appreciation. Fabrics fashioned in the looms, with magical colours, intricate designs and patterns are symbolic of the Bhutanese society and the country. The art of weaving although widespread is particularly impressive in Central and eastern Bhutan regions of Bhutan. In these regions almost all the women in the villages weave clothes for the family and to earn extra income. For the Bhutanese, the woven cloth and dress is associated with status, etiquette, social, cultural and religious events.

Cotton, silk, wool and yak hairs are used to weave fabrics for producing different types of uses such as men's dress (Gho), Women's dress (Kira), belts (Kera), scarfts (rachu and kabne), bags, seat covers, wall hangings, foot wear, etc, with variety of designs and intricate patterns.



**Figure 7. Dress made from silk: women's wear (Kira); Men's wear (Gho and official boots)**

Women of eastern Bhutan are skilled at weaving and some of the most highly prized textiles are woven by them. In the past, textiles were paid as a form of tax to the government. It was also a tradition in the past for people from western Bhutan to travel to Samdrup Jongkhar, in Eastern Bhutan to acquire/barter for woven textiles.

Khoma village in Lhuentse is famous for Kushuthara (fine silk), while Radhi and Bidung in Tashigang are known for Bura (raw silk) textiles, namely Mentsi Matha and Aikapur. Kushuthara is a silk on silk weaving technique with intricate hand laced patterns. It is the most expensive textile in Bhutan and is highly sought after by both wearers and collectors.

One type of cotton fabric woven in Pemagatshel is the Dungsam Kamtham, which lends its name to the village Decheling (Samdrup Jongkhar). Adang village in Wangdue Phodrang is known for textiles such as Adang Mathra, Adang Rachu and Adang Khamar, while the Bumthaps in central Bhutan are known for Bumthap Mathra and Yathra, both textiles woven out of Yak hair and sheep wool respectively. The people of Nabji and Korphu in Trongsa are known for textiles woven out of nettle fibres. The other use of nettles was for making ropes and string for bows. Weaving is also a vocation amongst the Brokpas (Yak herders) of Merak and Sakteng in North-eastern Bhutan.

Men usually contribute in spinning yak hair and sheep wool into thread working while looking after the cattle or sheep in the pastures. There are four types of looms that are used by Bhutanese weavers. They are the blackstrap loom, the horizontal fixed loom, the horizontal-framed loom and the card loom. The predominant type is the indigenous back-strap loom. It is used mostly by weavers from eastern Bhutan and is set up on porches or in thatched sheds to protect weavers and the cloth from the sun and rain. The horizontal frame loom and the card loom brought into Bhutan from Tibet and are still used today.



**Figure 8. Pedal loom: Weaving from sheep wool and Back strap loom**

### **The weavers from different parts of Bhutan**

The weaving tradition of Bhutan spans several centuries with traditional, classical designs continuing to be woven even today by the Bhutanese. The women weave the textiles from their homes and each region has its own traditions and produces its own specialties. Eastern, North Central and Central Bhutan all have strong, distinctive local weaving traditions. Today this composite culture is viewed as a source of identity and a national asset.

#### **Eastern Bhutan**

The country's largest group, the *Sharchhops* or 'easterners', inhabit Eastern Bhutan. Women from eastern region are considered Bhutan's most celebrated weavers and cloth is an important product of the region. Most learn the craft as very young girls, on their mothers' looms, doing the weaving during the winter months, when women prefer to spend their time indoors and there is not much agricultural activity. Traditionally, the local nobility often employed weavers in their households. The cotton and wild silk textiles manufactured were traded with people from central Bhutan, who came to exchange their woolen cloth for lac, indigo, and the Eastern textiles. Today most of their work is sold in Thimphu, while the traditional barter with central Bhutan continues on a much smaller scale.

Along Bhutan's eastern border live the semi-nomadic herders of the high valleys of Merak and Sakteng - these tribes have a unique lifestyle, language and dress and their own weaving specialties and are an integral part of the Eastern region. For centuries, cloth was central to the internal economy of eastern Bhutan. Tax in some areas was paid in the form of lengths of plain and patterned cotton and wild silk cloth until the 1950s. Eastern Bhutanese use the back strap loom, which they set up on porches, under bamboo mats, or in thatched sheds to protect weavers from the sun and rain. In Pemagastshel District, shelters on stilts are constructed in fields near the house so that girls and women can weave in the shade while watching the crops and livestock. Card looms and horizontal frame looms are also used.

Weaving techniques and technology have remained virtually unchanged over the years, in Bhutan. Exquisite textiles continue to be woven by hand on the back strap and card looms - and, for the past sixty years, the Tibetan horizontal frame loom.

### **Looms**

The possibilities of weaving patterns are determined by the loom being used. There are three types of looms (*thagshing*) used in Bhutan the back strap (*pangthag*) loom with a fixed vertical frame (the backstrap loom with a horizontal frame is used by the women of Laya, in Northern Bhutan), the horizontal frame looms with pedals (*thruethang*) and the card loom, a form of back tension loom, used for making a select group of narrow textiles usually belts.

### **Back strap looms**

Most weaving in Bhutan is done on two types of backstrap loom (*pangthag*, 'body or lap loom'). The most commonly used loom is the fixed vertical loom which has two warp beams that require a wooden frame, so these looms are usually set up against a wall. The warp here slants upward, away from the weaver. The second type of loom with a horizontal frame has a single warp beam, which is usually positioned so the warp rides parallel to the ground in front of the weaver. This kind of loom is easy to make at low cost and is easily transportable. Bhutanese weavers employ a length of bamboo as the shuttle case and a wooden sword to beat in the weft.

One method of winding the warp for the loom utilises two upright wooden posts about 150 cm apart. A thin, joining rod connects the posts near their top ends. Depending on the pattern of the cloth to be woven, two to five thin, additional wooden or bamboo rods are propped against the joining rod in order to keep the warp yarns in order during weaving and for the pattern warps. Extra warps are tied with loops of thread to heddle rods as the warp is prepared. The warp is most often wound in a single direction as a continuous circular length. Therefore, when it is removed from the loom the fabric comes out circular and needs to be cut across a narrow section of unwoven warps in order to create a flat rectangle.

Alternatively the warp may also be wound in another manner, using a third rod, which becomes the closing rod when the warp is transferred to a loom. When a panel of this type of cloth is completed, the closing rod is pulled out, releasing the warp-end loops. The fabric is a flat panel that does not require cutting.

When the warp is moved to a loom, the upper and lower warp beams of the loom replace the two fixed winding posts. The breast beam, typically a length of bamboo split in half lengthwise so that it grips the cloth, is tied to the weaver's back strap with leather or nylon cords. By leaning backward, the back strap



allows the weaver to maintain the warp tension as she weaves, periodically sliding the woven fabric upwards at the back and the unwoven warp downwards toward her.

Back strap looms with a single warp beam are used in herding communities in northwest Bhutan (Laya Lingshi). The warp beam is held in position with stone or heavy sacks of salt. The advantage of this loom is that it can be easily moved even with partially woven cloth on it.



**Figure 9. Laya: Weaving and product from yak hair (Bags, tents, adornments for yaks and typical ladies' dress)**

Using one heddle in this kind of loom produces a very dense warp and therefore the weft cannot be seen. If four heddles are used twill weft can be woven as on a peddle loom. Fabric woven on back strap looms is limited in width to roughly 65 cm. Garments and other textiles are fashioned by stitching together two or more lengths of cloth. A woman's dress (*kira*), for example, if made of silk or cotton, consists of three panels joined in the warp direction and oriented horizontally in the finished dress. If made of wool on a back strap loom, the dress will contain six panels oriented vertically.

### **Horizontal frame loom**

The horizontal frame loom is seen mainly in Thimphu, Central Bhutan, and Merak Sakteng and is mainly used for weaving with woolen and acrylic yarns, typically, twill weave. It was introduced to Central Bhutan from Tibet sometime around the 1930s. Around 1920, a young man named Sonam Dondhrup, from Lhuentse District, went to the Trongsa Dzong, to seek his fortune in the king's service. Sonam Dondhrup discovered he was interested in weaving and in his free time, he learned to work at a back strap loom and became a good weaver.

Azhi Wangmo, the young daughter of the first king noticed his weaving skills. Knowing that Tibet had different weaving techniques and used a different kind of loom, she sent him to Tibet to learn about the weaving being done there. She wanted Sonam Dondhrup to come back and train the Bhutanese weavers.

He spent about nine months in Tibet but no one would teach him until Azhi Wangmo sent two sets of gift cloth (*zong*) for the Tibetans. He came back, made a horizontal frame loom, and taught her how to weave on it. The two then trained

many of the women at the court in Trongsa. Later Azhi Wangmo went back to her home in Lhuntshe and taught the women there how to weave on the horizontal frame loom.

The horizontal frame loom (*thruethag*) is worked with pedals. The loom does not use a circular warp. The warp is wound around narrow rods laid parallel to the ground. At one end of the warp, as the winding proceeds, yarns are tied to or inserted through the heddles that control the ground weave. Four shafts or heddles are customary. Each time a heddle is used it lifts only a part of the yarn. By using this type of loom the weft is still visible between the warp and therefore it is easy to weave checkered textiles by using stripes in the warp and stripes in the weft. Supplementary (pattern) warps are not used on this type of loom. The warp is then transferred to the loom. The ground weft is wound on a long, bamboo bobbin with forked ends (for example, for weaving *yathra*) or on a very short bobbin that is inserted into a boat-shaped, wooden shuttle (for example, for weaving *mathra*).

The width of cloth made on this loom is between 20 and 65 cm. Panels of fabric from the loom are cut and sewn into finished textiles. For example, a woman's woolen dress may have between ten and fourteen narrow panels made on the frame loom, which are oriented vertically when the dress is worn. Blankets and rain cloaks consist of two or three panels cut from the same loom length and joined in the warp direction.

### **Card loom**

The Bhutanese use the card loom to produce very narrow textiles such as men's belts. Since the 1960s, narrow women's belts have also been made by card weaving. This loom looks similar to the back strap loom but the heddles are different. The range of textiles traditionally woven on this loom are similar to those made in Tibet and are used in contexts that were introduced from Tibet: for male dress (men's belt, *kerā*, and garters for securing boots) and religious purposes (ties for binding religious texts) and, sometimes, straps to hold reliquaries worn on the chest.

The Bhutanese card loom utilizes a continuous, circular warp mounted on the same frame as a back strap loom and similarly held taut by a weaver's body position. The cards once made of sheets of sturdy local paper or animal hide are often made from old X-ray film (improvised) or cardboard today. Each card has four holes one in every corner through which the warp is passed. The warp units are made of four yarns, each passing through a different hole in the four corners of a card. Two cards with eight warps make up a set. The cards are rotated by quarter turns to open and close each shed, and the weft is beaten down with a wooden sword. For a new style women's belt, about sixty cards are used.

The ground is usually a countered four-strand, warp-twined fabric, with twining that is inverted at intervals throughout the textile. Triple wefts are common. When

a women's belt is card-woven, it is decorated with various techniques of supplementary-weft patterning. Wool, acrylic, and cotton are used for the ground weave of textiles made on this loom.

### **Fibres**

Wild silk, cotton, and acrylic are the main fibres for weaving today. While some of the yarn is spun and processed locally, most of the wild silk and bright cotton and acrylic yarn is imported from India. The tribes of Merak Sakteng prefer to buy the cocoons as they are less costly and process them into yarns themselves. The fibres used are cotton, wool, silk (raw and refined), yak hair and nettle fibre (which produces a coarse fabric that is used for utilitarian purposes like strong bags though it was formerly used for making clothes as well). Wool from Bumthang, bura (raw silk) and cotton from warmer regions are used for weaving according to the regions. Yak hair is used to weave heavy textiles for tents, blankets and rugs.

### **Fibre preparation**

Bhutanese fibres are almost always spun with a drop spindle (*phang*) and transferred to a spinning wheel (*Chaphang*). Cotton seeds are separated with a *kaershing* or cotton gin and then fluffed before spinning. Only locally grown cotton is traditionally spun first with the aid of a spinning frame, then twisted again, using a drop spindle to produce a tighter yarn. Spinning is usually women's work, although men in the herding communities of Laya Lingshi and Merak Sakteng spin yarn from sheep, yak and goat wool. Bhutanese women also employ drop spindles to ply yarn and to tighten the twist of woolen, acrylic, and silk yarns from India. From the spindle, or the spinning frame, yarn is transferred to a rotating winding wheel or hand-held skein winder. It is then wound off into balls or skeins for weaving in natural colours or for dyeing. Extra warp wound around heddle sticks to create warp patterns. Once warp is placed on the loom these sticks are raised alternatively while weaving.

### **Nettle and hemp**

These fibres are obtained from several plants:

- a common nettle grass (*Girardinia palmata*)
- the stalk of *Cannabis sativa* (hemp), which grows wild in much of Bhutan and a tree bark.

Nettle was the original fibre used by local weavers in Bhutan.

The method of preparation of yarn from nettle is common to the region (India and Nepal) and involves:

- soaking the plant stalks, sometimes boiling them
- shredding them for twisting into yarn with the aid of a drop spindle.

The fibre though rarely used now, was once the chief material for production of clothing. By the 1940s, only the older Bhutanese remembered it. In Southern Bhutan it was worn in parts until the mid 1960s. Contemporary weavers seldom work with nettle except for producing rough and sturdy, bast-fibre carrying cloths, sacks, and bags that are sought after throughout Bhutan. Archers also use nettle fibre for stringing traditional wooden bows.

### **Silk**

Silk is the most prestigious fibre in Bhutan and also the most expensive. Although Bhutanese may call all silk *bura* ('insect cotton'), they distinguish several types of yarn:

- wild silk (*bura*)
- cultivated, reeled silk (*seshu*)
- Khaling silk (varieties of silk imported from Assam) and
- parachute silk (*namdru kuep*).

The distinguishing characteristics of silk yarn are whether it is produced by the domesticated mulberry silk moth (*Bombyx mori*), or by a wild or semi domesticated, non-mulberry silk moth; and whether it is reeled or spun.

**Wild silk:** Most wild silk is thicker than cultivated silk and is off-white in colour. It is rarely reeled as wild silk fibre is shorter than the silk from domesticated moths. This is because the cocoons are gathered after the larvae have metamorphosed into moths and eaten through their cocoons, severing the silk filament in many places. The broken cocoon is pulled apart and the fibres are spun, like cotton or wool.

**Preparation of the silk fibre:** Whether collected from the forest or cultivated in this fashion, the cocoons are steeped in a solution of hot water, which has been drained through fermented rice, to soften and de-gum the cocoons. While still moist, the fibre is drawn out of each cocoon by hand. As the thread is wound onto a spindle, fibre ends are joined by pressing them together and lumps are smoothed between thumb and forefinger.

The Bhutanese are sensitive about violating the Buddhist tenet of not killing living beings even accidentally and try and ensure that the moths are out of the cocoons before they are put into hot water. This has led the Bhutanese to purchase ready, spun dyed yarn and therefore, much of the yarn used in Bhutan today, is imported.

**Cultivated silk:** Domesticated silk worms that feed on mulberry leaves and extrude a fine liquid protein coated with sericin. When exposed to air, this

becomes the fine liquid protein becomes silk. The larvae, which cannot survive in the wild, are carefully protected and fed handpicked leaves. After molting several times the worm spins a cocoon, inside of which it metamorphoses into a moth over several weeks. If not prevented, it will then eat through the cocoon, breaking the silk fibre. In order to reel long, unbroken smooth fibres, mature cocoons are simmered, killing the moths inside. Waste fibres from breakage are also spun, yielding a coarser, less desirable yarn often termed 'raw silk' in the West.

**Khaling silk** refers to Assamese yarns imported by the National Handloom Development Project in Khaling (Tashingang District). Most of them are spun from the waste fibres of mulberry-bed silkworms. This cultivated, spun silk is not as fine as cultivated, reeled silk, but is somewhat rough and slubby.

**Parachute silk** was introduced to Bhutan from India during the Second World War. Old women remember that the royal grandmother, Azhi Phuntsok Choden, senior queen of the second king, was the first person to have the fibre, which came in the form of a heavy rope. The braided outer layer was unraveled for use as weft, and the straight strands of the rope's inner core were used for warps and pattern wefts. This fibre was thicker and cheaper than silk yarn from India and was dyed locally. Some say it is not of the same quality as other silk because it shows wear and does not hold colour well.

### **Cotton**

In temperate areas of Bhutan, cotton is the fibre for ordinary garments and other utilitarian textiles. Until the middle of this century, the majority of the cotton used in Bhutan was grown, spun, and woven locally. Traditionally, cotton was cultivated throughout the warm, southern hills. In some areas, a portion of the crop was turned over to the state in return for salt from Tibet. The cotton was then redistributed to villagers to spin and weave into cloth, much of which was again given to the state as a form of tax. Over the years cotton cultivation has become uneconomical and the increased availability of commercial machine spun Indian yarns has led to substitution of the local yarn with imported yarn.

Another fibre that the Bhutanese call cotton comes from a small tree. The Tibetan women who is said to have introduced weaving in Tashigang centuries ago taught people first how to weave simple designs in wool and then how to make yarn from a 'cotton tree' (*Chemashing*) native to the area. Fibre from this tree is still occasionally used for weaving in eastern Bhutan.

### **Wool**

In colder areas, local fleece was spun and made into the cloth needed by each household, as well as handed over in raw form to authorities, who then redistributed it to villagers for processing into cloth due to the state as tax. Local

wool was the major source of clothing and utilitarian textiles in regions such as north central Bhutan. Sheep wool still provides the primary fibre for villagers in Bumthang District (central Bhutan) and for semi-nomadic herders in western Bhutan (Laya and Lingzhi) and eastern Bhutan summer grazing areas. Until the late 1950s, raw Tibetan wool, and occasionally woolen yarn, were imported sporadically. In the 1970s and 1980s, modest quantities of raw merino wool were imported from Australia. In recent years, Australian breeding stock has helped establish hybrid flocks with softer varieties of wool.

### **Imports: Commercial Yarns and Synthetic Fibres**

Bhutanese weavers today have access to fibres from Japan, India, Hong Kong and buy the best they can afford. Popular varieties of yarn include: fine silk, mercerized cotton and blended cotton, polyester, silk-like acrylic yarn, machine-spun woolen yarn and acrylic yarn

### **Dyes**

#### **Natural Dyes**

Eastern Bhutan has a mild temperature climate and as a result is rich in flora and fauna. In this region, Bhutanese indigo, lac, madder and other wild dye plants are found in abundance. The dyeing and weaving skills of the women in these regions are well developed. Good colours are valued so much among the Bhutanese that strong taboos guide the dyeing process. Dyeing of yarn is done in the secrecy of the early morning behind closed doors and shutters - as strangers should not witness it and pregnant women should not come near it lest unborn babies steal the colours and spoil the dye baths. If a baby is born with pink or red birthmarks - they are supposedly from the *jatsho* and *tsoed* and blue and black marks from *tsangeha*. Secrecy is crucial not only safe guarding the dyeing recipes which were passed from one generation of women to another, and not shared with strangers, but also against the malevolent spirits that are lurking around.

During the first half of this century, specialists did the dyeing in the noble households of Central Bhutan. These women prepared dyestuffs from a variety of mineral or vegetable/herbal dye plants found throughout the Himalayas, on a large outdoor grinding stone and then they coloured silk and cotton yarns by steeping them in huge pots.

Natural dyes are called *tso-gning* (*old dye*) and chemical or synthetic dyes *tso-sar* (*New dye*). Commercial synthetic dye powders were known in Bhutan even before 1900 and have coexisted with vegetable dyes. They are very popular and easily recognizable by their vivid colours.

## Red

**Stick lac (*jatsho*)** is a resinous secretion deposited on tree branches by a parasitic insect. The larvae draw their nutrients from the sap of the trees and secrete a viscous fluid that covers their bodies and encrusts the twigs. The encrustation is scraped off for processing as a red dye. This ancient animal dye produces colours ranging from pinks to deep red and has been popularly used throughout the subcontinent. In Bhutan, stick lac is widely used but is also considered errant as some insects get killed during the harvesting. Found in the Eastern valleys of Bhutan, the resinous substance is harvested in October, as soon as the mature insects begin emerging from the encrustations. The hard nodules of stick lac are scraped off the branches. While lac is valued primarily as a dye, its residue is used as sealing wax.

Processing the stick lac to obtain the right colour is a slow process. Lac is soaked in hot but not boiling water and then ground into small pieces with some yeast and roasted wheat or barley grains. The pot is covered so the mixture ferments and a white cream rises to the surface. The mixture is left for about a week so that the colour obtained is good. It is regularly stirred during this time. The liquid is then strained through a sieve, and the residue hardens into a wax used for sealing documents. Finally, the yarns are steeped for up to a week in the covered pot. The steps followed for dyeing and the proportions of dye used vary with the yarn being dyed.

Wool: Dye to ratio is two to one; Yarns are soaked first in a solution of hardwood ash Wild silks: Dye-to-fibre ratio varies from five to one to nine to one. Silk yarns are first boiled in an alum solution. Then dried and wrapped in a thin cotton cloth while being immersed in the dye bath. The contents of the dye bath are boiled and more ingredients are added to produce darker shades.

**Madder:** Madder is widely used for dyeing wool, cotton, and silks. The madder, a creeper, called *tsoed* locally, grows in altitudes of 1,200 to 2,700 metres. In western Bhutan, the creeper flowers in August and is harvested soon afterward, when the seeds turn black. In the east, the plant is picked in late November. The stems are dried in the open or over a fire, and then chopped into small pieces that are stored.

Using the madder to dye involves boiling about a handful of madder twigs per pound of fibre, removing them, and then steeping the yarns in the mixture. The colour varies according to the dye-to-fibre ratio used and the steeping time and yields shades from orange to deep red. The most commonly used mordant is alum or the yarn may be soaked first in a solution of *Symplocos* leaves.

## Yellow

**Symplocos or Zim:** Four varieties of leaves of the *Symplocos* trees contain a yellow pigment. The shrubs are generally found on slopes above 1,000m and

leaves, which can be used fresh or dried, are picked in autumn. The colouring process is simple and consists of placing well-washed woolen yarn in a boiling pot of the leaves and leaving it there until the desired shade of yellow is obtained. The wool is then dried and may be steeped in a second dye bath of turmeric and coarsely ground buckwheat grains, which heighten its colour. If the second bath contains madder, a rich rust or orange will be the result. In some parts of Bhutan native turmeric is used for obtaining a bright yellow.

### ***Blue***

Bhutan's main blue dye comes from broad-leafed shrubs that contain indigotin and are collectively called indigo. Bhutanese indigo is different from that is cultivated in India. The plants are cultivated in kitchen gardens, in Bhutan. The leaves, usually picked in autumn, are used fresh or stored in airtight tines lined with banana leaves and sprinkled with yeast. Alternatively, they are covered with cow dung. In about twenty days, after the leaves have fermented and rotted, they are taken out and mixed with water dripped through hardwood ashes. This compound can be used for dyeing or is moulded into balls or cakes, which are dried and stored for future use.

The dried cake must be ground into powder, mixed with water, and fermented in an alkaline solution of hardwood ashes. The mixture is then kept warm but not boiled, and after about a week the yarn is immersed. In the olden days it was kept in a pile of horse manure for fermentation to take place - it is now kept near the hearth. The first dye lot is a light blue, with successive steepings yielding deeper shades. Yeast and *chang* (local rice beer or other fermented grain beverage) are added during the dye to maintain the proper level of fermentation.

### **Other Colours and Mordants**

Compound colours are achieved by mixing colours to yield new colours. For example, greens result when yarn tinted blue with indigo are dyed in a second solution of one of the *Symplocos* leaves or yarn dyed in sticklac is immersed in indigo yields shades of purples.

#### **Other substances used are:**

- **Black and brown dyes:** Walnut bark and husks, and the sour fruit of a tree called *chorgenshing*, mud mixed with a poisonous root (*chukchumein* Bumthang)
- **Yellow:** Leaves called *photorshing*
- **Red:** red is obtained from the purple skinned berries of thorn bushes (*kepitsang*)
- **Light blue and purple:** pine cones found over 3,000 m
- **Cream / wood colour** - Oak



- **Mordants** are substances that fix a dye on a yarn by combining with the dye. Traditional mordants include the *Symplocos* leaves, alumaceous earths, and sour fruits, pomegranate skin, crab apples.

### **Types of Cloth and Patterning Techniques**

Textiles of Eastern Bhutan can be classified into primarily three broad categories: plain weave fabrics, supplementary-weft-patterned fabrics, supplementary-warp-patterned fabrics.

#### **Plain weave fabrics**

Mongar and Pemagatshel districts produce patterned and un-patterned plain weave fabrics of cotton and wild silk fabrics. This relatively undecorated cloth of different varieties was woven for the local authorities and offered to the dzongs (Central authority) each year as taxes. Plaid and striped fabric for garments and household use continues to be produced.

While setting up the warp coloured threads are included with the basic colour to obtain striped fabric. The coloured thread will appear on both sides of the finished fabric. A textile with only stripes is called *thara*. Two colour combinations are popular: red-and-black (or blue) plaid on a white field; and yellow, white, and black on a rust-covered field (*sethra*, 'predominantly gold pattern'). Two versions of the rust-coloured plaid called *sethra* are seen today: *sethra dokhana*, which has black in it, and *dalapgi sethra*, which does not.

In the past fifty years, rows of small supplementary-weft patterns have appeared in some striped plain weave cloth used for women's dresses, an innovation loosely described as 'new design' (*pesar*). Pattern wefts are usually worked in pairs and are discontinuous, being inter worked with the ground weave only where the motif appears on the face of the cloth. The patterns are single-faced, visible only on the finished side of the weaving.

*Yuetham* or country cloth is made of wild silk or cotton and is very popular in the rural areas for garments. Today, Indian factory-made versions of this pattern are worn more often than hand woven cloth since they are much cheaper causing the real threat to the traditional art. Warp-striped cloth or *thara* is very popular and is available in many varieties, all of which have individual names:

*Shardang thara* or 'striped woman's dress' is a local pattern showing multicoloured warp stripes on a white field.

*Samkhongma* has narrow red-and-blue warp stripes on a white field

Mondre ('Mon or Bhutanese dress') has a pattern similar pattern to the *Samkhongma* and is worn mainly by the older people in rural areas.

### **Supplementary-weft-patterned fabrics**

Many other textiles that originated in the east, such as traditional women's belt (*kera*), are decorated with supplementary wefts, which are obtained by adding coloured thread to the weft. These coloured threads can show on one side of the fabric or both sides. If they show on one side they are called single faced, and when they show on both sides they are called two-faced or double faced. The thread used for the extra weft is usually thicker than the base fabric. Here, the supplementary wefts float on one surface of the plain weave ground when not floating on the other and create a negative pattern on one side of the cloth. Four to eight very fine supplementary-weft yarns usually functions as a single patterning unit. Supplementary wefts decorate multipurpose textiles (*pangkheb*) used for tax payments, doorway curtains, cushion linings, and bundle carriers. The most elaborate of these cloths, the ceremonial *chaksipangkheb*, has centre panel patterned from one end to the other with bands of continuous supplementary wefts.

### **Supplementary-warp-patterned fabrics or *Aikapur***

Supplementary-warp-patterned are made by adding coloured threads to the warp. Eastern Bhutan is famous for its supplementary-warp-patterned fabrics collectively known as *aikapur*. Woven of cotton, wild silk, or cultivated silk they are so fine as to appear to be embroidered.

It is a warp patterned weave which has extra warp threads manipulated to create double faced warp pattern bands called hor - which alternate with rows of plain weave. The width of the supplementary-warp-pattern bands determines the quality of the *aikapur*. Vertically, in the warp direction, these patterned bands follow a format: a primary motif; followed by a solid horizontal bar, a crosshatched bar, and another solid bar; a primary motif and so on. While primary motifs may repeat or vary within a given pattern band, the intervening bars are identical and there are always an odd number of crosshatches - three, five, seven or nine. As the number of legs '*kang*' or cross hatches goes up the design becomes broader. The greater the number of cross hatches and the more intricate the patterns - the more the work for the weaver and the more highly the fabric is regarded. A fabric with three legs is referred to as a *Bsampa*, with five legs *Bnapa*, with seven legs *Btsumpa*. Cloth with nine 'legs' or *Bgupa* is said to have been reserved for the nobility and the kings, but one often sees cloth with eleven (*Bdzongthrupa*) or even thirteen (*Bdzongsampa*) legs. *Aikapur* is a special cloth, treasured and saved for special occasions. *Aikapur* are distinguished by the colours of the background and the additional thread. Traditional colour schemes are:

- *Mentsi mathra*: Yellow pattern band on a red field
- *Lungserma*: Green and red pattern bands between colourful warp striping

- *Mentha*: blue or black and red pattern bands between colourful warp striping
- *Dromchu chema*: red, green, yellow, and white pattern bands.
- *Jadrichem*, or *jadrima* multicoloured warp stripes in any version of the above cloths

### Patterns:

The patterned bands of an *aikapur* contain motifs which may repeat or vary within the band. The motif most often encountered is *Shinglo* or 'tree leaf' motif. Bhutanese examine the delicate branches and leaves of these trees when assessing the quality of a fabric.

### Weavers of Merak and Sakteng

The semi-nomadic herders of the high valleys of Merak and Sakteng fashion hats, ropes, and bags out of yak hair and weave garments, floor mats, and blankets of yarn spun from their sheep wool. Some women spin wild silk cocoons into fibre, which they dye with lace and weave into tunic-style dresses (*shingkha*), women's jackets, and belts or obtain them from nearby villagers who weave them specially for bartering with the herders. The jacket pattern is always the same, showing rows of horses, elephants, and peacocks that are reminiscent of patterns in distant Southeast Asia. Geometric patterning on the belts, showing auspicious swastikas and flowers, is similar to that on jackets.



**Figure 10. An everyday dress for the inhabitants of Merak and Sakteng (North eastern nomads of Bhutan)**

### Plain weaves

Plain weave textiles are usually woven in patterns with stripes and plaids.

- Marthra: Plaid weave usually with red or maroon as the dominant colour.
- Serthra: Plaid weave usually with yellow or orange as the dominant colour.
- Thara: Woven only for production of horizontal striped Kira with white as the dominate colour.
- Kamtham Jardrima: Striped weave incorporating the colours of the rainbow.

### **Warp Pattern Weaves**

Warp is the yarn that runs lengthwise on the loom. The warp pattern designs are characterized by their supplementary warp floating technique that forms bands of repeated motifs on ground. The different warp pattern designs are differentiated with their colour schemes. The number of legs or cross hatches in each supplementary warp pattern band is one indicator of the superiority of the textile. The textile is even more priced when the weaver includes weft pattern designs.

**Mentsi Marthra:** Alternate yellow warp bands with plain weave red ground.

**Lungserma:** Alternate green red on yellow ground.

**Dromchuchem:** Literally means 'with little boxes' pattern bands are woven in threes.

**Mentha:** Narrow white warp bands on black ground. It is the one pattern which is worn solely by women.

**Weft:** Yarn that is passed back and forth through each shed across the loom and is interwoven with the wrap.

### **Weft Pattern Weaves**

Weft patterns are popularly referred to as **Sapma**, continuous weft patterns and **Tigma**, discontinuous weft patterns in Bhutan. The continuous weft patterns are very similar to those featured in other textile throughout South and Southeast Asia. The weft yarn is inserted between intervals of the warp yarn to create continuous weft patterns. The discontinuous weft patterns motifs resemble embroidery are indigenous to Bhutan. Coloured pattern yarns are knotted individually to the weft yarns to create geometric motifs which are usually combination of multiple pattern motifs.

**Sapma:** Continuous weft pattern designs.

**Tigma:** Discontinuous weft pattern designs. Textile experts often mistake the supplementary weft pattern designs for embroidery as they say it is impossible to weave the brocade patterning on a common back-strap loom.

The *sapma* and *Tigma* weft pattern designs are usually used as pattern designs for:

**Oshom:** Kira with the dark ground usually blue or black.

**Kushuthara:** Kira with a white ground.

**Shinglochem:** Woven both for Gho (Men's dress) and Kira (Women's dress), usually woven with alternate rows of wrap pattern bands.

### **Western Bhutan**

It is generally accepted that the western Bhutan does not have its own native weaving traditions, as it had easy access to cloth from other areas. However in

ancient times it has been described that men were actually the weavers in western Bhutan. These clothes were warm but simple, one color (white) type. Today, however, there are weavers in Thimphu and other areas west of the Pele La, the high pass that divides western Bhutan from the east. There are also communities in western Bhutan (Punakha and Wangdi Phodrang districts) weave with wool, wild silk, and cotton.

Nomads in Ha and Laya Lingshi, on Bhutan's western and north-western borders, Azhion clothing and other utilitarian textiles from yak and sheep wool. Rural families living at lower altitudes weave cloth from nettle fibre and make it into garments.

**Kantham Thara** - simple warp stripes or plaids

**Pchhanag** - completely black fabric of wool believed to have healing properties and good for the wearer's health.

### **Use of textile in religion, tradition and culture**

#### **Religious festivals and ceremonies:**

Thangkas (religious portraits) are normally from paintings but the more elaborate and prestigious one are made from cloth pieces sewn together. The larger one can cover the front of big structures, three to four stories tall. An example is the one in Paro which is believed to be over five hundred years and considered to have high blessing power. It is displayed once during the Tshechu (Religious festival with mask dances) of Paro around early April every year.



#### **Dress and costumes and other uses of textile**

Shabdrung Ngawang Namgayel, who came to Bhutan in the seventeenth century (year 1616 AD) and unified Bhutan, introduced a special garment for men, the *gho*, a long robe tied at the waist and pouched over the belt to form a pocket modified from the Tibetan man's robes (*chhuba*). The modification was made to develop a distinctively Bhutanese in form. This has developed into a more elegant form which most Bhutanese proudly wear since it identifies Bhutan as an independent country. Compared to the western dress it is more complicated and the youth find it cumbersome. Women wear an ankle-length robe called *kira*, tied at the waist with a wide sash and fastened at the shoulders with silver broaches. The man dress has one single pockets which goes around body while that of the woman are a few pocket made from the folds in the cloth.

The *gho* and the *kira* were declared as the national dress in 1989, and it is important for every Bhutanese to wear it in public places. This dress edict ignores ethnic and regional diversity that exists in the country but does not take into account the local inhabitants like the herders of Merak Sakteng in the East and Laya in the North who do not traditionally wear the *Gho* and *kira*.

### **Women's dress – *kira***

The *kira*, unique to Bhutan, is an unstitched garment that is ingeniously folded around the body and combines comfort and grace. The garment itself has evolved over hundreds of years. Like its counterpart for men, the *gho*, the *kira* uses indigenously woven fabric with a border. *Kiras* are fastened at the shoulders by *koma*, the distinctive jewelry made of silver or gold and often accented with turquoise. The *koma* hooks the *kira* in front and back on either side of the shoulder. Often there is a chain that connects the *koma* to each other, which falls like a necklace over a woman's chest. Then a colorful, tight woven belt or *kera* is added to the waist. A *wongju* or a short blouse of silk or polyester is worn under the *kira*. The *toego*, a short, loose jacket, usually machine made of silk, cotton, wool or synthetic fabric completes the ensemble.

A *rachu* is a ceremonial sash that Bhutanese women wear over their left shoulder during festivals, when entering government buildings or temples or during ceremonies and on official occasions. It is also intricately woven with colorful designs or embroidered with the eight auspicious symbols of Buddhism.

### **Women's belts (*Kera*)**

Women's belts are made of silk on cotton and hand woven on a card loom with traditional designs. Traditionally the *kera*, which is now normally worn by the elderly women, is broad and therefore folded in three and then worn. The pattern is usually reversible and the belt is fringed at both the ends. The *kera* is woven in many designs depending upon individual taste.

### **Blouse (*Wongju*)**

A *wongju* is a button less blouse with long sleeves worn by women under their dress (*kira*). It is made of thin fabric, silk or polyester, more rarely cotton.

### **Women's Jacket (*Toego*)**

This short buttonless jacket is worn by women on top of their long dress and can be made of any material: brocade, raw silk, synthetic or cotton fabrics.

### **Men's hand woven traditional dress – *Gho***

The *gho* is the traditional male national dress and is constructed out of three large panels and a fourth narrower panel stitched together to form the garment.

### **Men's belt (*Kera*)**

The men's belt is hand woven in plain wool and plain cotton with stripes, fringed at both ends and reversible. It is woven on a card loom.

### **Women's ceremonial scarfs (*Rachu*)**

Hand-woven from raw silk on cotton with colourful flowers and fringed at both ends, *rachu* are ceremonial sashes worn by women. They are folded in three, lengthwise and worn over the left shoulder as a mark of respect when receiving important officials or on entering dzongs (National or District administrative centres), temples and monasteries. They can also be draped over the shoulders like a shawl during religious ceremonies. Once unfolded, they are also used to carry children on the back. In olden times they served to carry luggage but sometime they also served as emergency shield during sword fights. The raw silk is thick and tough enough. Some *rachu* are now embroidered with auspicious signs in the Chinese fashion.

### **Layap dress**

The Layap people, about 800 in number have their own language, customs and dress who live in the north-western part of the country. They depend on the yaks for their livelihood with minor agricultural activities. The village women wear conical bamboo hats with a bamboo spike at the top, held by beaded bands. They dress in black woolen jackets with silver trim and a long woolen skirt, striped in natural earth colours and adorn themselves with lots of silver jewelry, which often includes an array of teaspoons.

### **Ceremonial scarves for men (*Kabney*)**

Men, according to their rank wear these ceremonial scarves made of raw silk dyed using vegetable dyes. They are used as a mark of respect to welcome important guests or officials, and when visiting *dzongs*, temples and monasteries. Everybody wears a *kabney* as a gesture of respect to the sanctity of a place, its religious contents and people. A *kabney* worn by the men is broader than the *rachu*, used by the women.



**Figure 11. Ceremonial/official scarves (*Rachu* and *Kabne*): Ministers, Students**

Scarves made from *bura* (raw silk) and fine silk have a very important role in the Bhutanese culture and tradition. The raw silk is usually in scarves (of different colour) for men including the monks and the fine silk is meant for women. The position of a person serving in the public service can be determined by the colour of the scarves. Ceremonial scarves of different colours are used according to the rank of the wearer. His Majesty the King wears a yellow *kabney* and officials wear orange, red, blue and white *kabney* of various sizes depending on their ranks.

The red is for those who receive honour from the king similar to the system in Great Britain. The members of Parliament wear blue scarf and the judiciary (serving judges) wear green scarves. White scarves without fringes are worn by those who receive the honour from the king but of a lower status compared to the red one. These are being bestowed to Government Secretaries. All those bearing these scarves also carry the ceremonial swords. The rest of the male population carries white scarves with fringes. The scarves worn by the ladies have intricate design and more difficult to weave but are simple to wear.

The Je Khembo, the religious head of the country wears a yellow *kabney*, same colour as that of the king and the monks wear maroon, indicating the rank of the wearer.

### **Ceremonial multipurpose cloth (*Chagsi Pangkheb*)**

A ceremonial multipurpose cloth, it is also given as gifts during special occasions or as taxes and are made of cotton, raw silk and more rarely silk. This textile usually is woven with traditional designs.

### **Shoes / Boots (*Tsholham*)**

Boots are traditionally hand-stitched out of sheep and cow hides, then decorated with brocades or wool and held in place under the knee with a narrow bootstrap. The main colours highlighting the shoes are red and yellow. Both men and women in the country wear them. The shoe colours and decorations depend upon the rank of the civil servant. Today, they are mostly made in Paro and Thimphu.

### **Woolen panel with geometric designs (*Yathra*)**

*Yathra* is a twilled hand-woven sheep wool panel, dyed with vegetable colours. And woven with geometric designs. A very warm fabric, it is used as a blanket, or converted into rain cloaks, bed covers, cushion covers, sofa set covers, jackets and coats for both men and women.

### **Other Woolen products**

Rope, tents, raincoats and the famous *Togtsi* cap are made of yak wool and yak hair. The black *Togtsi* cap of yak hair is water resistant and used in the rain as the water just drips off without wetting the head.



### **Rain Cloak (*Charkab*)**

Rain cloaks are hand-woven from sheep or yak wool, either on a pedal or back strap loom. Woolen fabrics with a black and white background are associated with the Ura valley of Bumthang, Farmers and yak herders use them to protect themselves from rain, snow and cold.

### **Bag (*Phe-chu*)**

The *phe-chu* is traditionally used for carrying foodstuff or other items. A woven strap allows the bag to be carried on the shoulder or positioned on the forehead, or even carried on the back in a *rachung* (scarf). *Phechus* originated from Kurtoe, Lhuentse.

### **Other products made of cloth are used in monasteries and altars:**

*Dhungcho* - cymbal covers, *Khep* and *Tenkhep* - altar covers silken, *Chephur gyalsthen* - six temple hangings, *Phen* - pair of triangular topped hangings, *Chephur* - a pair of cylindrical hangings, *Gyalsthen* - pair of cylindrical hangings with valences

### **Present status**

Until about mid 20th century most fibres were produced dyed and woven locally. Although the repertoire of dyes and fibres was much more limited than it is today, the weavers were conversant with the techniques, understood the local materials and produced some superb quality textiles.

Imported fibres adopted by weavers have altered the palette, textile and surface qualities and chemical dyes have replaced natural dyes and factory produced yarns are substituting hand spun yarn. Knowledge and skills accumulated through generations of experiences and family traditions are beginning to be lost irretrievably. In the last ten years because of the increased imports of machine-made yarn few women are dyeing yarn at all and, of these, even fewer are using vegetable dyes preferring the brightness obtained with synthetic dyes. Many are using a blend of natural and synthetic dyes.

A project started by the National Women's Association of Bhutan, referred to as the Khaling Project, has trained over a thousand weavers in the each of the last 4 years and has been instrumental in reviving some of their traditional designs and at the same time originating new ones. The Dyeing Unit there has developed recipes for dyeing with rhododendron leaves (yellow); marigolds (yellow); *Khempa/Artemisia* (green); and several other flowers and leaves. Shortage of funds and other problems has limited its scale of operations to a quarter of its original capacity and they now train 250 weavers for short periods and only 20 weavers in long term courses.

### **Efforts in Preservation of textiles:**

To preserve, sustain and promote weaving and textile development in Bhutan many initiatives were taken. This has helped attract the interest of tour operators and hereby contributed in promoting Bhutan's culture and tradition around the world. The textile products are now being purchased by both Bhutanese and foreigners alike. One such initiative is the textile museum in Thimphu and the exhibitions and displays held around the world.

### **Bhutan Textile Museum**

The **Bhutan Textile Museum** or the **National Textile Museum** is the museum located in Thimphu, Bhutan and operated by the National Commission for Cultural Affairs, Ministry of Home and Culture. Since its establishment in 2001, the museum has generated national and international attention and has acquired a large collection of antique textile artifacts exclusive to Bhutan.

The objective of setting up the museum is to promote Bhutan's achievements in the field of textile arts and to sustain and promote interest of the weavers to continue the traditional textile patterns. The museum also envisions becoming the centre for textile studies and research. The purpose is also to promote the history and culture of Bhutan and also contribute to generation of employment and income for many women both in the rural and urban set-up.

The Bhutan Textile Museum in Thimphu was first conceived by Her Majesty, the Queen Azhi Sangay Choden Wangchuck. It was established in 2001 and inaugurated by the Queen herself. The infrastructure of the museum was developed with fund support from Danish Development Agency. Government of Bhutan and private donors has also provided assistance to set up the museum and the technical support of the Peabody Essex Museum in the United States. Her Majesty serves as the patron of the museum and has enhanced national and international interest in the Bhutanese textile industry.

The museum is divided into six areas of special focus, including achievements in textile arts, the role of textiles in religion, textiles from indigenous fibres. The Royal Collection includes both warp pattern weaves and weft pattern weaves. It has an invaluable collection of Bhutanese antique textile artifacts of Bhutan, including crowns of Bhutan's kings, Namzas (dresses) and other accessories worn by the Royal Family, a pearl robe from Tsamdrak Goenpa (Monastery in Western Bhutan) and the bedding of His Holiness Shabdrung Jigme Dorji.

Some of the unique collections donated by Her Majesty the Queen Mother, Azhi Sangay Choden Wangchuck, and some private individuals on display in the museum are: the first version of the Raven crown, brocade *uzhams* (crowns) worn by the first king, and the second king, and a princess crown worn by the sister of the first king, Azhi Wangmo.

The ground floor of the Textile Museum has displays demonstrating the skills of spinning, colouring fibres, preparing a loom, and manipulating two sets of yarns. Decorative fabrics and textile arts and crafts are categorically displayed in the galleries situated on the first floor of the Textile Museum. There are displays showing the traditional regional garments produced by women and men in Bhutan, and those garments used for special religious occasions.

The museum also organises design competitions to display the best textiles. The method applied for this competition is the selection process of public polling. In this procedure, the each textile proposed in the competition is tagged with a number. Visitors to the museum vote "for the best piece" of art based on the number of the art piece displayed. The name of the artist is not shown. Besides *pesar* (*new design*), the traditional art form, innovative other textile designs in appliqué and embroidery have also been proposed for future competitions. The museum also has plans to host a textile festival which will be celebrated during the competition. To sustain the interest of the weavers, sellers and artists, an auction process through bidding for the textiles "under consideration" has been introduced. In this process, the base price for the item on sale is fixed by the weaver and any bid amount received over and above the weaver's base price enriches the coffers of the museum. This procedure is adopted to ensure quality products of textiles to be woven by the weavers displaying intricate and appealing designs. The museum has also engaged two permanent weavers – one for *pangtha* (bigger strips using back strap loom) and another for *thruetha* (smaller strips using horizontal loom) – to display the process of weaving. A small group of loom weavers at the museum produce work deriving from Lhuentse Dzongkhag, the ancestral home of the Bhutanese Royal Family in northeastern Bhutan. The weaver from this region are most celebrated for their workmanship

### **Current status of sericulture industry**

Accept for some collection from the forest there is no silk industry as such in the country.

Traditionally the cocoons were collected from the forest farm near the homes when the insects and come out whereby cutting the threads. The raw silk was used for making ceremonial scarves and dress of both male and female.

The government tried to introduce silk production in a couple of places in eastern Bhutan in the early eighties but these were eventually closed down. However, lately some proposal has been coming in to set up silk farms in southeastern part of the country. The silk threads and materials used for developing the products are from imports. The constraints with all types of industry for Bhutan have been its small size and population and the availability of high quality materials at reasonable rate in the neighbouring countries.

### Scenario of silk consumption (textiles, domestic production and imports).

Import is constituted mainly with import of thread for weaving and development of textile by the local weavers for *Gho, kira, kera, rachu*, ceremonial shoes, etc. Finished products are imported to stitch *kapne, toego, wongju*, etc. However accurate data could not be produced since a lot of import and export is conducted informally. Due to small population and excess to market outside and across the border there is lot of informal imports and exports by individuals. Almost all the products purchased by the tourist are not recorded.

#### Import in 2014 (Value in Ngultrum):

Commodity Description	Import India	Other Countries	Total Value (Nu)
Silk	108,193,281	2,479,194	110,672,474
All textiles	675,942,987	162,564,521	838,507,508

Commodity Description	Imports from India	Other Countries	Total Value (NU)
All textiles	29,926,398	542,792	30,469,190

#### Export in 2014 (Value in Ngultrum)

Commodity Description	Import India	Other Countries	Total Value (Nu)
Silk	108,193,281	2,479,194	110,672,474
All textiles	675,942,987	162,564,521	838,507,508

#### Information derived from paper by Dr. P. Kumaresen (Central Silk Board, Bangalore)

##### 1. Export/ Import Dominance (EID) Index and Balance of Trade (BOT) in Silk (Million US\$)

Export/ Import Dominance (EID) Index				Balance of Trade (BOT) (Million US\$)			
2010	2011	2012	2013	2010	2011	2012	2013
115.50	607.00	59.50	No exports	0.46	0.61	0.12	0.12

## 2. Silk import during 2013 : Source: COMTRADE database

Commodity	Value (Million US\$)
Woven fabrics of silk or silk waste	0.12

### Constraints in sericulture

Bhutan, being a small land locked country with a population just over 700.000 (Seven hundred thousand) is not able to produce silk on large scale. It is not able to compete with relatively cheaper imports. The market within the country is also limited due to the small population. In fact this is the major constraints with all agricultural products produced in Bhutan. Another factor that discourages the establishment of silk production in the country is the religious sentiment associated with Buddhism.

### Potentials of sericulture

Bhutan could have sericulture production if it can develop special product for niche markets. Bhutan has vision to become an organic country before 2020 and organic practice could be applied in sericulture too.

### Conclusions

The textile industry in the country has gained popularity and it is must as tradition to own a few dress (*Gho* for men, *kira* for women) jackets, scarves, coverings as heirloom for every Bhutanese family according to the affordability. In olden time poor people borrowed from the rich when they needed cloths to attend important festivals like the Annual *Tshechus* (religious festivals with mask dances which are believed to have blessing powers). Most of the tourists are also interested in textiles and these are sustaining this precious tradition besides providing income and employment of many families in Bhutan. Although the silk cultivation or production in the country has declined the organic brand that Bhutan is developing may contribute to its revival.

# **Sericulture scenario in SAARC region – a re emerging industry for poverty alleviation in India**

**K. K. Shetty<sup>1</sup> and Dileep Kumar<sup>2</sup>**

<sup>1</sup>Officer on Special Duty, International Sericultural Commission, Bengaluru, India.

<sup>2</sup>Secretary to Secretary General, ISC, Bengaluru, India

## **Abstract**

Sericulture is an economically viable occupation for the rural areas of India. It contributes significantly to achieve the national agenda of poverty alleviation and inclusive development. Over the years the country could transform the industry as a credible commercial enterprise contributing to the national economy in terms of employment generation and equity distribution from rich to poor. There is a greater opportunity to introduce and develop sericulture in developing countries as the production in the traditional areas in the world are beginning to decline due to rapid industrialisation and urbanisation. However, the challenge is to adopt appropriate commercial models to ensure that the occupation emerge as an economically viable in the new areas. At this occasion, it is pertinent to note that the successful model of sericulture practice developed in India could be replicated in developing countries, especially in SAARC region where the agro climatic conditions are similar. The Indian Government has also committed its willingness to help and support the developing countries to replicate to the sericulture development successfully practiced in India.

## **Introduction**

Sericulture is practised as a rural avocation since second century BC in the country. The silk and silk products are intermingled with the country's culture and civilization. No ritual for any communities is complete without silk as a wear in some form or other. At present, silk industry is emerged as a major employment provider in the country which leads to poverty alleviation and inclusive development.

## **Current Status of Sericulture Industry**

### ***Type of Silkworm***

India produces all the four commercially known silks in the world. Among them mulberry silk is the most important and contributes as much as 75 per cent of total production. Three other commercially important types fall into the category of non-mulberry silks namely: Eri silk; Tasar silk; and Muga silk. This silk is also known as Vanya Silk (Wild Silk).

### ***Mulberry Silk***

Bulk of the commercial silk produced in the country comes from this variety and often generally refers to mulberry silk. Mulberry silk comes from the silkworm, *Bombyx mori L* which solely feeds on the leaves of mulberry plant.

### ***Non Mulberry Silk***

#### ***Tasar Silk***

The major sources of tasar silk produced in India are from the tasar silkworm race *Antheraea mylitta*. These silkworms are grown out door on the leaves of Terminalia and several other minor host plants. The worms are either bivoltine or Trivoltine and their cocoons, like the mulberry silkworm cocoons, can be reeled into raw silk.

#### ***a) Eri Silk***

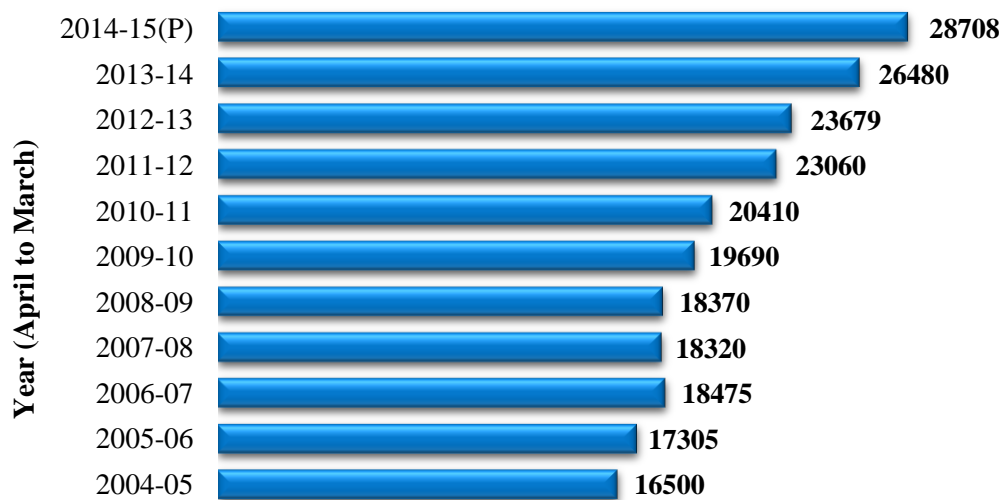
These belong to either of two species namely *Samia ricini* and *Philosamia ricini*. *P. ricini* (also called as castor silkworm) is a domesticated one reared on castor oil plant leaves to produce a white or brick-red silk popularly known as Eri silk. Since the filament of the cocoons spun by these worms is neither continuous nor uniform in thickness, the cocoons cannot be reeled and, therefore, the moths are allowed to emerge and the pierced cocoons are used for spinning to produce the Eri silk yarn.

#### ***b) Muga Silk***

The muga silkworms (*Antheraea assamensis*) also belong to the same genus as tasar worms, but produce an unusual golden-yellow silk thread which is very attractive and strong. These are found only in Assam and feed on *Persea bombycina* and *Litsaea monopetala* leaves and those of other species. The quantity of muga silk produced is quite small and is mostly used for the making of traditional dresses in the State of Assam (India) itself.

### **Silk Production in the country**

India is the second largest producer of silk in the world next only to China. The country produces 28,708 MT of raw silk of which the contribution of mulberry silk is 21,390 MT and non-mulberry silk; 7,318 MT. The non-mulberry silks are; eri (4,726 MT), tasar (2,434 MT) and muga (158 MT). The major contribution of mulberry silk is coming from the traditional multivoltine cross breed which is 17,520 MT (82%) and 3798 (18%) MT of import substitute bivoltine silk. The country could successfully tropicalize the bivoltine sericulture suiting to Indian conditions through a three pronged approach in the areas of; research and development, synchronization of production process by putting in place an effective management system, and incentivize investments at farmer's level to enhance production, productivity and quality. The following graph indicates the silk production in the country for the last 10 years:



**Figure 12. Silk production in India in last 10 years (MT)**

As could be seen above, the industry witnessed a robust and healthy growth, to the level of CAGR 5.69% during the last 10 years. The variety wise silk production through the years is presented in Table 1.

**Table 4. Variety-wise Raw Silk Production in India for the last 10 years**

Year	Mulberry Silk			Vanya silk				Grand Total
	BV	CB	Total	Tasar	Eri	Muga	Total	
2004-05	893	13727	14620	322	1448	110	1880	16500
2005-06	971	14474	15445	308	1442	110	1860	17305
2006-07	1100	15425	16525	350	1485	115	1950	18475
2007-08	1175	15070	16245	428	1530	117	2075	18320
2008-09	1250	14360	15610	603	2038	119	2760	18370
2009-10	1200	15122	16322	803	2460	105	3368	19690
2010-11	1400	14960	16360	1166	2760	124	4050	20410
2011-12	1685	16587	18272	1590	3072	126	4788	23060
2012-13	1984	16731	18715	1729	3116	119	4964	23679
2013-14	2559	16917	19476	2619	4237	148	7004	26480
2014-15	3870	17520	21390	2434	4726	158	7318	28708

Source : Compiled from the reports received from Provincial Sericulture Departments



BV: Bivoltine; CB: Crossbreed (Multivoltine)

The major reasons that can be attributed for sustaining the growth momentum in silk sector can be summarised as below:-

- Substantially enhancing the productivity of silk to the level of 97.3 kgs of raw silk per hectare of mulberry plantation, by integrating innovation, technological advancements and management practices in the production process,
- Focussed approach in enhancing silk quality matching international standards by developing improved breeds, introduction of a regulatory mechanism for the production and supply of quality silkworm seed, and developing advanced post cocoon machineries and technologies,
- Federation of farmers and other stakeholders through participatory extension mechanism, synchronisation of activities and incentivize investments to neutralize high input costs.

### Raw Silk Import and Export

#### Import

The country has been depending on the imports of raw silk to fill the demand-supply gap. The requirement of raw silk in India was around 32,197 MT of raw silk during 2014-15, of which 28,708 MT (89%) was domestically produced and the remaining 3,489 MT (11%) was imported primarily from China. The demand-supply trend indicates that the gap is narrowing down over the years due to increase in domestic silk production, especially the import substitute bivoltine silk. It is expected that the country would become self-sufficient in raw silk production by 2020. The following figure demonstrates that due to increase in domestic production, the import of silk is declining:-

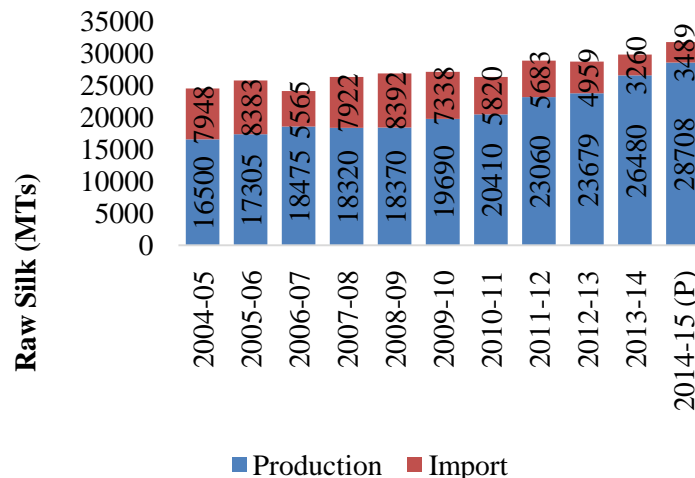


Figure 13. Trends in import of raw silk against domestic production

The details on import of silk for the last 10 years are presented in Table 2.

**Table 5. Import of raw silk**

<b>Year</b>	<b>Qty (MT)</b>	<b>Value (Rs. in Million)</b>
2004-05	7948	6072
2005-06	8383	7797
2006-07	5565	6734
2007-08	7922	7345
2008-09	8392	9031
2009-10	7338	9331
2010-11	5820	9276
2011-12	5683	11115
2012-13	4959	12386
2013-14	3260	8965
2014- 15 (P)	3489	9708

**Note – P = Provisional**

*Source: Director General of Commercial Intelligence & Statistics (DGCIS), Kolkata and Central Silk Board.*

### **Export**

India has developed an international market for Indian silk goods by creating a niche market for the handloom silk having its own weaves, textures and design. India earned foreign exchange revenue of US \$ 456.45 Million through export of silk goods in 2014-15. The exotic designs and an array of colour combinations of silk materials produced in traditional handlooms and the ability to supply them in short quantities is considered to be the strength of the Indian silk industry. Silk fabrics and readymade garments are the major items of the exports, which account for about 95% of the total value of exports. The traditional major markets for Indian silk goods are the USA and European countries, UAE, Saudi Arabia, Hong Kong and Singapore. Besides, the exports to countries such as Afghanistan, Sudan, Malaysia, Tanzania, etc., have been increasing significantly in the recent years.

**Table 6. Raw silk import, export and consumption during 2004-2015 (MT)**

Year	Production	Import	Export	Consumption (Production+Import-Export)
2004-05	16500	7948	71	24377
2005-06	17305	8383	188	25500
2006-07	18475	5565	60	23980
2007-08	18320	7922	139	26103
2008-09	18370	8392	66	26696
2009-10	19690	7338	313	26715
2010-11	20410	5820	17	26213
2011-12	23060	5683	42	28701
2012-13	23679	4959	13	28625
2013-14	26480	3260	11	29729
2014-15 (P)	28708	3489	6	32191

**Note:** P – Provisional; *Source:* Central Silk Board

**Table 7. Exports of silk goods during 2005 to 2015 (Million Rs.)**

Year	Natural Silk Yarn	Fabrics, Made-ups	Readymade Garments	Silk Carpets	Silk waste	Total
2005-2006	682	21607	8421	1034	199	31942
2006-2007	458	23196	8179	1325	228	33384
2007-2008	454	18517	7466	721	122	27279
2008-2009	351	20926	9866	587	53	31782
2009-2010	294	19426	8549	406	249	28925
2010-2011	394	20838	6833	211	362	28638
2011-2012	197	14979	7658	201	498	23534
2012-2013	219	14103	7872	212	629	23035
2013-2014	363	14556	874	157	993	24809
2014-2015 (P)	258	14654	1214	159	1091	28299

**Note** - P : Provisional

*Source:* Director General of Commercial Intelligence & Statistics (DGCIS), Kolkata, Central Silk Board

## Employment in Sericulture

Silk industry provides employment to 8.28 million people in the country. The Labour Force Participation Rate (LFPR) in silk industry is highest in comparison to any other avocations in the country. The contribution of women is about 54% and rural population about 90%. Thus the industry plays a major role in women empowerment and distribution of equity from rich to poor. The following chart indicate the employment generation in different sectors of silk industry for the last 10 years:-

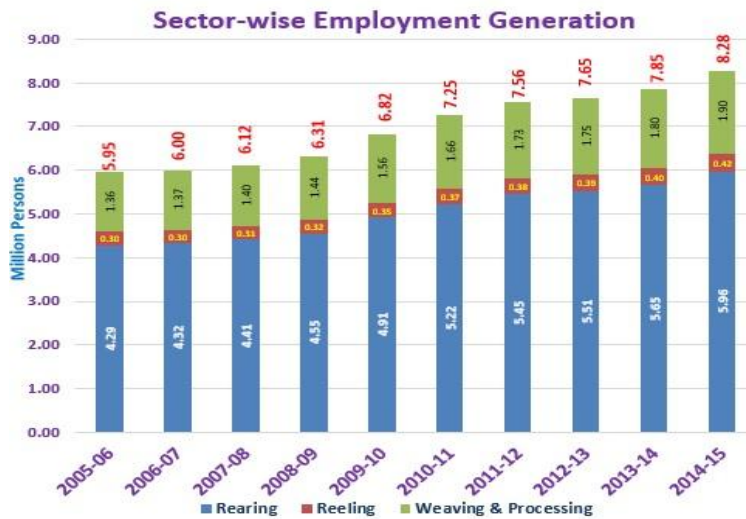


Figure 14. Sector wise employment generation in sericulture

## Silk Consumption

Indian Textile Industry contributes 4 percent to the GDP and 12 per cent to the country's total export earnings. It provides direct employment to over 35 million people, the second largest provider of employment after agriculture. Besides, another 45 million people are engaged in its allied activities. About 8.28 million persons, which is about 10.35% in textile sector, are getting their employment through silk industry.

As silk-wearing traditions and demand go back a long way in India, around 85% of the silk produced is consumed within the country. The Indian silk industry caters mainly to the domestic market for saree and dress materials, which has a round the year market across the length and breadth of the country. The trend in per capita purchase of pure silk is given in Table below. The purchase of pure silk goods has grown at a rate of 5.30% per annum during the period between 2006 and 2012.

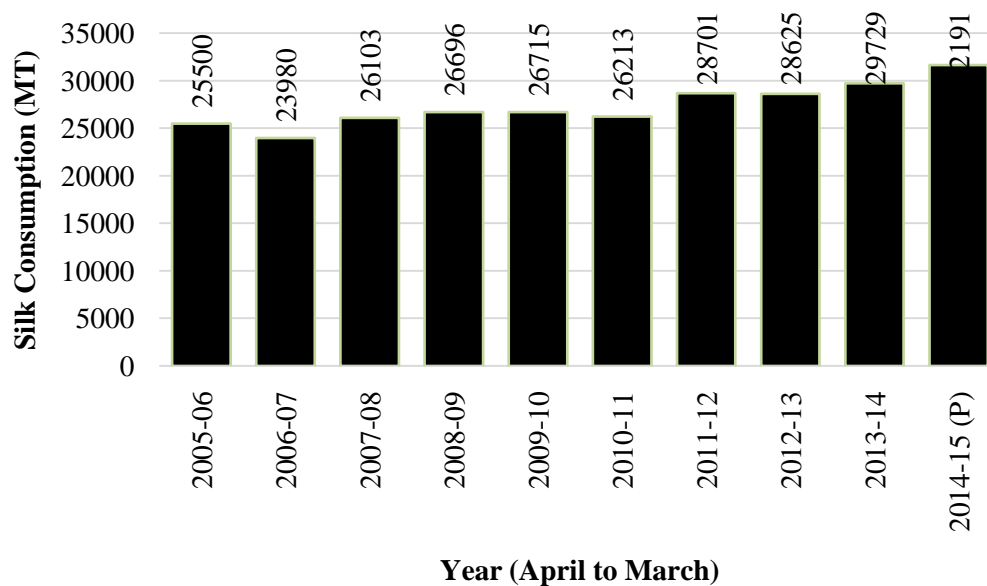
**Table 8. Per capita purchase of pure silk items**

Year	Per capita purchase of silk (metres)			Aggregate quantity (million metres)
	Urban	Rural	All India	
2006	0.36	0.05	0.14	154
2007	0.37	0.05	0.14	157
2008	0.36	0.03	0.12	140
2009	0.37	0.04	0.13	154
2010	0.40	0.05	0.15	175
2011	0.42	0.05	0.17	200
2012	0.45	0.06	0.18	221
<b>CAGR (%)</b>	<b>3.24</b>	<b>2.64</b>	<b>3.66</b>	<b>5.30</b>

**Note:** CAGR- Compound Annual Growth Rate

**Source:** Compiled from reports on National Household Survey, Market for Textiles and Clothing, Textiles Committee, Mumbai

The following chart indicates the trend in silk consumption witnessed in the country for the last 10 years:-



**Figure 15. Silk consumption in India during 2005-2015 (MT)**

### **Constraints of sericulture in India**

Though India is the 2<sup>nd</sup> largest producer of silk in the world, bulk of the silk produced in the country is sourced from multivoltine crossbreeds, which are mainly used for the traditional dresses of Indian women. It was found practically difficult to produce silk of international grades with these native breeds. Hence, the Government has been attempting to introduce and practise bivoltine sericulture suiting to Indian conditions. With the experience in hand for the last 2 decades, the Government has now rolled out a bivoltine development programme, which is now beginning to show encouraging results in substantially increasing the production. The major highlights of this programme are; cluster approach, converging technologies, innovations and incentives among the farmer groups, federating farmers and synchronizing activities to disseminate technologies and inputs, ensuring quality consciousness in the production process and to establish linkages with the various disciplines to ensure equitable distribution of benefits among the sectoral members. The major challenge now facing the industry is to replicate this successful model to larger areas to ensure that the country would be self reliant in producing quality silk by the year 2020.

The Indian sericulture industry is mostly confined in the unorganised sector making it highly difficult to synchronise and manage the various activities to produce uniform quantity of cocoons. Although attempts have been made recently to federate the farmers at cluster level, it is yet to exhibit a visible level of impact in the production processes.

Many of the traditional sericulture areas in the country have been replaced with other activities due to rapid industrialisation and urbanisation. The Government has taken steps to shift the production basis to other potential areas. This is a huge task which demands financial support and skill development.

Some of the other constraints are:-

- i) Inconsistency in output quality,
- ii) Absence of quality pricing system,
- iii) Inability to develop farm based models, and
- iv) Reluctance of younger generation to continue sericulture activities, etc.

### **Potential of sericulture in India**

Indian silk industry is bestowed with a strong production base, a rich tradition in production and weaving and consistent support extended by the Government agencies. Important strengths of the industry, in Indian context are given below:

- Being agro-based and eco-friendly, it aptly fits into the frame work of socio-economic development programmes,

- The industry is backed by a strong production base, traditional skills, family labour and availability of advanced technologies,
- Ideally suited to the agro-climatic and socio-economic conditions of the country,
- Strong and consistent domestic demand, which is increasing at the level of 2.5% annually,
- Availability of a large pool of scientific and technical manpower to develop innovations, technologies, and taking up emerging challenges witnessing in the field,
- A strong extension delivery mechanism to connect with the stakeholders,
- An effective marketing system to facilitate equitable distribution of benefits among the stakeholders.
- Strong traditional skill in almost all the disciplines which are being sharpened and fine tuned by integrating innovations and advanced technologies.

### **Conclusions**

The sericulture and silk industry has emerged as a highly employment generative occupation contributing to the national economy of the country. The resources and technologies available in the country could be now disseminated to other developing countries for replicating the results achieved here. We are pleased to say that the Government of India is willing to help and support these countries towards this direction.

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# **Sericulture scenario in SAARC region – a re emerging industry for poverty alleviation in Maldives**

**Abdul Latheef Moosa**

Agriculture Officer, Ministry of Fisheries and Agriculture, Male, Maldives

## **Introduction**

### **Location, Geography & Topography of the Maldives**

The Maldives (or Maldive Islands), officially the Republic of Maldives, is an archipelago of some 1192 islands, formed in 26 natural atolls and grouped in double rows like a necklace of islands set vertically across the equator. The Maldives are located south of India's Lakshadweep islands, and about seven hundred kilometers (435 mi) south-west of Sri Lanka, on the Equator. The Maldives shares boundaries of its Exclusive Economic Zone (EEZ) with Sri Lanka and India in the north-east and Chagos Island in the south. Islands vary in size from 0.5 km<sup>2</sup> to around 5.0 km<sup>2</sup> and in shape from sandbanks with sparse vegetation to elongated strip islands. All islands are very low lying and none exceeds an elevation of 3 m above mean sea level. Over one thousand marine species inhabits the waters of the Maldives.

Basic geographical characteristics:

Total Land Area	: Approximately 300 sq.km
Lagoon and reef area	: Approximately 21,300 sq.km
Largest Atoll	: Huvadhu Atoll, in the southern region (Approximately 2,800 sq.km)
Smallest Atoll	: Gan in Laamu Atoll, 5.16 sq.km
Number of inhabited islands	: 199
Number of islands leased for Commercial agriculture	: 25

### **Population of the Maldives**

The Maldives is the smallest Asian country in terms of population. It is also the smallest predominantly Muslim nation in the world. The population of Maldives has increased rapidly during the last few decades. However with a population of nearly 400,000 the country still remains one of the smallest independent nations in Asia. About a quarter of the population is resident in Male' the capital. Outside Male' the largest population are in Hithadhoo Island in Addu Atoll, Fuamulah



Island and Kulhudhufushi Island in Haa Dhaalu Atoll with 9,640, 7243 and 6,354 respectively. The rest is dispersed sparsely in the rest of the 196 inhabited islands.

### **Ministry of Agriculture and Fisheries**

Ministry of Fisheries and Agriculture has the mandate for the sustainable management and development of the nation's Fisheries and Agriculture. Responsibilities of MOFA cover sectors fisheries, agriculture, livestock and forestry as well as development of uninhabited islands through long-term lease for commercial agricultural production. The Agriculture and Forestry Services is sub-divided into 4 broad sections. That is Plant & Animal, Protection & Quarantine Section, Agriculture Research & Extension Section, Agriculture & Forestry Development Section and Land Resources Section.

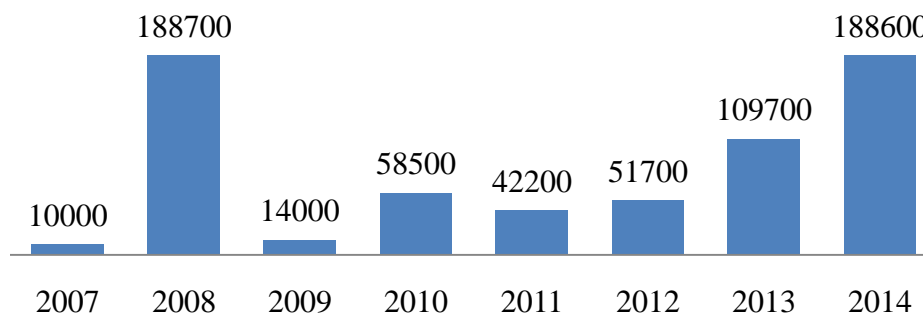
### **Agriculture in the Maldives**

Agriculture has been a fundamental sector in terms of providing crucial support to the livelihood of the people of the Maldives, despite the poor soil and limited land and water conditions for agriculture. Recently developments in commercial agricultural and livestock farming activities with the introduction of new crop varieties and animal breeds show the Agriculture in the Atoll Environment is very promising.

### **Scenario of Silk consumption in the Maldives**

#### **Importation of Silk**

Statistics show that an average of more than 100,000\$ worth silk products has been imported to Maldives annually from different countries. Silk products imported to Maldives mainly are Silk yarn, woven fabrics of silk, silk scarf and shawl.



**Figure 16. Imports of Silk products from 2007 – 2014 (US\$)**

Maldives is not a country that has the means to manufacture silk or its products so it has always been imported yet plays an important role in clothing industry beginning from ancient times till today. Silk fabric has been used as the main material to make cloths for centuries not to mention our traditional cloth is made of silk fabric and named after it as “fashuvi libaas”; ‘fashuvi’ meaning ‘silk’ and ‘libaas’ referring to the traditional dress itself.



**Figure 17. Old woman with her conventional weaving equipment**



**Figure 18. Weaving in an exhibition of traditional activities**

Silk is not just used to make traditional cloths, even though the era of traditional cloth ended use of silk never declined. The fashion may have changed, the designs may have become modernized but the material remained the same hence the love for silk remained. Almost two decades ago a new era began, the era of shawls and scarfs which definitely increased the need for silk since silk gives its

shimmering appearance due to the triangular prism-like structure of the silk fiber, which allows silk cloth to refract incoming light at different angles, thus producing different colors.

In addition to its shimmering property according to the most people who use silk it also suits to a country like Maldives. It is suitable for our temperature; it is affordable and achieves all we want to achieve in a cloth we wear. Furthermore silk materials are being used for decorations in different functions or in different occasions for example in weddings or official events such as award ceremonies or different seminars. Silk is known for the elegant look it gives to anything that it touches.



**Figure 19. Silk Products**

Therefore in my opinion need for silk and its products in clothing industry will always be high among Maldivians. We have got use to the famous Chinese, Indian, and Malaysian etc silk over the years. Silk products have become part of our lives due to its attractiveness and will always be. The beautiful ladies with silk dresses and shawls in the halls decorated with silk will always be part of our tradition.

**Table 9. Importation of silk from different countries in past 8 years (in US\$)**

	2007	2008	2009	2010	2011	2012	2013	2014
<b>INDIA</b>	46370	7600	7600	3600	3600	5400	1400	1300
<b>MALAYSIA</b>	13050	9200	86950	9200	37000	21400	11700	6500
<b>SRILANKA</b>	4200	43300	1800	6000	6000	6000	6000	6000
<b>THAILAND</b>	5600	1800	1700	5800	3000	9500	25000	1600
<b>UAE</b>	1000	2700	5700	27000	27000	4200	13700	107000
<b>SINGAPORE</b>	9000		3200	1750	26000	19300	47700	10400

*Source: Maldives Customs statistics*

## **Constrains & Challenges to establish Sericulture Industry in the Maldives**

### **Lack of Technical know how**

The Maldives imports most staple foods to meet the domestic consumption needs and to feed the continuous influx of tourists as well as the expatriate labor force. As distribution of locally produced fresh fruits and vegetables on a regular basis imposes high operation costs and cheaper and regular supplies of better quality products are available through imports from neighboring countries. Due to mentioned facts, Agriculture Ministry of the country have been putting all their efforts of human resource building on training people on basic horticulture areas in order to increase the production of fruits and vegetables and to minimize their import. So the lack of sericulture experts is and will be the biggest challenge on introducing and establishing a sericulture industry in the country.

### **Poor Soil Condition**

Islands of Maldives has a very sandy soil with very less water holding capacity, which causes difficulties growing some particular species of plants which requires more water. Only 5% of the total area of the country is land, 10-15% of which is suitable for farming. Main sources of water for irrigation is ground water and rain. Quality of ground water differs from island to island. Most of the islands has fresh and clean water tables while some islands are saline due to sea water intrusion occurred by heavy pumping of ground water for different purposes.

### **Unavailability of silkworm and Mulberry breeds**

There is no record that shows existence of any silkworm varieties in the Maldives, which means the dependence to other countries for silkworm seeds to start sericulture in the Maldives. There is a wild variety of mulberry grown in the islands, which has to be improved for the successful establishment of sericulture industry.

### **Scarcity of Land**

Maldives consists of a group of small islands and none of them exceeds 5 km<sup>2</sup>. Almost 95% of the country's total area is sea and it leaves only 1% land for all the uses. Land is essential for the establishment and development of any industry and limitation of land in the country is one of the challenges for the establishment of such industries like sericulture.

### **Financing**

The amount of commercial bank loans has increased over the years, but still it amounts to only 1% or less of the total loans granting to all the major economic activities. Commercial banks are not willing to lend sufficient finance for the investment needs for agriculture development. Attempts to initiate commercial

agriculture venture often fails because local do not possess the means to procure financing to start new projects.

### **Transportation**

Transportation is a key factor in every economic activity, particularly so in the case of the Maldives where the population is highly dispersed. A number of studies have been conducted during the last decade to understand and assess the transport needs of the country and identifying development strategies. These studies have shown that development of the country has been hindered by inadequate transport network. The geography of the Maldives makes the country dependent on air and sea transport which are expensive means compare to land transportation. The ferry network established between the islands and atolls need lot of improvement to make it a reliable and convenient mean of transport. Cargo ferry service is almost nonexistence.

### **Potential to establish and develop a sericulture industry in the Maldives**

#### **Demand**

Silk threads have been playing an important role in clothing industry since ancient times. Ancestors made all their women dresses with some extend of silk to decorate the dress. Local dress code and materials used, might have been changed over the years, but people still wear traditional clothes in lot of occasions, like wedding ceremonies, birthday parties, national events and festivals. Silk fabrics are been used to decorate places during national events and festivals. People also have started using silk to decorate modern clothes and it became part of fashionable clothes. This trend and habit of wearing traditional clothes created a big demand for silk threads and fabrics for local consumption.

Maldives is known for its beauty and it is a famous destination for high class tourists. Almost one million tourists visit the country in recent years. There is a huge demand for traditional clothes which are decorated with silk, among tourists.

#### **Employment**

The Maldives has one of the lowest labour force participation in South Asia, especially for women. Youth unemployment is substantial and has been increasing since the late 1990s. Generating employment opportunities, particularly for school leavers became a serious national issue. The establishment of a sericulture industry could solve this problem to a huge extend in rural islands.

#### **Transportation**

The development of new industries has been very much limited due to high transportation costs in the past years. Recently, various attempts have been made

towards the developing the transport sector. In this regard, in addition to the transport study of 2003 under the regional Development Project, a domestic maritime Transport Study has been undertaken, and implemented in 2007. A study has been carried out on establishing ferry services in the country and started implementation in 2009. Almost all the inhabited islands are already connected by the Ferry Network, but cargo ferry services are yet to be introduced and developed in most of the regions. Transportation cost of goods are expected to be decreased with this evolutionary changes to the transport system.

### **Promoting Seri-Tourism**

Sericulture can be practiced in small scale in resort islands where they have some lands allocated for farming. Suitable silkworm seeds will be imported from India and a small mulberry garden can be grown in island itself to feed the worms. A simple post cocoon facility can be established and the silk obtain can be used to prepare silk products like handbags, waist clothes, scarfs etc. to sell as souvenirs for the tourists. It will help tourists around the world to know what sericulture is and create more demand for silk products.

There are inhabited islands surrounded by resort islands, to where tourists visit to explore island life and buy souvenirs. Raw silk also can be imported from countries like India and Bangladesh to weave in these islands and prepare souvenirs to market for the tourists and locals can acquire a good price for them.

### **Government policies and strategy**

The Maldives find itself in a vulnerable situation by depending its economy in Tourism and Fisheries which represents the twin pillars of country's economic structure. Despite of the current minor role of agriculture in the country's economy, constrained by different reasons, this sector has high potentials for further development as the third economic pillar.

The policies set out in Agriculture Master Plan includes Diversifying and Expanding Agriculture sector by exploring new agricultural activities and expanding existing activities, while ensuring the sustainability of physical and natural resources. Suitable uninhabited islands are being leased for long term to private parties to encourage commercial agricultural production. Different loan schemes have been introduced for individuals and agricultural co-operatives to overcome the constraints in agriculture financing.

### **Conclusion**

Introduction of commercial enterprises in rural areas is vital for the development of Maldives. Despite of the challenges to introduce sericulture industry in the Maldives, the country holds a good potential to introduce such an industry. With

the technical help from countries like India, which has successful sericulture industries up and running, there is a good chance of making it possible in the Maldives. As a developing country, Maldives is working its way to building an independent economy. Working age group of the country is bigger than ever which makes it even more important to create employment opportunities. According to the Agricultural Master Plan, Government policies and strategies are set to support agriculture diversification and expansion.

A preliminary study has to carry out to get the exact picture regarding opportunities and constraints, including availability of mulberry varieties, availability of silkworm breeds suitable for the environment of Maldives, Environmental Impact Assessment of introducing silkworms into the ecosystem, etc.

Maldivians has been doing weaving of the imported silk yarn since ancient times. The equipment use for weaving is conventional and it is very time consuming. Post cocoon activities can be promoted in the country with the introduction of new technologies and it would generate significant amount of employment opportunities. Introducing and promoting sericulture in the Maldives, whether from seed to silk or cocoon to silk, is important and agriculture sector of the country can be strengthened with such diversifications to alleviate poverty.

# **Sericulture scenario in Nepal – a re-emerging industry for poverty alleviation in Nepal**

**J. B. Shrestha**

Program Director, Directorate of Industrial Entomology Development  
Department of Agriculture

## **Abstract**

Since ages, silk and silk fabrics have attracted mankind and have found their place among the most valued and elegant fabrics. Silkworm rearing is normally a family business suited to the multi-income life style of a rural farmer. There are many factors that influence the success of silk production. Poor technical backstopping, poor productivity, high cost of production and labor unavailability continue to be the bane of Nepalese silk industry. The farmers, however, are found to face manifold problems during mulberry cultivation and silkworm rearing. A sincere delving into and addressing of the problems faced by the farmers is required to provide an insight to the concerned officials. Coming up with feasible solution, so as to obtain higher returns from the sericulture enterprise can be practicable through sustainably expanding the production of high quality silk so that it can be fed into the silk textile value chain, whereby enabling promotion of silk exports to the global market as well as creating additional jobs and incomes in rural areas.

**Key words:** Sericulture, sericulture-farmers, silkworm diseases, cocoons, SILKS, plan

## **Introduction**

Nepal is primarily an agricultural country comprising mostly of agricultural labors with eighty percent of its population living in the rural areas. About 65.7 percent of its total population depends on agriculture for their livelihood. Agriculture shares 38 per cent in country's total GDP. Thus, agriculture is the base of national economy. Considering this, the government has accorded high priority to develop agriculture sector in its periodic plans. A twenty year Agriculture Perspective Plan (APP) considered sericulture as a particular commodity to enhance farmers' income, reduce rural poverty and create employment opportunities.

The importance of sericulture was realized when sericulture development program began well in planned way with the establishment of a nucleus sericulture farm at Khopasi in Kabhreplanchok district in 1974/75 with the name of Industrial Entomology Project. Currently there are nine governmental sericulture farms under the Directorate of Industrial Entomology Development (DOIED) all over the country. They act as resource centres for silk worm rearing



and sericulture development for providing required technical and physical inputs.

Sericulture in Nepal is an agro based cottage industry in which through rearing of silkworms the end product, silk is produced (Ueda *et al*, 1975). Till date, no other fabric can match silk in lustre and elegance. As long as human desire for silk garments continues, the sericulture activities remain in demand for sure. Silk, naturally produced animal fibre, is the queen of textile. Sericulture involves agriculture, art and industry; silkworm rearing is an art in the hands of rural people. In the post cocoon processing, that is, reeling of the silk from the cocoons produced by the silkworms is a part of an industry, which might be of different levels of financial investments both for the rich and the poor.

The present global scenario clearly indicates the enormous opportunities for the Nepalese silk industry. The need of the hour for Nepal is to produce more bivoltine silk with reduced cost of production to meet the growing demands of quality silk. The domestic production of raw silk in Nepal is not enough to meet the domestic demand and surplus for export demand. It is estimated that against the demand of around 250 mt of raw silk per annum, the domestic production of raw silk per annum is around 4.0 mt. The gap of nearly 246 mt of raw silk in demand per annum is mainly of high-grade quality mulberry raw silk, which is not being produced in the country to the extent required.

### **Historical perspectives of silk industry in the country**

#### **Past efforts and sericulture state of art**

Past efforts made in sericulture have not been capable of bringing about satisfactory results. However, despite all the difficulties, some noteworthy achievements have been made, though these are in limited scale such as core human resource developed, valuable silkworm races developed, some high yielding mulberry cultivars have been selected, Nine Sericulture farms and stations have been established and packaging of sericulture technology have been done. However, to make sericulture grow fast the entire sector requires strengthening properly.

- In past almost 2,700 sericulture farmers were prepared but now only 1,300 are in sericulture vocation. The total cocoon production is only about 40 Mt. Thus, it is felt that sericulture needs revitalizing for cocoon production and productivity.
- Government of Korea assisted in sericulture in Nepal since 1973 for developing trained, establishing of training facilities and producing silkworm eggs.

- Since 1990, Government of Japan through JICA provided technical support in developing human resource, developing high yielding silkworm races, technology verification and in "Promotion of Quality Cocoon Production and Processing Project".
- Similarly, during late 90's under UNDP support, "Sericulture for Rural Development Project" was implemented in four clusters covering seven districts.

## Current status of sericulture industry

### Type of silkworm

Mulberry Silkworm (*Bombyx mori* L.)

Almost all of the commercial silk produced in Nepal comes from this variety and often silk generally refers to mulberry silk. Mulberry silk is produced by rearing silkworm, *Bombyx mori* L., which solely feeds on the leaves of mulberry plant. These silkworms are completely domesticated and reared indoors.

### Production scale (statistics) and volume (last 10 years)

#### Mulberry Area, Cocoon, Raw silk and Silkworm Egg Production in Nepal

Year	1996-97	97-98	98-99	99-2000	2000-001	001-002	2006-2007	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
<b>Mulberry Area Ha</b>	21.7	105	225	214	245	280	300	380	1300	1380	1450	1530	1610
<b>Cocoons MT</b>	24.5	17.6	20.3	25.7	31.4	34.2	31.34	33	26.6	26.1	31.4	37.6	42.2
<b>Raw silk MT</b>	0.4	0.4	1.2	1	1.4	1.4	1.31	1.36	1.19	1.09	1.31	1.57	1.76
<b>Egg Production Boxes</b>	1703	1050	2015	2110	6220	6400	6000	6000	6000	4500	5000	5000	4200

Particulars	Average in Farmers' Field in Nepal,	In Governmental Farms in Nepal	Japan
Leaf yield per ha.	12 tons	20 tons	30 tons
Cocoon yield per box	20 kg	30 kg	35 kg
Cocoon yield per ha.	800 kg	1200 kg	1500 kg
Leaf : cocoon ratio	30:1	26:1	25:1
Renditta cocoon/raw silk	7.0	6.5	6.5

### **Government's perception**

The Agriculture Development Strategy identified high value cash crop as an important means for poverty alleviation and rural development including the reduction of gender imbalances and promotion of environment conservation. The government's commercial agriculture development program laid emphasis on sericulture development as one of the major components, although Sericulture Development Programs have been categorized into priority two.

### **Coverage**

At present, a total of 1350 hectares of land have been planted with mulberry, involving about 4000 farm households. The mulberry coverage is spread in the southern lowlands and the central midlands of the country.

### **Cocoon and raw silk production**

At present the cocoon production has reached to 45 tons and raw silk production 4 tones per year. Compilation of progress data of Tenth five-year plan indicates that cocoon and raw silk production is on increasing trend. However, the progress appears to be slow and the privatization process is almost sluggish.

### **Silkworm egg production**

Sericulture Development Division, Khopasi has progressed remarkably in the area of silkworm seed production and distribution. Its annual egg production is more than 5,000 boxes per year (with the potential capacity of 10,000 boxes per year), enough to meet the country's demand. Attributive or characteristic recent study of Nepali eggs needs to be done in terms of viability, hatching and quality cocoon production.

### **Marketing supports**

It appears very sad to note that there is not so well organized market available in the country for sericulture farm outputs in the private sector. Government sector arranges some provisions to buy cocoons produced by farmers through nine sericulture development offices established at Eastern, Central and Western Development Regions, if the private sectors are not able to do so. Cocoons purchased are transported to Khopasi and Itahari, where they are processed for raw silk yarn production. Some of the sericulture farmers produce Zaguri silk by means of Zaguri Charkha and sell to private sector buyers. Country's textile units import twisted silk yarn from abroad, mostly China. Government of Nepal fixes the purchase price of cocoon as per the grade quality.

### **Sericulture technology**

Nepal is not traditionally a sericultural country and it had to rely on temperate technologies borrowed from Korea and latter from Japan. Attempts have been made to reform the borrowed technologies and restructure the packages to match

different agro-climatic situations of Nepal. A farm size of 0.25 hectare has been recommended as model size mulberry garden, whereas the small and marginal farmers may also adopt smaller models of 0.1 to 0.15 hectare of mulberry garden.

Both the exotic and native mulberry varieties are available in Nepal. However, eighty per cent mulberry plantation comprises of Kanva-2 variety (Indian variety). Silkworms used in Nepal are bivoltine varieties. Khopasi center has procured and maintained a number of pure line breeds for later use in silkworm egg production.

#### **Raw silk import and export**

Raw silk import in Nepal is estimated to be around 250 MT per annum. The export of raw silk is negligible.

#### **Employment in sericulture (production, post-harvest, processing)**

Sericulture as a farm based labour intensive activity is based on production by mass principle. It has the higher employment generation potential than that of all the traditional crops. Almost 13-15 person-year of labor employment is generated per hectare of mulberry land.

Sericulture as a labour intensive industry in all its phases, can generate employment up to 11 persons-days for every kg of raw silk produced.

#### **Scenario of silk consumption (textiles, domestic production and imports)**

Raw silk consumption in Nepal is estimated to be more than 250 mt (of raw silk), which is imported from broad apart from some of raw silk produced domestically in Nepal, that is, 4.0 mt of raw silk.

#### **Issues and constraints in sericulture**

##### **Reasons behind the delayed progress**

Despite high potential and joint efforts through bilateral and multilateral cooperation, sericulture development program has not been able to catch up momentum. Moreover, post cocoon activities involving reeling, twisting, weaving and production of items out of silk fabric have not been adequately developed. The covered areas became large with scattered programs resulting in limited impacts. Sericulture is an agro-based industry consisting of mulberry cultivation, rearing of silkworm for egg and industrial cocoon production, and cocoon processing for silk yarn and cloth production. All the research, development, egg production and outreach responsibilities are rested on the Khopasi center that is burdened itself by multi pronged problems. Like other high value commodities, inadequate supply of technical services and production inputs, insufficient mobilization of manpower and budgets are the major problems in the production and development of sericulture. Institutional network to support varied agro-climatic situations is lacking. There is lack of sufficiently trained extension workers to whom the farmers could contact and rely in time of needs. Improper

and underutilization of available physical facilities and skilled manpower are other major problems. Garden management at farmers' level is poor due to the cultivation in marginal land. There is lack of clear-cut policy, priorities and adequate fund in the sector. Productivity of cocoon is low at farmers' fields due to poor feeding and absence of separate silkworm rearing house. Percentage of low quality cocoon production is high (30%) and use of such cocoons is there resulting in bad quality yarn production. Unavailability of required quality and quantity of silk in the country has caused import of fine silk from abroad.

There is need of stronger coordination among GOs and NGOs and also among manufacturers and traders involved in sericulture development and silk business. Country's sericulture program has not been able to match the need of indigenous demand and advance towards commercialization of Nepalese sericulture.

### **Main issues and constraints**

- Sericulture is a complex component of agricultural and industrial vocations and it requires simple but timely delivery of technical services, care and managements.
- Similarly, the institutional strength in terms of grainage management, inputs delivery, and intensive Sericulture facilitation services during rearing and harvesting is not adequate.
- The overall mulberry garden management is poor with poor quality leaf production resulting too low cocoon productivity.
- Mulberry saplings are distributed annually to a certain number as per fixed targets but afterward their care or management is lacking. It also lacks packaged technology for the small farmers.
- No separate rearing house is there to rear silkworms thus leading to high mortality and low productivity.
- So far, sericulture activities are mainly carried out from government sector only none of the cooperatives or private business sector have been attracted to this sector because of low incentives in sericulture business in comparison to the government support given to sericulture farmers in both of our neighboring countries. In the government sector also, the trained and experienced sericulture technicians are often deployed in areas other than sericulture.
- In agriculture sectors, many NGO/INGO, bilateral and multilaterally supported programs have mentioned the importance and need of sericulture development in this country but while allocating the resources, do not give adequate priority.
- Sericulture in Nepal is not growing rather it is limping. In reality, sericulture lacks dedication and honesty in getting service from all concerned sectors.

There is also lack of timely and effective supervision and performance based monitoring & evaluation at field level. Thus, keeping aside the past negative aspects, attempt to fully explore the nature's gifts adopting consolidated strategies concentrating sericulture only in High Priorities Areas of district like Illam, Dhankuta, Sunsari, Morang, Kavre, Nuwakot, Bhaktapur, Dhading, Chitwan, Tanahu, Kaski, Lamjung and Syngaja need to be made (Benjamin and Jolly, 1986).

The value chain analysis of both agricultural and industrial aspects of sericulture needs to be carried out. In coming years ahead, sericulture development program needs to be taken into account as the "project approach scheme" and managed to mitigate the issues and constraints in this field. A "National sericulture policy" needs to be prepared, in order to develop commercial sericulture to improve the living standard of the farmers. In future, all the sericulture activities in the country should be guided by this policy.

### **Other problems**

The Nepalese sericulture industry is currently facing several other problems, which have restricted full utilization of its potential. Some of the major problems are given below. In sericulture, the production and productivity of quality cocoon largely depends on the healthiness, growth of the silkworm larvae and the suitable environmental conditions. Silkworm *Bombyx mori* is a very delicate insect and is prone to many infectious diseases caused by various pathogenic microorganisms, which are not only found in diseased caterpillars but also scattered in the rearing rooms and on appliances being infected from the carcasses and feces of diseased caterpillars. These infectious microbes left over become an easy source of secondary contamination and spread of diseases (Ayuzawa, 1972). Proper hygiene and timely use of effective medicines can prevent and control disease outbreaks and reduce mortality and losses.

Nepal silk yarn is of poor quality, which not only affects our competitiveness in the world market, but has also resulted in a preference for imported yarn in the domestic market. Though the Nepalese breeds have the potential to produce the good quality of bivoltine silk, the problem arises due to lack of:

- sufficient thrust on the adoption of improved technologies
- strict disease control measures
- quality leaf due to insufficient inputs to mulberry garden;
- appropriate mountages
- grading system for cocoons
- quality-based pricing system as well as use of young age silkworms (Sekarappa, *et al*, 2012).

### **Farmer perceptions of sericulture**

The dissemination of information of technologies/practices largely depends on the perception of the farming community. Farmers that have engaged in sericulture are quite positive about sericulture as an alternative (or complement) to traditional cash crops. Based on interviews of 50 farmers, an assured market and the likelihood of a regular and remunerative income were by far, the most important criteria for them for being attracted towards sericulture, irrespective of landholding size.

### **Explanation on the problem in the area**

In spite of having favorable agro-climate for superior bivoltine mulberry sericulture, suitable socio-economic settings and the advantage of having silk producing neighboring countries, sericulture development could not catch up momentum. The major constraint in the development is the lack of tradition and technical knowhow among growers and existing agricultural extension networks. Another problems faced in extension are the modalities of the transfer of technology from the extension worker to the farmer, the lack in number of trained extension workers. There is lack of core manpower specialized in different high tech field of sericulture and extension field staffs. There is also lack of strong institutional networks and facilities.

Insufficient government patronization, lack of enough financial assistance, lack of proper management, bureaucratic complexities are the factors, which stagnate or retard this industry. Financial problems of the entrepreneurs are also a major problem of silk industries. Insufficient raw materials & import based raw materials increase the risk very much.

### **Potentials of sericulture**

The agro-climatic conditions of about 38 districts in Mid hills (for bi-voltine sericulture) and about 20 districts in the Terai belt (for bivoltine and cross breed sericulture in specific seasons) and also the socio-economic settings are ideally suitable for the development of sericulture industry in Nepal. The bivoltine cocoon produced in Nepal is as good as those produced in Japan, China and Korea. There is vast potential for sericulture development in Nepal, which is yet to be fully explored and utilized. Its present productivity is far below the potential. The sericulture industry possesses a great potential for expanding rural employment and increasing farmer's income. Recognizing the potential of sericulture as an employment generating endeavor, the Government should seriously consider its development priority.

## **Feasibilities**

There are ample evidences to prove that sericulture farming in Nepal has a good and bright prospect. Most importantly the climatic condition of this country is highly suitable for sericulture development. Some parts of Terai belt and the Mid-hill areas comprising warm to cool temperate regions have climatic suitability and congenial environment for sericulture-farming. The situation is further supported by the socio-economic condition such as the presence of cheap labor and traditional weaving background of rural farm community. Mulberry, a major component in sericulture farming, is widely found in Nepal and has existed in numerous forms of species, varieties and strains. The temperature, rainfall and humidity form the ideal ecology required by mulberry cultivation and bivoltine silkworm rearing.

Bivoltine silkworms fed with good quality mulberry leaf produce quality silk thread. Proper plantation and management of mulberry plant is not only helpful to produce high quality silk thread but also improves environment by supporting forestation activities. Mulberry also can tolerate sloppy land and grow with minimum irrigation facilities. In addition, it also supports to meet the fire wood demand reducing the pressure in natural forest.

Sericulture links science, art and industry producing precious silk yarn by rearing silkworm feeding mulberry leaves. Reeling silk thread involves both agricultural and industrial activities and both contribute to provide ample opportunities for employment and higher income for long period of time. Sericulture being a labor-intensive vocation it is highly suitable in Nepalese agro-socio-economic condition where surplus labor and nature-gifted climate exist. Silk due to its inherent quality of softness, shininess and luster is in high demand both at national and international market.

Majority of Nepalese farmer possess less than 0.5 ha of land whose productivity is quite low and opportunity for growing other crops profitably is also low. All agriculture forces have work in the field for a period of 7-8 months and rest of the months they are underemployed and sericulture is such a crop that can absorb it.

Sericulture activity was initiated in Nepal in some areas of Kathmandu, Ilam, Kavre, Chitwan, Syanga, Dahding, Nuwakot, Lalitpur, Sunsari, Dhanukuta, Tanahun, Kaski and Palpa on a trial basis in terms of technology packaging, marketing, silkworm eggs availability and suitability of developed technical package. Thus, in view a multitude of micro-climatic variations in Nepal and accumulated field level experiences and available information till date guides that Nepalese mid hill areas have immense potentiality for production of high quality bivoltine silk.

Efforts made in past have aroused significant awareness among rural farmers and the adoption trend is on increase. In many pocket areas sericulture-farmers have



adopted sericulture farming as an important cash-earning crop in their cropping pattern.

### **Scope and potentiality of sericulture development**

Nepal's agriculture policy in principle agrees to implement strategy of social mobilization, policy of decentralized agricultural, development and small-scale labor-intensive industrialization to expand rural employment and more equitable income distributions among the various socio-economic groups and the sericulture fits in it.

Sericulture as an industry has the potential of providing employment and income generation opportunity to the farmers, particularly rural women. Sericulture activities such as garden maintenance, silkworm rearing, cocoon harvesting, and silk reeling are mostly done by rural women. Studies done elsewhere and within Nepal has shown that Sericulture not only support income generation but also is socially respectable and is environment friendly vocation. The bivoltine cocoon produced in Nepal is as good as those produced in Japan, China and Korea. It is suitable to Nepalese soil and climate, topography and social structures. It is an exportable item having global demand, which can be produced in the country using indigenous resources.

### **Topography and climate**

Studies done in the past have verified that the soil type, climate and social structures and farming system of various geographical locations ranging at an altitude of 500-2,000 MSL of more than 58 districts of Nepal are suitable for the production of quality cocoon.

Mulberry can be grown in relatively remote areas where perishables commodities like vegetables and fruits or fish cannot be farmed properly. Mulberry farming is also found suitable for mitigating the effect of climate change on the part of agriculture.

### **Social structure**

Traditional farming system cannot engage small farmers for more than 7-8 months in a year and so for these smallholder's family members, above 21 years and below 60 years, which is around 45 percent of the total Nepal population, sericulture can be an appropriate vocation. Most importantly, sericulture does not displace the main cereal crops, rather it supports, providing additional income by cultivating mulberry in the ridges of the field, canals, public ponds or unused public land. In Nepal in more than 60 percent of agricultural activities are done by women. Sericulture is women farmer friendly. Women groups also can be self-reliant in financial and social aspects involving in silk reeling and weaving, enterprises.

### **Support to poverty alleviation**

Sericulture is a labor-intensive farming system right from the mulberry cultivation to finished silk items production. Commercial agriculture leads to establishment of small cottage agro-industry and small enterprises at rural level, which can create job opportunities for the underemployed or unemployed rural youth. Sericulture from 1 hectare of land creates 14 m/y jobs including yarn and fabric production. Besides this, the landless labors can be benefited by engaging themselves in reeling cocoon or waste cocoon or weaving.

Mulberry leaves as well as insect excreta contain high level of protein. Feed remainings, pupae and pupae exoskeleton can also be used to make nutritious feed for animals for additional income.

### **Environment conservation and environment benign**

Mulberry plants maintain greenery and checks soil erosion. Likewise, mulberry plantations on sloppy and terraced lands, terrace ridges and gardens help maintain the environmental balance. Green mulberry plants can help in sequestration of carbon, which has potential also to bring about extra income to farmers.

### **Export potential product**

Sericulture considerably helps in enhancing agricultural trade by export of quality silk yarn and silk base materials. At global market, the demand for silk item is ever increasing as well as so is the case in our neighbouring countries. In Nepal, mulberry cultivation in about 10,000 ha. of land can produce about 500 Mt. of raw providing job opportunities to more than 40-50 thousand people and NRs. 40-50 billion worth silk products can be exported.

Cocoon and silk are light weight high value commodity of greater export potentials. The silk yarn and silk made commodities have ever-increasing demands and potential market throughout the world. Development and establishment of internal sources of silk supply will help to earn foreign exchange through import substitution and export promotion. Thus, there is enough ground and possibility to justify sericulture as an appropriate agro-enterprise for rural sector development.

### **Mulberry saplings production**

Mostly the government farms like Mulberry Nursery Management Centre, Bhandara, Chiwan; Silk Processing Center Itahari, Sunsari, Sericulture Development Program, Pokhara, Kasaki and Parental Stock Seed Cocoon Resource Center, Bandipur, Tanahun are responsible to supply the required saplings. If necessary, few selected farmers are involved to fulfill the mulberry saplings requirement.

### **Gender consideration**

Sericulture includes women farmers in all its production aspects augmenting the women farmers' income.

### **Beneficiaries**

The sericulture benefits large category of population during farm to fabric production process. Small landless, middle and big farmers, reeling and weaving entrepreneurs, industrialists, local shopkeepers and export traders are the large beneficiaries of sericulture.

### **Ownership and sustainability**

In the silk production component, the sustainability strategy is to involve the lead firms so that they are “incentivized” to provide villagers in their value chain with the kind of inputs and knowhow so that they can continue to improve their productivity and expand their production. Agro-climatic conditions of mid hill district are conducive for silkworm rearing, however some extra care is required during the summer season to prevent heavy losses due to high temperatures.

### **Recommendations**

To overcome the difficulties the silk industry can follow the following recommendations:

- Ministry of Agriculture Development/Department of Agriculture (MOAD/DOA) in collaboration with Agro Enterprise Centre (AEC)/FNCCI should prepare a Blue Print or a Master Plan on sericulture development by involving private sectors and NGOs.
- MOAD/DOA should form a National Sericulture Development Board or Sericulture Promotion Committee with representation from different ministries and private sectors to co-ordinate all development efforts of this sector
- DOA should arrange training for leader farmers and study programs for producing adequate number of technical manpower.
- DOA by involving AEC, NGOs and private sectors should formulate HRD strategy for sericulture.
- The training facilities of Institute of Agriculture and Animal Science (IAAS) should be expanded as a separate Department of Sericulture.
- MOAD should allocate right person at right place and create a separate sub-faculty within Plant Protection faculty.
- MOAD should develop basic core manpower in different specialized sericulture field.

- DOA should identify client's research problems
- DOA/NARC should undertake client oriented and problem solving research in collaboration with Agriculture Institutions, AEC, NGOs and Private Sectors.
- DOA should carry out sericulture extension activities through sericulture command centre.
- DOA should co-ordinate the efforts of NGOs, INGOs, private sector and international organizations develop and disseminate location and season specific technology at grass root level.
- DOA should encourage private sector to replicate mulberry plantation, silkworm rearing and set up post cocoon units to utilize available cocoons.
- DOA should allow, support and assist the farmers and entrepreneurs to acquire eggs from more than one source considering the need for location specific suitability.
- MOAD/MOF should provide incentives to private sector to undertake post-cocoon activities
- MOAD should incorporate market planning and strategy in the long term perspective plan for sericulture development
- MOAD should establish National Sericulture Development Board for sericulture development
- Government should develop and implement a network of Sericulture Information Linkage & Knowledge Systems (**SILKS**).

### **Conclusions**

To make sericulture an income generating or lucrative enterprise or to develop sericulture as an agro-based industry, it is necessary to:

- Develop commercial Sericulture in order to diversify and commercialize agriculture by increasing the production and productivity of silk cocoon.
- Develop and strengthen cooperatives and private entrepreneurs to establish income generating Sericulture enterprises/cottage industries at rural level.
- Enhance export of Raw silk and silk-based products and import substitution by establishing income generating small-scale Sericulture enterprises and cottage industries at rural level.

To achieve the above goals following policies shall be adopted. The basic thrust of this policy is intensification and commercialization of sericulture in potential areas based upon comparative advantages by Production of high quality silk/cocoon for internal and export market. The Execution of sericulture programme shall be based on cluster and package approach broadly guided by private public cooperative partnership approach.

### **Policy recommendations**

- **Develop commercial Sericulture in order to diversify and commercialize subsistence agriculture by increasing the production and productivity of silk cocoon.**
- Detection of unproductive mulberry farm and farmer numbers and motivating the farmers to rejuvenate their gardens to make it productive.
- Provide free mulberry saplings to replace old or dead mulberry tree to such farms.
- Encourage farmers to prepare organic farm manure and apply FYM adequately in their gardens. Most mulberry gardens in Nepal are found nutrients deficient and so mulberry yield is low.
- Provide technical services to prepare gardens with minimum of 1,200-1,500 mulberry trees in each garden.
- If new sericulture farmers plants mulberry in more than six Ropanis (0.3 ha) area at one time/go then s/he shall be provided with fully subsidized mulberry saplings.
- Motivate the farmers to plant high yielding mulberry varieties.
- Continue selecting potential high yielding indigenous mulberry varieties and expand its cultivation.
- Recommend appropriate leguminous intercropping.
- Involve NGO/INGO/CBOS/cooperatives in the mulberry areas expansion campaign.
- Identify the location specific technological need and carryout on farm studies as per the local demand.
- Carry out multi locations specific varieties of both silkworm races and mulberry varieties and based on the findings, disseminate their use.
- Sericulture technology extension shall be disseminated through "Farmers to Farmers Extension" concept.
- Imparting extension service in mulberry cultivation, silkworm rearing and reeling through trained and skilled farmer facilitators.
- On farm research studies will be conducted using Farmers Field School tool and farmers and science concept.
- Small sericulture farmers shall be granted small hand tools, Saplings and fertilizer at subsidized rate or free of case wise basis.
- Capital subsidy in irrigation shall be granted like in other crops.

- Assistance to establish drip irrigation system in gardens shall be granted
- Fencing materials and irrigation facilities in mulberry garden of Small farmers groups shall be provided at 50% cost subsidy.
- Sericulture farmers producing more than 100 kg of cocoon shall be granted with local material based mountage worth of Rs 8,000.
- Chowki rearing center (CRC) will be established in cluster or farmer's group producing more than 2 Mt. of fresh cocoon and fencing material shall be given at 50% subsidized rate.
- Sericulture farmers having mulberry garden sufficient to rear 3 boxes at a time in a season shall be encouraged to construct a separate rearing house/shed. 50% subsidies worth construction materials of the total construction cost of the rearing house/shed shall be provided from government program. The groups will be supported with seed money to start group revolving funds to purchase disinfectants and other small equipments required for silkworm rearing.
- One sericulture farmer facilitator shall be deployed and in first year his or her salary shall be borne 100% from government fund and from second year onward 25% salary shall be borne by the group and 75% by government and then in following years government share shall be decreased each year by 25% and fifth year onward 100% salary shall be borne by the group.
- Encourage to the best possible to involve the community's participation in Sericulture farming. Landless farmers in groups shall be allowed to plant mulberry in lease hold forestry areas and involve in silkworm rearing.
- Community forestry consumer group shall be encouraged to participate in silkworm rearing.
- Quality cocoon mulberry leaf production and productivity increasing activities viz; ensure availability of effective disinfectant and required inputs; due attention, care and management and monitoring of proper mounting and cocoon harvesting technique regularly.
- Intensive monitoring and visit by the farmer facilitator during the rearing period shall be made.
- Necessary technical assistance for the procurement of improved rearing equipments and construction of separate rearing house shall be made.
- Ensuring supply of good quality disease free silkworm eggs.
- Research findings shall be verified to test the suitability in the particular location prior recommending it to the farmers.
- Verification trial shall be carried out involving the sericulture farmers of the specific location.

- Various mass awareness programs on the importance and the need of the sericulture program in Nepalese farming system shall be implemented.
- All the governmental sericulture farms and station shall be made responsible to meet the set cocoon production target and technical service to be provided to the farmers.
- Any NGO/CBO or INGO or farmers group or cooperatives desiring to work on sericulture in the cluster area or districts should collaborate with the command area farm chief or cluster chief.
- All sericulture farmers shall be provided with "Sericulture Card" which shall keep all sericulture related information under the supervision and guidance of command area chief.
- For small farmers to get the loan is not easy in terms lengthy paper works. So, to make the loan flow easy the "GRAMIN BANK" concept shall be adopted to provide loan to the farmers on group or project collaterals basis.
- No interest shall be charged on the loan for the gestation period.
- Loan shall be repaid back within 5 years period.
- For small farmers the gestation period shall be of 2 years.
- Sericulture should include under Priority Sector Loan program of the government
- **Develop and strengthen cooperatives and private entrepreneurs to establish income generating Sericulture enterprises/cottage industries at rural level.**
- Cooperatives/private entrepreneurs shall be motivated and priority to be given to get into cocoon collection and reeling activities
- For first five years, cocoon buyers shall be granted full subsidy on the cost of cocoon collection and transportation.
- Cooperatives or private entrepreneurs interested to purchase fresh cocoon directly from the farmers by signing a contract with DOIED to purchase cocoon shall be granted 40% of the total average cost of the average annual cocoon estimated to be produced in five years period, to start cocoon purchase "Revolving Fund". The rest of the amount shall be provided at the rate of 20% with verifying the cocoon purchase record.
- One cocoon drier shall be established in each cluster producing more than 2 M. tons cocoon.
- Sericulture farmer producing 500 kg of fresh cocoon shall be felicitated with merit sericulture farmer prize and certificate of recognition.

- Present system of grading based on shell ratio shall be continued until market runs on its own then dry cocoon only shall be graded.
- Once the Cooperatives and Pvt. sectors start coming into marketing of the cocoon and raw silk the grading and the pricing shall be done on the very day of the marketing in the presence of both buyers and sellers.
- Women entrepreneurs desiring to reel spawn silk shall be granted 50% subsidy in the cost of Charkha. Similarly, if women groups desire to reel the waste cocoon it will be sold to them at 50 subsidized prices from govt. farms.
- Any cooperatives producing more than 2 M. ton of fresh cocoon if desire to establish cocoon dryer; 50% subsidy on the total cost of the dryer shall be granted and the other 50% if it is taken on loan then 50% interest subsidy will be granted.
- The reeling machine located at Itahari now if any cooperatives or Entrepreneurs desires to run on lease shall be given for 5 years without any charge.
- Gradually Cocoon auction market shall be introduced providing market and storage facilities for the seller.
- 2% levy will be charged from both buyer and seller for the maintenance of the auction market.
- Until the private comes into Sericulture market business present system of buying cocoon by the Government shall be continued Respective command area farm will be made responsible for it. These farms should be strengthened.
- Run the cocoon market four times in a year.
- Sell the cocoon from the govt. farm directly to reelers without taking any profit.
- Campaign activities with slogan “Sericulture for small farmer’s economic improvement” shall be launched.
- **Enhance export of Raw silk and silk based products and import substitution by establishing income generating small-scale Sericulture enterprises and cottage industries at rural level.**
- Silkworms, and it is by products have been used to prepare medicine, cosmetic and surgical materials. In this perspective, future export of such items can be considered along with enhancing silk thread and silk based items. Thus to enhance sericulture product export the silk should be included in priority export item list of government. Thus, a working policy document for sericulture export enhancement shall be prepared with priority to provide investment for developing necessary infrastructures, facilities, technology and legal frame works.



- Area where more than 10 M ton of cocoon is produced priority shall be given to cooperatives and entrepreneurs to establish modern reeling and processing unit. 50% subsidy on the factory cost of the reeling and twisting and weaving unit shall be granted along with rebate on custom and VAT charges.
- Entrepreneurs or Cooperatives exporting Nepali silk yarn or silk base products shall be felicitated with "merit sericulture entrepreneur prize and certificate of recognition".
- Cocoon price management committee under the coordinator ship of the Joint Secretary Agriculture Trade Promotion and Statistic Division of MOAC shall be formed. The committee will have seven members representing Government Departments, Industry and Finance Ministry, private enterprises, cooperatives and farmers organizations.
- International Market price and domestic price shall be informed to al the concerned.
- Cooperatives shall be encouraged to initiate Insurance and depending upon the proposal Gov. will support in its implementation.
- Prepare project proposal on specific issues of sericulture development and govt. shall support to make the funds available either from the national coffers or on international loan.

### **Institutional development and strengthening**

Sericulture is a mixture of both agriculture and industrial activity. While strengthening the institution the geographical difficulties, social and financial status of the farmers all must be kept in mind. In view of its complexities, linkages, and coordination requiring from multi disciplinary sector, it is recommended to establish a National Sericulture Promotion Board.

The members in the board should be from Ministry of Finance, Industry, Research Institution, and Agriculture Colleges. The chairperson should be from private sector and the member secretary from governmental sector, desirably the Program Director, DOIED. According as the need of the market the board members can be changed.

### **National Level**

- **National Sericulture promotion Board shall be established:**
  - The board shall be independent.
  - Proper linkage among government, cooperative, and private sectors shall be maintained.
  - Financial liability shall be borne by all the stakeholders.

- The Board shall provide advice on policy formulation and necessary amendment, to government bodies or concerned institutions.
- Board shall play important role in creating mass awareness program.
- Until the Board comes into existence, DOIED shall perform all the activities mentioned above.

- **Silkworm Seed Production Unit Strengthening:**

- Develop required physical infrastructures for the development of silkworm eggs.
- Cluster area may need different quality seed, so develop it accordingly.
- Initiate seed cocoon production at farmer's level after 4-5 years period.
- Disease free but high yielding race of parental lines to be developed or purchased from developed countries.
- Make quality seed available coinciding the leaf flush development time in a particular area.
- Provide premium price to seed cocoon producer.
- Initiate seed certification system preparing the act rules and regulation.
- Sericulture Development Section, Khopasi should be developed as parental line preservation and center for technology development.
- Strengthen and run Chittapol as grainage center.
- Dhunebasi, Pokhara Bandipur, Syngja as seed cocoon producing farm and Bhandara and ithari as sapling producing farm.
- Strengthen Silk Processing Center, Itahari, more as silk processing centre.
- Make training available to all seed technician both in country and abroad.
- Develop eggs transportation vehicular facilities. In short, Infrastructure facilities like Seed farms, Grainages, Cocoon markets, Technical Service Centers, Reeling units, Training centers, need to be established for development of the Sericulture Industry.

**Regional Level**

- Develop short-term silkworm egg storage center at Pokhara and Dhankuta sericulture farms where all the silkworm eggs required for the respective region can be store for 8-10 days before sending to farmers for brushing.
- Develop Pokhara sericulture farm as Sericulture Training and Research center to provide facilitators training, as well as on farm trials.
- Keep Linkage with regional institution related to sericulture.

- Develop training curriculum for the facilitator and other concerned.
- Use these centers as technical backstopping point for the region.

### **District Level**

- District having sericulture cluster should formed- A district Sericulture coordination committee consisting of representative from District Development Council, Village Development Council, Farm, cluster, farmers group, Women development office and other concerned in the district.
- In the production area depending upon the number of sericulture farmers develop Sericulture Technical center. It should be run under the management and resource of the VDC.

### **Human resource development**

- Human resources development through technical/vocational training especially for preparing silk farmer Facilitator among farmers groups to provide home-to-home technical service shall be started.
- Develop Basic Core Technical Resource required for all disciplines of sericulture and specific specialist as per the demand of nature of work and need.
- Special attention need to be given in deploying silkworm breeder for Parental line maintenance and selection, Silkworm production and distribution
- Deploy facilitator at the rate of one facilitator per 50 Sericulture farmers.
- Organize In country mass training program on weaving and designing silk material getting Specialist on post cocoon activities from China Japan or Korea or Thailand.
- Organize refresher training once in a year for technician, traders, reelers, and workers.
- Organize training program on sericulture business Management.
- Give international exposure to higher level HR in breeding, selection, and reeling.
- Especially in Government sector all sericulture-trained personnel should be deployed in Sericulture activities, right man in a right place concept must be strictly followed.
- Organize cooperatives management training to run sericulture as a vocation
- Provide training to private sector and cooperative personnel.
- Develop facilities in higher education institution for higher degrees in sericulture.

### **Cluster development**

- Based on the climate and topography and the comparative advantage select
- Area and identify the farmers.
- Select 50 farmers to make one cluster.
- Provide all technical support to such cluster require for running an enterprise.
- For an effective implementation of sericulture program make organization responsible for as well as assign one person to be responsible for each cluster.

### **Minimum criteria of a Cluster:**

Cluster	50 farmers
Each farmer	2 Ropanis mulberry farm
Production per farmer	70-80 kg of quality cocoon
Production per Ropani	35-40 kg of quality cocoon
Each cluster production	1,750-2,000 kg of quality cocoon

### **Role and responsibility of government sector, private, non-government sector, cooperatives and farmers**

Major stakeholders and their responsibility shall be as follows:

#### **Role of Governmental Agencies**

- Research and development and technology packaging.
- Special training on seed cocoon production
- Seed and sapling production and supply.
- Market and marketing of sericulture products.
- Quality control and testing/inspection.
- Facilitators and regulator deployment.
- Sericulture commodity specific Export program development and extension services.
- Linkages and coordination among various stake holders.
- Cocoon market and price information dissemination.
- Institutional development at farmers' level.
- Conservation and development of parental source of silk-worms and mulberry plants.
- Exchange of information through the promotion of coordination and networks with regional and international organizations and institutions.
- Development of human resources.

### **Role of the NGO**

- Support in seed distribution.
- Production program management.
- Farmers training management.
- Collection purchase and selling of cocoon/raw silk/other products.
- Support programs.
- Coordination with Govt. sector.

### **Role of the Private Sector**

- Production of mulberry saplings.
- CRC operation.
- Production of seed cocoons.
- Silk (raw, spun) yarn production.
- Silk fabric production.
- Inputs supply.
- Marketing.
- Chwoki rearing management.

### **Role of the Farmers**

- Mulberry saplings production and distribution.
- Mulberry farming and cocoon production.
- Skilled farmers' involvement in seed cocoon production.
- Spun silk production from under grade cocoon.
- Group activation.
- Participate in farm level research and studies.

### **Role of the Cooperatives**

- Provide inputs to its members.
- Cocoon collection and purchase.
- Cocoon reeling and trade.
- Seed cocoon production and egg production.
- Other required inputs production and distribution.
- Silk material weaving.
- Post cocoon commercial processing industries management.
- Assist in mulberry area expansion.
- Training and technology extension.

### **Coordination and linkages**

In order to make Sericulture Development program a Success, it is essential to have strong linkage and coordination among the various stakeholders. For this, following strategies shall be adopted.

- Meeting and visit of stakeholders.
- Seminars and workshops
- Study tour programs both domestic and international level.
- Training and field visit
- Joint project preparation and monitoring & evaluation

### **Sericulture networking**

- Sericulture facilitators, farmers networking
- Experience sharing.
- Facilitators exchange program.
- Field visit and field day, workshops seminar, Interaction among farmers, entrepreneurs.

**National coordination committee** to be established under the chairpersonship of DG, DOA, members shall be from Department of Industry, AEC, Trade promotion center, farmers' group and member secretary to be from Directorate of Industrial Entomology Development.

Similarly, at the cluster or district level there will be **District/Cluster Coordination Committee** and the members shall be from NGO / farmers / facilitators and representative from Women Development Section. It shall be chaired by the representative of private entrepreneurs and member secretary shall be as designated by the chair.

### **RESEARCH AND DEVELOPMENT**

- Research and studies shall be conducted to the best extent possible at farmers' field, involving scientist from National Agriculture Research Council, Nepal Academy of Science and Technology and Institute of Agriculture and Animal Sciences (IAAS).
- The National Coordination Committee headed by DG, DOA shall make research as one of the main agenda of all discussion.
- Farmers and science concept shall be followed at the farmer's level studies and research.
- MOU shall be made with sericulture culturally developed countries.

### **Financial aspect**

- Sericulture in the long run is not a costly vocation. However, initially while developing physical infrastructures and Human Resource Development some additional investment is required. In view of the long term benefit it provides in terms of employment generation, agriculture commercialization, export item production and its contribution to poverty alleviation it can be said that it is a social investment rather than a development investment. Sericulture development is for the benefit of the small poor farmers' subsidy /support scheme in sericulture and is mainly to create income-generating opportunities at the rural level. A small subsidy/support scheme to sericulture cooperatives, farmers group and entrepreneurs engaged in sericulture in production and postproduction sector, enhances establishment of small sericulture industry to develop export products. It is a cost effective occupation.
- Long term sericulture has been estimated to need NRs1.43 billion investment in 10 years period for full-fledged development to produce exportable products worth 12-13 million US\$.

### **Sericulture saving scheme**

- Support to "Sericulture Savings Scheme" for old age pension for sericulture farmers / cooperatives and small entrepreneurs engaged in production and postproduction of sericulture activities shall be initiated. The members of the scheme shall contribute 10% of their cocoon sale or silk yarn sale or materials sale using Nepali silk yarn income and government shall contribute equal amount as counterpart fund The total the amount shall be deposited in fixed deposit account, on which fixed interest will be earned. The pension support amount shall be paid from the savings under this program
- To this scheme NGO, INGO or development partners and government programs working on sericulture also can support the scheme.

### **Sericulture insurance scheme**

- Crop insurance is a new area in agricultural development sector and its need has been felt for a long time. In this backdrop, to begin with the cocoon insurance scheme involving cooperatives shall be started and the government's share towards premium should be sanctioned through cooperatives.

### **Legal framework**

- Sericulture Act and Regulation, to meet the legal obligation under SPS agreement shall be prepared and executed for the security of reelers, weavers and farmers.
- Steps to provide legal status to technical evidences and parameters standards for initiation of seed certification program should initiated.

### **Monitoring and evaluation**

- Performance based participatory monitoring and evaluation system for the implemented programs and policy execution shall be maintained involving all the stakeholders from field to national level. Monitoring and evaluation will be made effective by developing scientific indicators.

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# **Sericulture scenario in SAARC region – a re-emerging industry for poverty alleviation in Pakistan**

**Attaullah Khan**

Director, Arid Zone Research Institute (PARC), Umerkot, Pakistan

## **Abstract**

Sericulture is a short gestated (40 days) and labor intensive cottage industry which can be helpful to alleviate poverty in the rural areas. In Punjab province of Pakistan, sericulture activities were introduced under Forest Department, Govt. of Punjab since 1975. Chinese, Japanese and F<sub>1</sub> (Korean) silkworm races were fed with Husang China, Japan Early and Chinese Ever green mulberry varieties and were studied under laboratory conditions at Pakistan Forest Institute Peshawar during 2004-05. The interaction for sex ratio and fecundity was significantly high (45% female to male) 527.5 eggs/female were recorded in Chinese race fed with Husang China mulberry variety, and significantly lowest (14.5% female to male) 220 eggs/female as observed in F<sub>1</sub> (Korean) race x Chinese Evergreen mulberry variety. The objectives of this paper are to study the sericulture production structure and the analysis of farm level technical efficiency measures. The results show that most of the farmers involved in this enterprise are illiterate. This industry is further characterized by inappropriate rearing sheds, complete lack of extension service, dependence on government forests for mulberry leaves, facing peak season shortage, supply of poor quality silkworm seed and improper processing and marketing facilities. Labour share more than 70 percent of the total cost of production and however promises reasonably high return on investment. Stochastic production frontier analysis indicates that the sericulture enterprise faces increasing returns on scale. Average technical efficiency is found to be 0.88 with a minimum of 0.37 and a maximum of 0.98 leaving significant scope for improvement in productivity and thus profitability. The results further show that technical efficiency is positively associated with the size of the activity.

## **Introduction**

The practice of raising silkworm is known as sericulture. The discovery of silk production dates to about 2700 B.C. Sericulture is one of the most important cottage industries in a number of countries like China, Japan, India, Korea, Russia, Italy and France. Apart from silk, there are several other by-products from sericulture and moriculture activities e.g. herbal medicine, handmade twigs products, fodder for cattle, for soil preservation. Sericulture development provides opportunities to improve the living standards of people in the rural area in developing countries.

## World Raw Silk Production

The total world raw silk production during 2011 was about 1,31,479 MT. The bulk of world's silk yarn is produced from mulberry silk which accounts for 95% of world silk production. Mulberry sericulture had been successfully used by two of the world's most populous countries i.e. China and India with population of 1.31 billion and 1.132 billion people respectively (World Population Bureau, 2007). The two nations had successfully integrated mulberry sericulture into their agricultural productions. According to 2009 world Mulberry Raw silk Production, China leads with a total silk production of 1,04,000 MT (79.10%) while India stands second with 23,060 MT (17.54 %) in the global silk production.

In Pakistan, sericulture industry has limited growth mainly due to poor quality of mulberry leaves and silk seed. Thus the cultivation of mulberry is one of the most important factors in the production of silkworm eggs, rearing of silkworm cocoons and on the whole in the entire operation of sericulture. The silk worm (*Bombyx mori* L.) is domesticated insect, which feeds exclusively on mulberry leaves to produce raw silk in the form of cocoon. The silkworm has been extensively utilized as model organism in biological studies as well as for economic gains. Commercial rearing of silkworms has been in practice for over 5000 years in different parts of the world (Nagaraju & Goldsmith, 2002) and an estimated 4310 silkworm germplasm strains are being reared worldwide (Goldsmith *et al.*, 2005). The life cycle of silk worm is greatly influenced by environmental stress and nutrition particularly during larval period. Relative humidity (RH) affects all stages of the insect. The revival of sericulture in Pakistan requires the production of good quality silk seed with resistance to diseases and ability to cope with environmental stress. Day to day change in weather during the larval rearing poses great threat to the cocoon crop. The larval growth of silkworm is under direct influence of temperature and humidity. Silk worm larvae spun best quality cocoons at 22°C and 65% RH (Ramachandra *et al.*, 2001; Srivastava *et al.*, 2007; Suresh Kumar *et al.*, 2008). Many sericigenous insect species have been extensively exploited for the extraction of silk protein fibers due to high commercial value. Tropical tasar silkworm *Antheraea mylitta*

Drury is reared in central and eastern parts of India, experiences extreme thermal conditions during its lifecycle (Hansda *et al.*, 2008; Sinha and Srivastava, 2004; Suryanarayana *et al.*, 2005). Forty four ecoraces of *A. mylitta* have been identified with significant phenotypic and behavioral variations (Srivastava *et al.*, 2002 and Srivastava *et al.*, 2004). Tropical tasar silkworms primarily feeds on leaves of Sal (*Shorea robusta*), Asan (*Terminalia tomentosa*) and Arjun (*T. arjuna*), besides many other secondary food plants. Among the ecoraces, Daba is a ruling commercially exploited semi-domesticated ecorace reared in almost all tasar

growing states of India. On the other hand, Laria being a Sal based wild ecorace predominantly exists in the tropical moist deciduous forests of Jharkhand, less amenable to human interference but has good commercial cocoon characters (Suryanarayana and Srivastava, 2005).

### **Historical perspectives of silk industry in the country**

The practice of raising silkworm is known as sericulture. The discovery of silk production dates to about 2700 B.C. Sericulture is one of the most important cottage industries in a number of countries like China, Japan, India, Korea, Russia, Italy and France. Apart from silk, there are several other by-products from sericulture and moriculture activities e.g. herbal medicine, handmade twigs products, fodder for cattle, for soil preservation. As far as the sericulture activities are concerned, it was introduced in the Sub-continent through the “Silk Road” during the Christian era. It was introduced in Azad Jammu and Kashmir in 1951 in the NWFP in 1952, in Balochistan in 1959 and in Sindh in 1976. There are two rearing season i.e., spring and autumn in Pakistan, only one-third of the demand is met through local production with a bigger quantity through annual imports. Sericulture in Pakistan is still an industry of nomads which could not expand on large scale due to a number of reasons among which lack of research and trained personnel is a major factor. Sericulture development provides opportunities to improve the living standards of people in the rural area in developing countries. In Pakistan, sericulture industry has limited growth mainly due to poor quality of mulberry leaves and silk seed. Thus the cultivation of mulberry is one of the most important factors in the production of silkworm eggs, rearing of silkworm cocoons and on the whole in the entire operation of sericulture. Systematic Evaluation of Development projects and programs was conceived and formulated back from 1960s till date by donor agencies to assess the projects performance and impacts. Similarly, Government of the Punjab established a full-fledged Directorate in 2008 to monitor and evaluate ongoing and completed development projects to ensure that all the objectives must be accomplished and standard operating procedures (SOPs) have been met.

### **Current status of sericulture industry**

- a. Type of silkworm :** Chinese, Japanese and F<sub>1</sub> (Korean) silkworm races are available in Pakistan
- b. Raw Silk Production**

**Table 10. Raw Silk Import and export**

<b>Volume and Value of World Raw Silk Import Country</b>	<b>Value Imported (USD Thousand)</b>	<b>Quantity Imported (Tones)</b>	<b>Share in World Imports (%)</b>
India	94,890	3,408	29%
Italy	66,869	2,014	20%
Japan	44,757	1,295	14%
Romania	40,885	1,242	13%
DPR Korea	35,059	1,095	11%
Vietnam	10,645	318	3%
France	6,534	213	2%
Pakistan	4,828	354	1%
Germany	3,333	113	1%
China	2,725	398	1%
Others	15,784	667	6%
Total	326,309	11,117	100%

Source - ITC, calculation based on COMTRADE statistics

### **Employment in sericulture (production, post-harvest, processing)**

In Punjab there are two main regions with a great potential of sericulture i.e. Lahore and Multan. These regions are actively playing a major role in producing raw silk for Pakistan. The farmers are well known about this cottage industry and needed minor trainings for rearing and by products from sericulture and mulberry plants. In Lahore region total beneficiary of sericulture are 781 during the year 2013-14, while in Multan 1274 beneficiaries are on board during 2013-14 (*Re-evaluation Report on Project “Development of sericulture activities in Punjab”* 2014)

### **Constraints in sericulture**

In Pakistan, sericulture industry has limited growth mainly due to poor quality of mulberry leaves and silk seed. Thus the cultivation of mulberry is one of the most important factors in the production of silkworm eggs, rearing of silkworm cocoons and on the whole in the entire operation of sericulture. Illiterate farmers and unavailability of good quality seed are the main reason for low production and failure of the industry. Farmers often depend on local seed which is poor quality and can't tolerate the unfavorable conditions. Furthermore, they sale raw

silk, instead of raw silk if they have skills and make by products from raw silk than farmers can get maximum benefits, which ultimately increases their interest in sericulture.



### **Potentials of sericulture**

A family comprising of 3 to 5 members can rear 2 to 3 packets on average and can earn Rs.30,000/- to Rs.50,000/- in a period of 35 to 40 days in addition to their routine business. The uplift of local sericulture industry will increase the local production of silk and will reduce the silk import which is 111.17 tons per annum with expenditures of Rs.50.000 million every year. As per discussion with key stakeholders it's concluded that the scope of the cottage industry is very bright in Pakistan if it will organized with government, local NGOs and local farmers. The farmers will be trained properly for the management of culture as well as plantation of mulberry plants and nurseries. The females can play a vital role in this industry, besides the sericulture they can develop by products from mulberry plants during the off season.

Consultation has been made with forest department Government of Punjab. Representative of the department said there is a great potential for sericulture in

Pakistan. The farmers can get one crop/year easily but with slightly management by overlapping they can harvest two crops. The completed a project “**Development of Sericulture Activities in Punjab**”. He further said that they have fourteen varieties i.e. local mulberry, Chinese Husang, Japanese Early and late, China evergreen, Atropurporia, Chinese Lun-40, Japanese Hybrid and Korean varieties (exotic and native species of mulberry) at their farm. The mulberry plants can be used for other by products like, baskets, fodder, Shahtoot Jam and Juices and cut cocoon reeling units. Temperature plays a vital role for this industry. Sericulture gives maximum output during spring season in Pakistan. Best temperature for sericulture ranges 20-30<sup>0</sup>C with 60-65 R.H. he further said that the local seed packet is available @ Pak Rs.350/- while imported seed packet are @ Pak Rs.2000/- (20,000 eggs). Farmer get produced 25 kg silk from one packet and that silk can be sold @ Pak Rs.700/kg (17500/harvest). Full grown larvae feed approximately 60 kg leaves/day to molt pupae. At least 200 trees are needed to grow 20,000 larvae. The temperature of lower Sindh ranges 10-35 <sup>0</sup>C during the months of December to April which is suitable for this industry. In Punjab province activity has been carried out in Okara, Sahiwal, Toba Tek Singh, Jhang, Khanewal, Layya and Bahawalpur districts. The beneficiaries farmers were 814 and the activity is to be continued.

In Sindh the activities were carried out at Miani forest Hyderabad, Naukot, Khipro. The drawback of this activity was that the farmers get leaves from government farms and it's very difficult to fulfill the requirement of all farmers through government farms. Now a day the activities have been stopped due to unavoidable circumstances. Mostly land used by sericulture has been leased to local farmers and they removed mulberry plants so the activities are stopped.

Pakistan is not in a position to fulfill the requirement of the local need of silk hence Pakistan imports the silk from china and other countries and paying handsome money to importers. Other than this illegal import from Iran to Pakistan is also reported

Other suggestion is that instead to sale raw silk the further process can be made to develop fine product/handmade cloth as farmers get better price. Farmers will be train for food preparation and preservation as they made shahtoot juice and jam to get maximum out come with a standard taste.

### **Conclusions**

Sericulture is a traditional small scale cottage industry with potential of better commercial opportunities to the rural households. There should be more prospects to strengthen the extension of farmers by providing them the good quality and disease resisted silk seed for improved production of cocoon and raw silk.

Dependency on old and traditional methods of silkworm rearing and climatic factors of effecting silk habitation are the major factors of low productivity of silk cocoon. Farmers must be well trained in process of silk rearing especially building of sheds where the maximum care with timely management is must to get best silk production.

Capacity building through trainings of departmental staff especially officers/researchers for production of pure races of silk seed and silk disease control treatments is useful to improve the silk production in Punjab. Foreign expertise may also be engaged to help out in subsiding the technical drawbacks of sericulture industry.

To improve the production of silk cocoon, farmers are persistent to purchase imported silk seed for good production, as the quality of local seed is not good enough to produce quality cocoon. However, they are not much aware about the climatic dependency of silk rearing. Furthermore, the department should execute the process of silk seed import from advance countries to improve the local research on production of good quality and disease resisted seed and silk on regular basis.

To strengthen the sericulture activities of silk seed rearing and production process in the province, independent and collaborated research is required to be carried out. The department must collaborate with local research institutes, academia and foreign research agencies especially research agencies of China.

To conduct Research & Development for improved quality and quantity of seed, department should also work to develop and produce hybrid types of seed on experimental basis which can be reared in ambient temperature of various locations of Punjab throughout the year or at least twice a year. Advance research may be conducted on the botanical aspects of moriculture development, entomology, disease control, breeding, processing and marketing of end product. To conduct these activities, capacity building of the staff is necessary.

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# **Sericulture scenario in Sri Lanka – a re-emerging industry for poverty alleviation in Sri Lanka**

**Sivapatham Sivakumar**

Provincial Director of Agriculture, Northern Province, Sri Lanka

## **Abstract**

Sericulture is an art of rearing silkworm from the production of silk and bi product. Sericulture as a cottage industry has flourished in many countries. China and India contributes more than 60% of world's annual production of silk. Sericulture has a major role in the employment generation for the rural people. The study has been undertaken to analysis of re – emerging of sericulture industry for poverty alleviation in Sri Lanka. It seems that history of sericulture industry in Sri Lanka, the present status of the usage of silk and silk based products and finally possibilities of re – emerging of sericulture industry in Sri Lanka. In the most region of Sri Lanka, the climatic and other conditions are suitable for the sericulture industry in Sri Lanka. Being a labour intensive rural based industry it offers a qualitative and quantitative change in the poverty alleviation with a creation of employment from unskilled farm labourers to skill workers to all sections rural and the Government should take suitable steps to re – introduce the sericulture industry in Sri Lanka that improve the standard of livings and reduce the poverty alleviation in Sri Lanka.

**Key words:** sericulture, Sri Lanka, possibilities

## **Introduction**

Sericulture is derived from the word *Su* and *Si* which means silk in Chinese. In sericulture *Seri* means *silk* and *culture* means *rearing*. Therefore, sericulture is an art of rearing silkworm for the production of silk and other byproducts. Sericulture as a cottage industry has flourished in Brazil, China, France, India, Italy, Japan, Korea, and Russia. China and India contributes more than 60% of world's annual production of silk.

Sericulture provides regular employment to the farmers which ultimately check the migration of population from rural areas to urban areas, thereby minimizing the population and pollution in urban areas by arresting the growth of slums in urban areas. Sericulture has a major role in the employment generation for the rural people and Sericulture is a women-friendly occupation. Female participate in sericulture activities reduces migration of rural people. So, sericulture is an ideal occupation for the weaker sections of society. Hence, sericulture can be considered as an essential tool for the rural development for improving the

standard of living of human population of village level. Sericulture is an eco – friendly industry. It exhibits harmony between mankind and nature and show that how natural resources have been used by villages without disturbing the ecology.

Silk being an exclusive fiber and popular as “Queen of Textiles”, the money moves from the rich and urban market to the poor and rural producers. As the developed countries retreating from the silk production in view of increased cost of human power, silk production provides hope and opportunities to the developing countries.

This country paper attempts to describe the status of sericulture in Sri Lanka in the past with special reference to the use of silk based products, demand for the produce, import and export of the produce, favorable factors for mulberry cultivation and silkworms rearing, cocoon processing, employment opportunities generated, income generated, and religious sentiments for collapse of the sericulture. It is also attempted to describe the potentials for revival of sericulture and expansion of it in Sri Lanka with special reference to the demand for the silk products in future, physical resources availability, human resource availability, possibilities for modernization of processing, financial feasibility and social acceptability.

### **Historical perspective of Silk Industry in Sri Lanka**

The first attempt to establish the Sericulture Industry in Sri Lanka was made in the early seventeenth century. The Government opened 16 sericulture farms in widely different areas of the country, extending from hot – dry regions to warm – wet and cool – wet areas. Foreign assistance was received in the form of expertise for the development of these farms. Further attempt was made in the 1900's in the Kandy area. In the period of 1943-1956 a serious attempt was made by the Department of Cottage Industries to establish a special unit to deal with Sericulture within the Department of Minor Export Crops, envisaging the subsequent establishment of a statutory authority with responsibility for Sericulture Development.

In 1946, sericulture was established in Puttur and Atchuvvely areas in Jaffna district of Sri Lanka. During this period Jaffna local variety of mulberry plant was cultivated and *Bombyx mori* silkworms were reared. At that time reeling unit was also available in this area. They produced silk yarn. In 1958, this industry was collapsed due to the religious sentiments. Under the five year plan of 1971- 1976, another attempt was made to revive the industry but expected results were not achieved.

In 1976 sericulture industry in Sri Lanka came under a separate authority, The Silk and Allied Products Development Authority known as SAPDA. The functions of the SAPDA were to promote and develop sericulture and to regulate

the industry in Sri Lanka. SAPDA was the only raw silk producer in the country, with four farms and several clusters of small holdings which belonged to the farmers in the rural areas. SAPDA had established a filature about 125 kilometers from Colombo.

The Government of Sri Lanka noted repeatedly the great potential for the industry in view of favorable agro climatic factors and the plentiful availability of rural labour at low cost, with a relatively high level of education and literacy. The tropical climate permitted sericulture practiced throughout the year with continuous growth of mulberry enabling multiple cropping and year-round production of cocoon.

A Law (Law No. 30 of 1975) to provide for the development and regulation of sericulture in Sri Lanka was developed to establish a public authority known as the Silk and Allied products Development Authority and to regulate its powers and functions and to make provision for matters connected therewith or incidental thereto on 28<sup>th</sup> July, 1975. This law consists four main parts as follows:

1. Part I : Establishment of the Silk and Allied Products Development Authority
2. Part II: Functions and Powers of the Authority
3. Part III: Finance and Accounts of the Authority
4. Part IV: General

### **Mulberry cultivation and silkworm rearing**

There were local varieties of mulberry and Kanva 2 from India appeared to be more suitable and accounts for a large part of the mulberry acreage. Local varieties were drought resistant and had good yield potential. The national silkworm breeding stock comprised of 46 pure lines, including multivoltine, bivoltine and univoltine races introduced from Japan, Korea and India. The stocks maintained by the silkworm breeding centre at Nillambe under SAPDA. The breeding was carried out successfully. The country was self-sufficient in the supply of silkworm eggs. The workers of the SAPDA quickly learned the techniques of mulberry cultivation and silkworm rearing, achieved high levels of productivity.

Stifling and reeling facilities were installed and the weaving of fabrics carried out on handlooms. Thus a fully integrated operation came into existence although it was on a small scale. The UNDP / FAO project which started in 1983 provided the services of consultants and skilled workers. In addition, a great deal of equipment was supplied. Spectacular progress was made during the period 1982 – 1986 as is shown by the following increases.

**Table 11. Spectacular progress from 1982 – 1986**

Activities	Increasing percentage (%)
Production of green cocoons	433
Productivity per box of silkworm eggs	288
Cocoon productivity per acre of mulberry	192
Raw silk production	372
Silk fabric production	255

Source: *International Congress on Tropical Sericulture Practices*

In the period of 1981, Jaffna local variety and kanva 2 Indian varieties were cultivated in an extent of 25 ac at Vaddakkachchi farm and 10 ac at Iranaimadu in Kilinochchi district. At that time silkworms were reared and green cocoons were produced. Due to the administrative struggle, this industry was closed in Kilinochchi district in the period of 1986. Figure 1 show the Mulberry cultivation in Vaddakkachchi farm at 1984 period.



**Figure 20. Mulberry cultivation in Vaddakkachchi farm at 1984**

At the same time mulberry cultivation and silkworms rearing units were functioned as follows:

**Table 12. Places and extent of some Government farms functioned earlier**

Places	Approximate Extent (ac)
Pallekale	250
Vaddakkachchi	25
Iranaimadu	10
Korana	10
Galaka	>100
Battigama (Mattara district)	-

Source: *Personal communication with K. Thangarajasingham*

### **Machineries used in the past**

Green cocoons from various parts of the country were brought to the filature for drying and reeling. Cocoon sorting was done manually by holding cocoons against the light. Three types of dryers were used for cocoon drying. Once was a stream dryer used for drying floss silk. A second was an Indian – manufactured electric dryer with a maximum capacity of 100 kilograms which was used for drying small lots of green cocoons. About eight hours was needed for drying to be completed and the temperature was regulated at two – hour intervals for maximum results. For larger quantities of cocoons, the third type was a hot air dryer used with a conveyor belt for carrying a maximum load of 600 kilograms. The temperature was also regulated manually and drying was usually completed after six and a half hours. Generally, the temperature at the feeding end was set at 120°C, while it was about 70°C at the delivery end.

The Japanese and Korean machines were used for cooking cocoons, for multi - end reeling and rereeling of 21 denier yarn. Problems were experienced in the automatic feeding and brushing of cocoons. Both operations were done manually. One multi - end and three semi – automatic machines, as well as two reeling machines, were in operation. A separate set of machineries with a capacity of about two kilograms per day was available for making dupion yarn. The machine had no drying facilities and the yarn was dried in the open air under shade.

One problem was the use of bad quality cocoons to make floss silk. This silk was used in cottage industries for making yuki yarn while the rest was exported. Skeining was done manually with the help of a simple mechanism.

Since Sri Lanka was a small producer of silk producing mainly for the domestic market, no booking or bailing took place. Packs of approximately one kilogram were made and stored in polystyrene bags. After the silk yarn was twisted, five – kilogram bags were made and sold. The twisted yarn was used for weaving in the factory and the rest was sold.

The Government farms formed the backbone of the sericulture industry, it realized that for the development of sericulture, smallholder participation on a large scale and extension services were necessary. The role of the Government farms was very important. For instance, they had shown where mulberry cultivation and silkworm rearing could be done best of all and where they were successful under different conditions such as:

1. According to the experience at a farm in the dry – hot area the cultivation of mulberry and silkworm rearing were possible provided there was irrigation.
2. One of the best farms was in a coconut estate thus showing the prospects of crop diversification and better utilization of coconut land.
3. Mulberry cultivation in degraded tea lands in the mid – country and its use for soil conservation form the basis of smallholder operations.

There were smallholder projects. Some of the farmers produced excellent results in their early attempts at silkworm rearing. The productivity per box of silkworm eggs had varied from 22 to 41 kilograms. In 1986 the average productivity per box of silkworm eggs was 26 kilograms for all the farms. Some farms had a productivity of over 30 kilograms. One farm recorded a productivity of 40 kilograms. SAPDA formulated a five year corporate plan in cooperation with international agencies, banks and non – governmental organizations. It envisaged an increase in mulberry acreage from 975 acres to 5,225 acres in 1995. This was to be achieved through the implementation of a small farmer projects under an integrated rural development project and under the guidance of local authorities such as the Agricultural Development Authority. Participation of private sector entrepreneurship was also sought.

From 1988 to 1992 the production of the green cocoons was 195,385 kilograms, while that for raw silk and twisted yarn was 12,640 kilograms and 10,986 kilograms respectively for the same period. A total of 47,447 meters of silk material was also produced.

### **By product from sericulture industry**

Wijayasinghe and Rajaguru (1977) conducted tests to determine the effects of silkworm pupae (SWP) as a replacement for various levels of the local fishmeal on the performance of broiler starters, broiler finishers and laying hens. They used a dry, mechanical and manual method for removing the chitinous exoskeleton, in order to avoid the loss of soluble nutrients that can occur with wet methods. The pupal residue was not defatted although the pupal oil contains nearly 75% unsaturated fatty acids, which imparts a peculiar odor, and some previous investigators have reported that the flesh and eggs of animals fed undefatted SWP have an unpleasant odor. Others have not observed this effect and it was not observed in this investigation. The authors note that the pupal oil, with its high unsaturated fatty acid content has a number of valuable industrial uses, and there are a number of patented biological and chemical methods for deodorizing the pupae. They also note that a large quantity of SWP can be expected to be available as a byproduct of the rapidly expanding sericulture industry in Sri Lanka.

### **Weaving centers**

Mulberry cultivation and silkworm rearing were carried out efficiently by Sri Lankan workers. Handloom weaving of different silk fabrics had made good progress. New silk based cottage industries were introduced with success. SAPDA had more than 30 handlooms used for weaving sarees, dress materials and other items such as furnishing fabrics, curtain materials, etc. During this period, many weaving centers were established throughout the country. Some of them are;

- Kundan MAS Pvt. Ltd.
- Wellavatta weaving yarn
- Vasanthapuram silk center, Neeraviyadi, Jaffna

There were over 10,000 handloom centers, known as ‘textile schools’ all over Sri Lanka in the 1970s. Each of these centers had at least 20 or 30 machines. In addition to these centers, households too joined this industry. In later years these industries collapsed completely. The power-loom industry too was in a stage of near collapse. Earlier the Textile Industries Department and also some cooperatives had established a power-loom industrial center in every district. Subsequently, all of them had to be closed down.

### **Current status of sericulture industry**

Globally, silk is produced in more than 20 countries across the world. While the major producers are in Asia, sericulture industries have also been established in Brazil, Bulgaria, Egypt and Madagascar as well. It is a highly employment intensive industry. The major silk producing countries in the world are; China, India, Uzbekistan, Brazil, Japan, Republic of Korea, Thailand, Vietnam, DPR Korea, Iran, etc. Few other countries are also engaged in the production of cocoons and raw silk in negligible quantities; Kenya, Botswana, Nigeria, Zambia, Zimbabwe, Bangladesh, Colombia, Egypt, Japan, Nepal, Bulgaria, Turkey, Uganda, Malaysia, Romania, Bolivia, etc.

In China alone, about one million workers are employed in the silk sector. China, India, Brazil, Thailand and Uzbekistan are the leading producers of silk in the world. Global production of raw silk has been on a decline; from 128870 MT in 2005, world raw silk production has fallen to 126995 MT in 2009. Since 2005, the world trade of silk and silk products has also witnessed sluggish growth.

14 silk producing countries are situated in Asian region. The contribution of Asian region is 90%. China, India, Japan, Korea are the top silk trading centers. Year 1995 witnessed world’s highest production of raw silk to the extent of 1,05,438 tonnes and only after 1970, china surpassed Japan and became No.1 in the world silk production.

As may be seen from the above world raw silk production was about 1, 31,479 MT in 2011. China leads the world with silk production of 1, 04,000 MT or 79.1% of the produce. India is the second largest producer of silk in the world and has 17.5% share in global raw silk production. All the countries except China and India have been witnessing a declining trend in raw silk production in the last two decades. The major silk consumers of the world are; USA, Italy, Japan, India, France, China, United Kingdom, Switzerland, Germany, UAE, Korea, Viet Nam, etc.

**Table 13. Global Silk Production (Mt)**

<b>Country</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>
Bangladesh						24
Brazil	1177	811	770	558	614	550
Bulgaria	7.5	6.3	9.4	6	8.5	8.5
China	98620	84000	115000	104000	126000	130000
Colombia	0.6	0.6	0.6	0.6	0.6	0.6
Egypt	3	3	0.3	0.7	0.7	0.7
India	18370	19690	21005	23060	23679	26538
Indonesia	37	19	20	20	20	16
Iran	180	82	75	120	123	123
Japan	96	72	54	42	30	30
North Korea	-	-	-	300	300	300
South Korea	3	3	3	3	1.5	1.6
Philippines	1	1	1	1	0.89	1
Syria	0.4	0.6	0.6	0.5	0.5	0.7
Thailand	1100	665	655	655	655	680
Tunisia	0.08	0.04	0.12	3	3.95	4
Turkey	15	20	18	22	22	25
Uzbekistan	770.5	780	940	940	940	980
Vietnam	-	-	550	500	450	475
Madagascar	15	16	16	16	18	18
<b>Total</b>	<b>120396</b>	<b>106170</b>	<b>139100</b>	<b>129662</b>	<b>152846</b>	<b>159776</b>

Source: *International Sericultural Commission*

Southern Asia comprises the countries of Afghanistan, Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, and Sri Lanka. The earliest evidence for the use of silk fibre for cordage in South Asia comes from the sites of the Indus Civilization dating to between 2450- 2200 BC. The silk moth species being utilized in the past are now commonly known as Muga, Tussar and Eri.

In Sri Lanka, sericulture activities were carried out successfully in the past. But now this industry was totally collapsed due to the religious believe. But Sri Lanka has possibilities and potentialities to re – emerge the sericulture industry in our region.



### **Type of Silkworm**

Tharanga Aluthwattha (2013) observed that the silk moth used in Sri Lanka is the domesticated, popular mulberry moth *Bombix mori*. *Antheraea cingalesa* and *Cricula ceylonica* are widely used in India to produce native and unique “yellow” silk and “wild Muga” silk. These two species are endemic to the island. But no information was found about the use of other species in silk industry of the island. The presence of muga silkworm *Antheraea assamensis* in island is doubtful and needs confirmation.

### **Type of mulberry plant**

There were many local varieties of mulberry and Kanva 2 from India cultivated for silkworm rearing. These varieties appeared to be more suitable and accounts for a large part of the mulberry acreage. Local varieties were drought resistant and had good yield potential. Now many local varieties are found in homestead level throughout the country. Fig 3 shows the Jaffna local variety of mulberry plant in homestead level.



**Figure 21. Jaffna local variety of mulberry plant**

### **Raw Silk Import and Export**

Historically, Sri Lanka has **traded textile** with nations like India, China and Middle Eastern countries. Sri Lanka imports the silk from other countries and exports silk based by products to other countries. Following tables show the import and export of value of silk based products of Sri Lanka yearly.

**Table 14. Sri Lanka Imports by Product in US Dollars - Silk – Yearly**

Products	2005	2006	2007	2008	2009	2010	2011
Silkworm cocoon suitable for reeling				176	22,308		11,631
Raw silk (not thrown)		1,805				122,713	147,128
Silk waste	3,089	15,345	3,925				
Silk yarn (other than yarn spun from silk waste) not put up for retail sale	114,457	90,165	119,695	25,636	29,736	133,329	24,916
Yarn spun from silk waste, not put up for retail sale	15	1,965	4,803				46,796
Silk yarn and yarn spun from silk waste, put up for retail sale; silk -worm	26,311	22,603	29,147	20,084	325	1,592	260,927
Woven fabrics of silk or of silk waste	4,248,045	3,696,921	7,474,586	8,509,300	5,359,748	4,561,603	9,066,919
<b>Total</b>	<b>4,391,917</b>	<b>3,828,804</b>	<b>7,632,156</b>	<b>8,555,196</b>	<b>5,412,117</b>	<b>4,819,237</b>	<b>9,558,317</b>

Source: *United Nations Commodity Trade Statistics Database*  
<http://www.indexmundi.com/trade/imports/?country=lk&chapter=50>

**Table 15. Sri Lanka Yearly Imports in US Dollars - Raw silk (not thrown)**

Year	Trade Value	Weight (kg)	Quantity
2006	1,805	212	212
2010	122,713	7,600	7,600
2011	147,128	12,264	12,264

Source: *United Nations Commodity Trade Statistics Database*  
<http://www.indexmundi.com/trade/imports/?country=lk&commodity=500200>

**Table 16. Sri Lanka Exports by Product in US Dollars - Silk**

Products	2005	2006	2007	2008	2009	2010	2011
Silk waste	5,077						
Silk yarn (other than yarn spun from silk waste) not put up for retail sale.....						233,419	286,447
Yarn spun from silk waste, not put up for retail sale				1,929			
Silk yarn (other than yarn spun from silk waste) put up for retail sale; silkworm.....	217			25,962			
Woven fabrics of silk or of silk waste	40,966	2,348	1,918	38,327	9,021	149	9,586
<b>Total</b>	<b>46,260</b>	<b>2,348</b>	<b>1,918</b>	<b>66,218</b>	<b>9,021</b>	<b>233,568</b>	<b>296,033</b>

**Source:** *United Nations Commodity Trade Statistics Database*

<http://www.indexmundi.com/trade/exports/?country=lk&chapter=50>

Now the silk based industries are now battling main problem that is the high cost of silk. “If bring down the cost of silk, then local people would be able to purchase silk products and may be able to export silk products at a lower price too. But the government’s assistance is needed for this solution.

### **Scenario of silk consumption**

#### **World**

Silk has a miniscule percentage of the global textile fibre market-less than 0.2%. This figure, however, is misleading, since the actual trading value of silk and silk products is much more impressive. This is a multibillion dollar trade; with a unit price for raw silk roughly twenty times that of raw cotton. To give an idea of the value, however, the annual turnover of the China National Silk Import and Export Corporation alone is US\$ 2-2.5 billion in 1999. Unlike some other textiles, silk-wearing traditions and demand go back a long way. A good example is India, where the local demand greatly exceeds supply (and hampers export growth). India has thus become the largest importer of raw silk, despite the fact that it is

now the second largest producer. Some other silk producers are also experiencing fast-growing local demand, such as China, where consumers are increasingly able to afford the lower price range silk products. This pattern is also expected to repeat itself in Vietnam.

## **Sri Lanka**

There is huge demand for the products of silk in Sri Lanka due to the fact that members of 3 major ethnicity of the country are having the habit of using silk. 74 % Singhalese, 12% Tamils, 8% Muslims, 5% Moors are living in Sri Lanka.

### **Textiles in Sri Lanka**

#### **Handlooms textile industry**

The handloom textile industry is one of the country's oldest traditional crafts. The elegance of locally handcrafted sarees, the vibrancy of painstakingly woven soft toys, the innovative colour combinations of upholstery fabrics: these are part and parcel of Sri Lanka's centuries old **handloom textile industry**. The industry has helped showcase the undying creativity of generations of Sri Lankans taking them to the international arena. The mix of manufacturers includes leading **handloom weaving manufacturers** as well as small scale producers. With the help of factories, some small scale weavers have been given an opportunity to showcase their talents and penetrate international markets. Leading producers have not only found success but also present their wares to tourists to Sri Lanka, which has always resulted in an excellent response.

A range of designs and colours are on offer; individual and innovative designs, craftsmanship, colour combination and patterns are handed down from generation to generation. These items are designed for niche markets where handmade products of high value are preferred. **Sri Lankan handloom producers** are capable of supplying numerous products to such markets in Italy, Germany, France, UK, Norway, Netherlands and Maldives, which are some of **the largest buyers for Sri Lankan handloom textile products**. Awareness of modern design trends, combined with traditional craftsmanship and the influx of new processing techniques, **Sri Lankan handlooms** have been given a new life. The industry has gained a dominant identity and a foothold in the competitive international market. Though **handloom weaving** is a skilled profession, training facilities and centres are already available in Sri Lanka. As an added advantage, trainees do not require prerequisites. Countries are looking for environmental friendly, handmade products made with sustainable supply chains. Handloom products are completely sustainable and use eco-friendly raw material or recycled material with minimal environmental pollution. Thus, there is a great opportunity for the **Sri Lankan handloom industry** to flourish. Further, development of the

industry would reduce the flow of imported material to the local market and save valuable foreign exchange.



**Figure 22. One of the handloom in Jaffna**



**Figure 23. Handloom products in Sri Lanka**

**Table 17. Sri Lanka Yearly imports in US Dollars – Powerlooms for weaving fabrics of a width not > 30cm**

Year	Trade Value (\$)	Weight (kg)	Quantity
2005	957,314	142,578	73
2006	881,821	131,335	412
2007	885,759	121,736	39
2008	577,377	72,761	7,031
2009	143,442	12,786	27
2010	68,478	7,625	36
2011	529,852	51,006	10,224

**Source:** *United Nations Commodity Trade Statistics Database*

**Table 18. Sri Lanka Exports by Product Textiles and Textile Articles  
(Million US Dollars)**

<b>Products</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Silk	0.046	0.002	0.002	0.066	0.009	0.234	0.296
Wool, fine or coarse animal hair, horse hair yarn and woven fabric	0.117	0.022	0.019	0.065	0.043	0.005	0.027
Cotton	18.070	22.921	22.163	16.727	19.236	16.597	26.188
Other vegetable textile fibers, paper yarn and woven fabric of paper yarn	48.353	54.810	26.187	4.404	3.692	3.725	5.099
Man made filaments	2.131	2.628	5.138	6.518	5.126	6.603	6.077
Man made staple fibers	23.593	26.316	24.907	23.417	20.262	26.278	29.583
Wadding, felt and non – wovens: special yarns, twine, cordage, ropes and cabl.....	13.560	13.652	14.580	17.056	15.049	18.716	24.004
Carpets and other textile floor coverings	7.643	12.733	9.592	7.492	4.141	5.347	6.617
Special woven fabrics: tufted textile fabrics: lace, tapestries, trimmings..	13.811	18.234	15.650	14.712	15.441	25.006	23.504
Impregnated, coated, covered or laminated textile fabrics	3.408	3.247	3.601	3.273	2.405	3.982	6.688
Knitted or crocheted fabrics	0.565	0.329	0.181	0.358	0.091	0.008	0.038
Articles of apparel and clothing accessories, knitted or crocheted	1115.816	1344.104	1536.483	1668.928	1571.650	1693.491	2104.548
Articles of apparel and clothing accessories not knitted or crocheted	1625.482	1561.405	1589.693	1606.314	1538.147	1612.070	1873.721
Other made up textile articles, sets worn clothing and worn textile article.	36.263	39.090	39.269	43.467	30.928	39.337	42.225
<b>Total</b>	<b>2908.859</b>	<b>3099.495</b>	<b>3287.465</b>	<b>3412.798</b>	<b>3226.218</b>	<b>3451.397</b>	<b>4148.616</b>

**Source:** *United Nations Commodity Trade Statistics Database*

The table 8 sets 'Silk-worm cocoons suitable for reeling, import weight (kg)' for Sri Lanka contains data from the year 1991 until 2011.

**Table 19. Silkworm cocoons suitable for reeling, import weight (kg)**

Year	Value
2011	492
2009	312
2008	4
1994	0
1993	0
1992	0
1991	1

**Source:** *United Nations Commodity Trade Statistics Database*

<http://www.factfish.com/statistic-country/sri+lanka/silk-worm+cocoons+suitable+for+reeling,+import+weight>

### **Constraints in sericulture**

There are a lot of risks that are noticeable in the development of silk industries. Among them insufficient patronization is main. Lack of enough technical and financial assistance, lack of proper management, bureaucratic complexity government cannot help this industry. Financial problems of the entrepreneurs are also a major problem of silk industries. Insufficient raw materials and import based raw materials increase the risk very much. There are also many other risks at the silk industries slowdown, shutdown of traditional silk production centers, international political unrest, especially international terrorism, slump in economic development resulting in low economic standards of people, inability to obtain export orders, poor quality of silk products, transaction and fluctuating exchange rate risk are few.

In Sri Lanka, sericulture industries faced many difficulties. In addition, re – emerging sericulture country will face many problems. The list of issues follows the main links in the silk production sector.

Development of agro – ecological – specific varieties of mulberry plant is questions. Sri Lanka has many local traditional varieties of mulberry plants. Now a days many hybrid varieties are available in the world. The finding of suitable high yielding varieties for various agro – ecological region in Sri Lanka is very much important.

The selection and adaptation of suitable silkworm breeds for various climatic conditions is very much important. Because Sri Lanka has various climatic ranges from warmer to cooler climate within the country. Therefore the selection of silkworm breed is very much important. Multiplication of silkworm breeds specially suited to local breeding and rearing conditions also very much important.

Availability of good quality seed cocoon, more efficient cocoon drying and reeling techniques is the main factor in the sericulture industry. Techniques of reeling, twisting and weaving processing are also important in the sericulture industry. Ensure the adequate domestic production of silk in desired quantity and quality is the main concern in the sericulture industry. Growers of mulberry plants, reelers, twisters and other related entrepreneurs who are engaged in the processing should be financially supported to initiate the industry by giving the loans by banks and assistance from government and non – governmental organizations.

Re – emerging sericulture country Sri Lanka is constrained by lack of sufficient research and development systems, which are costly and time - consuming to build. Their emerging technical institutions need sufficient numbers of qualified specialists.

Highly qualified personnel in sericulture are needed to build up the sericulture industry in Sri Lanka. Several advanced countries in sericulture will support or award graduate and post – graduate scholarships programmes in sericulture to candidate from Sri Lanka. The extension system should be strengthened to train the technical personnel with medium and low – level skills in the country.

Another category is organizational and management problems. Organize the supply of inputs, organize the producers communities, arrange for collection and processing of the cocoon harvest and arrange the shape of marketing systems are the main factors which have to be considered in re – emerging sericulture in Sri Lanka.

Other issue is closely related to the price structures that should ensure incentives to the primary producers of mulberry plant growers, reelers and twisters. The regulation of market prices for raw silk and the construction of government intervention should be regularly implemented in future.

Major limiting factor of expand the silk production is the importation of silk based product from other countries in remarkably low price as well as high quality. Therefore Government has to implement the special tariff regulations in the importation of silk based product.

### **Sericulture in Sri Lanka**

Sri Lanka is an island off the south – eastern cost shores of India, 880 km north of the equator, in the Indian Ocean. It lies between 5° 55' and 9° 55' north of the



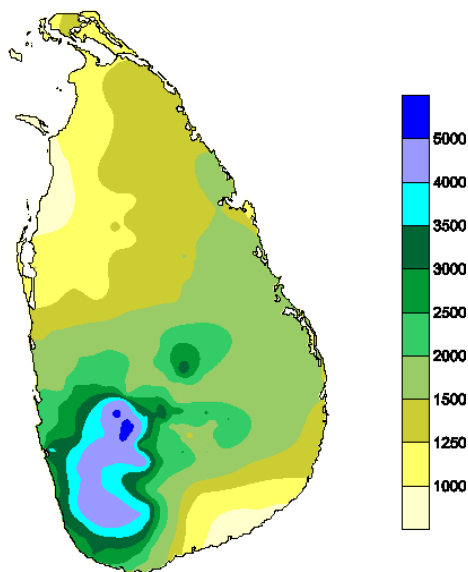
equator and between the eastern longitudes 79° 42' and 81° 53'. Sri Lanka is mainly an agricultural country. The chief crop is rice with which the country is almost self sufficient. Tea, rubber and coconut are also important agricultural crops, with tea being a major foreign exchange earner. In addition, other crops of importance are cocoa and spices such as cinnamon, cardamom, nutmeg, pepper and cloves. Fruit and vegetables, native to both tropical and temperate regions, grow well in Sri Lanka. Sri Lanka is also a major exporter of precious and semi-precious stones. Many factors determine the possibilities of re – emerging of sericulture industry in Sri Lanka. Some of them are discussed below;

### **Climatic conditions**

Climate is the sum of atmospheric elements (and their variations), solar radiation, temperature, humidity, clouds and precipitation (type, frequency, and amount), atmospheric pressure, and wind (speed and direction). Due to the location of Sri Lanka, within the tropics between 5° 55' to 9° 51' North latitude and between 79° 42' to 81° 53' East longitude, the climate of the island could be characterized as tropical.

### **Rainfall**

Rainfall in Sri Lanka has multiple origins. Monsoonal, Convective and orographic rain accounts for a major share of the annual rainfall. The mean annual rainfall varies from under 900mm in the driest parts (southeastern and northwestern) to over 5000mm in the wettest parts (western slopes of the central highlands). (Fig. 1).



**Figure 24.** Annual Rainfall in Sri Lanka

Rainfall distribution in Sri Lanka has traditionally been generalized in to three climatic zone in terms of “Wet Zone” in the southwestern region including central hill country, and “Dry Zone” covering predominantly, northern and eastern part of the country, being separated by an “Intermediate zone,” skirting the central hills except in the south and the west. In differentiating aforesaid three climatic zones, land use, forestry, rainfall and soils have been widely used. The Wet zone receives relatively high mean annual rainfall over 2,500 mm without pronounced dry periods. The Dry zone receives a mean annual rainfall of less than 1,750 mm with a distinct dry season from May to September. The Intermediate zone receives a mean annual rainfall between 1,750 to 2,500 mm with a short and less prominent dry season.

### **Rainfall requirement for sericulture**

Mulberry can be grown in a rainfall range of 600mm to 2500mm. Under low rainfall conditions, the growth is limited and requires supplemental irrigation. On an average, 50mm once in 10 days is considered ideal for mulberry.

### **Temperature**

#### **Temperature in Sri Lanka**

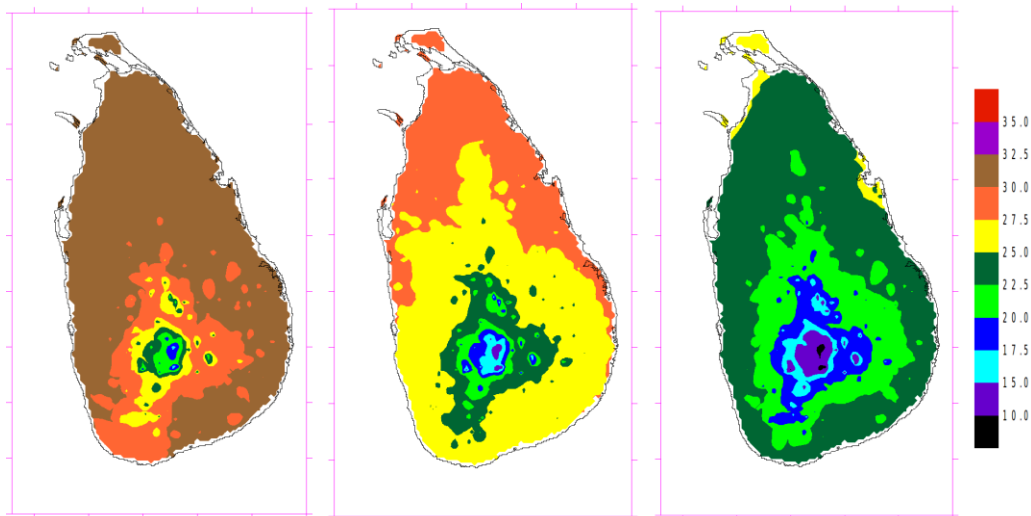
Temperature conditions in Sri Lanka are also characterized by a significant temperature decrease in the central highlands according to the vertical lapse rate of temperature, approximately around 5-6°C for every 1,000 m rise in elevation. However, descending southwest monsoon winds over the central hills towards lee side get warmer adiabatically causing ambient temperature be increased along with decreased humidity. Hence, in this region, fall of temperature with rising altitude is not very distinct compared to the same elevations of the other side of the central hills, Wet zone.

Regional differences observed in air temperature over Sri Lanka are mainly due to altitude, rather than to latitude. The mean monthly temperature differs slightly depending on the seasonal movement of the sun, with some modified influence caused by rainfall. The mean annual temperature in Sri Lanka manifests largely homogeneous temperatures in the low lands and rapidly decreasing temperatures in the highlands.

As low temperature is an important climatic factor affecting plant growth in the Wet and Intermediate zones of Sri Lanka, a sub-division based on the altitude takes into account the temperature limitations in these two climatic regions. In this delineation, the Low- country is demarcated as the land below 300 m in elevation and the Mid-country with elevation between 300 - 900 m while the Up-country is the land above 900 m elevation. Both Wet and Intermediate zones spread across all three categories of elevation while the Dry zone is confined to

the Low-country resulting seven agro-climatic zones covering the entire island. There is a considerable variation of temperature across these agro-climatic zones. For example, average temperature in the coastal Wet zone is 27 °C and it decreases to about 20 °C in the mid country and further dropping to 13 - 16 °C in the montane areas of the Up country. The entire Dry zone which consists of lowland plains, except for a few isolated hills, has a mean annual temperature of 30 °C, although maximum temperature may even exceed 37 °C occasionally. In general, the seasonal variation of temperature throughout the island is minor, but there is a general tendency for higher temperatures during the period of March to October while December and January are cooler when temperatures at high altitudes may even drop to around zero at night.

In the lowlands, up to and altitude of 100 m to 150 m, the mean annual temperature varies between 26.5°C to 28.5°C, with an annual temperature of 27.5°C. In the highlands, the temperature falls quickly as the altitude increases. The mean annual temperature of Nuwaraeliya, at 1800 m sea level, is 15.9°C. The coldest month with respect to mean monthly temperature is generally January, and the warmest months are April and August. The mean annual temperature varies from 27°C in the coastal lowlands to 16°C at Nuwara Eliya, in the central highlands (1900m above mean sea level) (Fig 2). This relatively unique feature manifesting as sunny beaches to rain forests inland is a tourist attraction.



**Figure 25. Average Annual Temperatures**

### **Temperature requirement for sericulture**

For the optimum growth of mulberry and good sprouting of the buds, the mean atmospheric temperature should be in the range of 13°C to 37.7°C. The ideal temperature should be between 24 and 28°C. Temperature plays a vital role on the

growth of the silkworms. As silkworms are cold-blooded animals, temperature will have a direct effect on various physiological activities. In general, the early instar larvae are resistant to high temperature which also helps in improving survival rate and cocoon characters. The temperature has a direct correlation with the growth of silkworms; wide fluctuation of temperature is harmful to the development of silkworm. Rise in temperature increases various physiological functions and with a fall in temperature, the physiological activities are decreases. Increased temperature during silkworm rearing particularly in late instars accelerates larval growth and shortens the larval period. On the other hand, at low temperature, the growth is slow and larval period is prolonged. The optimum temperature for normal growth of silkworms is between 20°C and 28°C and the desirable temperature for maximum productivity ranges from 23°C to 28°C. Temperature above 30°C directly affects the health of the worm. If the temperature is below 20°C all the physiological activities are retarded, especially in early instars; as a result, worms become too weak and susceptible to various diseases. The temperature requirements during the early instars (I, II, III) are high and the worms feed actively, grow very vigorously, and lead to high growth rate. Such vigorous worms can withstand better even at adverse conditions in later instars.

### **Relative humidity in Sri Lanka**

Between December and March, monsoon winds come from the northeast, bringing moisture from the Bay of Bengal. Humidity is typically higher in the southwest and the Central Highlands and depends on the seasonal patterns of rainfall. In the coastal areas such Colombo experience daytime humidity above 70% all year round, rising to almost 90% during the monsoon season in June. Dry zone experiences a daytime low of 60% during the monsoon month of March, but a high of 79% during the November and December rains. In the highlands, Kandy's daytime humidity usually ranges between 70% and 79%.

### **Relative humidity requirement for sericulture**

For the optimum growth of mulberry, the ideal temperature should be between 24 and 28°C with the relative humidity of 65 to 80 percent and sun shine duration of 5 to 12 hours per day.

Humidity plays a vital role in silkworm rearing and its role is both direct and indirect. The combined effect of both temperature and humidity largely determines the satisfactory growth of the silkworms and production of good-quality cocoons. It directly influences the physiological functions of the silkworm. The young-age silkworms can withstand to high humidity conditions than later-age worms and under such condition, the growth of worm is vigorous.

Humidity also indirectly influences the rate of withering of the leaves in the silkworms rearing beds. Under dry conditions especially winter and summer the leaves wither very fast and consumption by larvae will be less. This affects growth of the larvae and results in wastage of leaf in the rearing bed. Retarded growth of young larvae makes them weak and susceptible to diseases. Like temperature, humidity also fluctuates widely not only from season to season but also within the day itself. Therefore, it is necessary for the silkworm rearers to regulate it for their successful crop. For this purpose, wax coated (paraffin) paper is used to cover the rearing beds during young-age rearing to raise humidity and to avoid leaf dryness. Otherwise, wet foam rubber pads or paper pads soaked in water can also be used to increase humidity in the rearing beds. Rich farmers can use humidifier with humidistat to regulate humidity in the rearing room. However, it is important to lower humidity to 70 percent or below during the moulting time in each instar to facilitate uniform and good moulting. Water forms a large proportion of insect tissues and survival depends on the ability to maintain and to balance water in the body.

### Soil condition in Sri Lanka

Sri Lanka has a wide diversity of soil types. This diversity is chiefly due to climate and topographic factors. The soils of Sri Lanka have been classified at great group level for the whole country and series level information are available for some parts of the country. Table 9 shows the important great soil groups of Sri Lanka.

**Table 20. Important great soil groups of Sri Lanka with equivalent great soil groups of Soil Taxonomy**

Soil order	Sub – order	Great Soil Group	Great Soil Groups in Sri Lanka
Alfisol	Ustalfs	Rhodustalfs	Reddish Brown Earths
		Haplustalfs	Non-Calcic Brown soils
	Aqualfs	Tropoqualfs	Low - Humic Gley soils with low BS
		Natraqualfs	Solodized Solonetz
Ultisol	Udults	Rhodudults	Reddish Brown Latasolic soils
		Plinthudults	
		Tropudults	
	Ustults	Tropustults	Red Yellow Podsollic soils
	Humults	Tropohumults	
	Aquults	Tropaquults	Low-Humic Gley soils with high BS
Oxisol	Ustox	Eustrtox	Red Yellow Latosols

		Haplustox	
Vertisol	Usterts	Pellusterts	Grumusol
Aridisol	Orthids	Salorthrids	Solonchaks
Entisol	Aquepts	Tropaquepts	Alluvial soils of variable texture & drainage
	Fluents	Tropofluents	
	Ustents	Tropustents	
	Psamments	Quartzipsamments	
Inceptisol	Auepts	Tropaquepts	Half Bog soils
	Tropepts	Ustropepts	Immature Brown Loam soils
Histosol	Fibrists	Tropofibrists	Bog soils
	Hemsists	Tropohemsists	
	Saprists	Troposaprists	

*Source:* Punyawardena, B.V.R, 2004

### **Soil conditions for mulberry cultivation**

Mulberry flourishes well in soils which are flat, deep, fertile, well drained, loamy to clayey, porous with good moisture holding capacity. The ideal range of soil pH is 6.2 to 6.8 slightly acidic soils. Saline and alkaline soils are not preferred. The optimum pH required for mulberry is 6.5 to 6.8. Soil amendments may be used to correct the soil to get required pH.

### **Agronomic practices for mulberry cultivation**

Mulberry is mostly propagated through cuttings. Generally, the mulberry plants are raised from semi-hardwood cuttings. Cuttings are selected from well established garden of 8-12 months old. Only full grown thick main stems, free from insect and disease damages having a diameter of 10-12mm are chosen for preparation of cuttings. The cuttings should be of 15-20 cm with 3-4 active buds and should have 45° slanting cut at the bottom end. Care should be taken to make a sharp clean cut at both the ends of cuttings without splitting the bark. Manually/power operated mulberry cutter (stem cutting machine) is available for quick cutting of propagation material. Cuttings may be planted straight away in the main field itself or nursery may be raised and the sprouted and rooted seedlings may be planted in the main field. The latter method is advisable because of its easy establishment in the main field.

### **Silkworm Rearing**

Rearing house is a separate house that is ideal for rearing of silkworm. The rearing house should have sufficient number of windows to permit cross

ventilation. Provision should be made to make it air tight for proper disinfection. Rearing house has to be built in such a way to provide optimum temperature of 26-28° c and RH of 60-70% for the growth of silkworm at minimum operational cost.

### **Land availability**

Sri Lanka has a total area of nearly 62,705 sq km excluding inland water. Sri Lanka socio economic data 2014 shows that 37.4 % of the land area nearly 23,452 sq km is arable land in 2011. Nearly 37.4 % of the agriculture land area is occupied by permanent crops. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow.

### **Availability of Labours**

Sericulture is possible only where labour is efficient and abundant. Sericulture cannot be profitably conducted on hired labour and it will pay only as a subsidiary occupation for families whose members can cultivate mulberry and rear silkworms. In a village having the silk industry, a large number of families find such subsidiary occupations as plucking leaves, digging, weeding, pruning and other process connected with rearing worms and reeling cocoons. Sri Lanka socio economic data shows that unemployment rate in 2012 are 4%. The table 11 is indicated the following information.

**Table 21. Labour force and Unemployment**

<b>Unemployment Rate (%)</b>	<b>Year 2013</b>
<b>By Gender</b>	
• Male	3.2
• Female	6.6
<b>By age groups (Years)</b>	
• 15 – 19	18.7
• 20 – 29	13.0
• 30 – 39	2.7
• 40 – 49	
• 50 and above	1.0

**By level of education**

No schooling	-
Grade 0 – 4 (year 1- 5)	
Grade 5 – 9 (year 6-10)	3.4
GCE O/L	5.9
GCE A/L and above	8.6
<b>Over all</b>	<b>4.4</b>

Source: *Department of Census and Statistics*

Sri Lanka customs, Department of Trade and Investment Policy and Central bank of Sri Lanka (2014) indicates that the 86 % of the total population which is 20.675 mn is living in the rural areas and it indicates that the age group population between the 0 and 14 is 5.222 mn, age group between 15 and 64 is 13.834 mn and more than 65 age group is 1.619 mn. So the age group between the 15 and 64 is ideal and target age group and we can use these for these purposes.

**Marketing facilities**

Sri Lanka is well fitted to take up the textile industry. In most of the functions like marriage and puberty, Singhalese and Tamils wear sarees, frocks, men wearing dresses like shirts and veddi. These dresses are purely silk or combined with other materials. The bride and bridegroom in wedding should wear pure silk dresses in Hindu cultures. At that time Government should limit the importation of silk from other countries and stop the synthetic silk production. Other most of the relatives and friends also wear silk dresses. So the demand for the silk dresses is high in Sri Lanka.

**Potentials and possibilities of sericulture industry in Sri Lanka**

As a result of this study it has been observed that many of the factors are positively suited for the re – introduction of sericulture industry in Sri Lanka therein. When compare the climatic condition of Sri Lanka and climatic requirement for the sericulture industry is almost same. Sri Lanka is climatically suited for the re – emergence of sericulture industry. When we take the rain fall pattern in Sri Lanka, the mulberry cultivation in dry and intermediate zones of the Sri Lanka is possible. Because these two regions receive annual rainfall between 600 mm to 2500 mm ranges. Wet zone receives more than 2500 mm annual rainfall. This region is not suitable for mulberry cultivation. In dry and intermediate zones we can go for the mulberry cultivation. In the dry zone, some



of the months are hot climate. There is no rainfall. At that period supplemental irrigation should be done. Major, medium and minor tanks are available in this region. Through this we can do the supplemental irrigation and agro wells also can be used for this purpose during the dry period.

When comparing the temperature requirement for sericulture industry that is mulberry plant cultivation and silkworm rearing and the temperature prevailing in the Sri Lanka regions are almost same. This sericulture industry also very successfully carried out in this region. Therefore there is no doubtful to carry out the sericulture industry in Sri Lanka will be more potential.

Mulberry cultivation in the island will be very successful. High potential many local varieties of mulberry plants are available throughout the country. In the past, Mulberry cultivation and silkworm rearing were successfully carried out in the Sri Lanka.

The possibilities of re – emerging of sericulture industry in Sri Lanka has positive impact because the climatic factors and soil conditions are favourable for the sericulture industry in Sri Lanka. It is climatically suited for the re – emerging of sericulture industry in Sri Lanka.

When we look at the land availability in Sri Lanka, there is many abandoned lands are available for the mulberry cultivation. It is one of the factors which influence the re – emergence of sericulture industry. Land is enough to engage in sericulture industry in Sri Lanka.

Mulberry can be grown in small plots of land ranging from quarter of an acre to couple of acres either as a dry or an irrigated crop by individual farmers. Silkworms may be reared inside the houses in separate rooms. Mulberry cultivation is only possible in rural areas where the 86 % of population (nearly 17.7805 mn people) are living. Most of the rural areas, the principal occupation of the people is agriculture. In this region many boys and women are found without employment and in some places handloom industries are carried on. But they use other fiber materials like cotton for productions.

When so much of labours are available, it would be a blessing to the vulnerable people who are living in the rural areas if sericulture industry is re – introduced in this regions.

Considered from the aspect of market facilities, if silk is locally produced, there is no doubt that it will find a good market opportunity in Sri Lanka. Because the usage of silk dresses and silk based product is high in Sri Lanka.

There is, thus, a very grate scope for the sericulture industry in Sri Lanka and it is quite fitted to take up the industry and capture the market as certain track in this region are climatically as ideal as any other silk producing country.

## **Conclusion**

The study reveals that the history, present status and potential to re – emerge sericulture industry in Sri Lanka. In the past, sericulture industry was successfully carried out in this region. Then it had collapsed due to the religious sentiment of not accepting the killing of large numbers cocoon in the process of producing silk threads. Sri Lanka is a potential country to re – emerge sericulture industry in this region. There are many factors influencing in this sector to re – introduce in this region. They are;

- There is huge demand for the products of silk in Sri Lanka due to the fact that members of 3 major ethnicity of the country are having the habit of using it.
- The climatic factors and soil prevailed in many districts of Sri Lanka are favorable for successful Mulberry cultivations.
- The climatic factors prevailed in many districts of Sri Lanka are favorable for successful silkworm rearing.
- The Sericulture will provide significant employment opportunities to the women and unemployed youths and create livelihood income to them
- The Sericulture will contribute significantly to the saving and earnings foreign exchange.
- The demands for the silk products within the country have been increasing year by year with the increase in population and per capita income in the country.
- The demand for the silk has been increasing in the user countries with the recession of silk production in all countries except China and India.
- A large extent of suitable land remains uncultivated land can be effectively used for mulberry cultivation.
- A large number unemployed youths, women headed families, widows, war victims looking employment opportunities can be engaged in sericulture.

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## **Prospects of sericulture in SAARC countries**

**S. Nirmal Kumar**

Ex-Director, Central Sericultural Research and Training Institute  
Berhampore, West Bengal, India

United by same geographical boundaries and historical ties, South Asia is one of the most densely populated regions in the world and livelihood of millions of people of this area depends mainly on agriculture. SAARC region has a rich topographic and climatic endowments and variations where wide varieties of crops such as wheat, rice, cotton, sugarcane, maize, mulberry, vegetables, fruits, roots and tubers, ornamentals, medicinal and aromatic plants are grown. A significant increase has been observed in the export earnings from the agricultural crops during the recent years in the SAARC countries. South Asia is a dynamic and complex region that presents the world with significant opportunities and challenges. It is one of the fastest growing regions in the world and has demonstrated its potential for emerging as a significant economic entity in economic space of the world.

Sericulture sector has the potential to provide opportunities to increase income, alleviation of hunger & poverty and curve down socio-economic problems of the region. Therefore, priority should be given by the member countries for the growth of sericulture sector. The problems and prospects of sericulture and ecology of the SAARC countries are more or less the same. In view of this the main objective should be sharing information mutually for the advancement of sericulture. The role of scientific information is becoming increasingly important in the modern context of technological revolution. Availability and accessibility of requisite information is an important facility and its timely absence is irreparable loss. Sericultural technology information is key for more production and for sustainability. The teeming millions of the region should be well fed and well clad and march for further progress for the achievement of a common desired goal-self-sufficiency. Common efforts and mutual transfer of technologies shall enhance the onward march towards prosperity.

Sericulture is having the commercial potentiality which can create self-employment and income generating opportunities to raise the economic and social status of the rural lives and support the environmental protection. Sericulture being a labour-intensive and income-generative agro-industry, has been instrumental in bringing about socio-economic mobility among different sections of society and assuming increasing significance in the rural development paradigm among the three disadvantaged categories in the rural context, based on class, caste and gender. Exploring the social relevance of sericulture in the

process of rural development with an emphasis on the need to identify the appropriate interventions and strategic approaches in making sericulture one of the sustainable forces of rural development in SAARC countries is the focus.

Livelihood generation is one of the major potentials of sericulture and silk industry. Sericulture has emerged as the most important cash crop with minimum investment, low gestation period, high employment potential and highly remunerative return. It is well suited to the agrarian economy of the tribal. Suitable for every section of society, a big farmer or a landless aged person or a youth, man or a woman. Involves simple technology, which is easy to understand and adopt. Sericulture has provided downstream employment and income generation in rural and semi-urban areas, high participation for low-income and socially under privileged groups. Sericulture is the activity of low investment and high output.

### **Status of sericulture in SAARC countries**

**Afghanistan:** Afghanistan was once an essential segment of the Silk Road - a historical network of interlinking trade routes across Afro-Eurasian landmass that connected East, South and Western Asia with the Mediterranean and European world as well as parts of North and East Africa. It has a long history in the national and international silk production and silk carpet markets. Balkh and Kunduz provinces were major silk producers in the North of Afghanistan 30 years ago (Desert horticulture 2012). During the years of conflict, the production level of silk cocoons decreased because producers of silk products were unable to continue their business, so there was less demand for cocoons and silk thread. Although much of the know-how still remains, it takes a push-and-pull action to encourage farmers to start silkworm propagation and to get back into home-industry making silk products. Traditional farmers are concerned that they cannot develop this market alone and need government assistance. Agriculture officials in Herat have reported that sericulture has witnessed an unprecedented growth (Wadsam 2014). According to the figures from the agriculture department in Herat, more than 50mn AFN was generated in revenue from sericulture. Herat offers fertile soil and suitable weather for production of silk. The Agriculture Department in Herat has enhanced their efforts to bring the thousand-year old sericulture business back to life in Afghanistan. Herat silk is expected to mark the renaissance of the 'Silk Road' legacy.

**Bangladesh:** Sericulture in Bangladesh has a long history and glory in silk production because of its agro-climatic advantages. Sericulture is an important rural industry with around 6.50 lakhs people involved. In 1977 Government set up the Bangladesh Sericulture Board (BSB) located at Rajshahi to provide support to the silk industry. Bangladesh Sericulture Research and Training Institute (BSRTI) is the research and training arm of BSB. During the

period of 2002-2005, mulberry cultivation increased due to the imposition of tariff on imported silk and providing project support. Silk cocoon and raw silk production showed increased trend for rearing high yielding silkworm eggs. The demand of silk raw material increased to 300 mt. An appreciable amount of 50 mt of silk yarn is produced in Bangladesh (ISC, 2013). Sericulture activities are implemented in 48 districts and 202 upazilas in the country and about 10 million mulberry have been planted. These activities have generated employment for more than 5 million people and produces 1 million kg. cocoon (BSB, 2013). As reported by Abdur Rashid *et al.*, (2014), more than 60% of cocoon production is from 29 villages spread over two unions in Bholahat upazila- a traditional silk producing area under Rajshahi district. Sericulture is identified as a prospective earning sector in Bangladesh. It has a prospect for developing this sector with proper aids and necessary support of Government and Non-government organisations. The silk products of Bangladesh are known to the world and have earned good reputation. There is an ample scope for Bangladesh to enter into the world silk market.

**India:** Sericulture is mostly a village-based industry providing gainful occupation to around 7.5 million in the rural and semi urban areas, which represent the economically weaker sections of society. There is substantial involvement of women in this industry. Although sericulture is considered as a subsidiary occupation, technological innovation has made it possible to take it up on an intensive scale capable of generating adequate income. It is also capable of providing continuous income to farmers. India is the second largest producer of silk in the world with an annual silk production of 26,480 MT (Provisional) in 2013-14. India has the unique distinction of being the only country producing all the five kinds of silk namely, *Mulberry*, *Eri*, *Muga*, *Tropical Tasar* and *Temperate Tasar*. Among them, mulberry silk is the most popular variety, which contributes around 73.6% of the country's silk production. Silk and silk goods are very good foreign exchange earners. The present global scenario clearly indicates the enormous opportunities for the Indian silk Industry.

In India, Mulberry silk is produced mainly in Karnataka, West Bengal, Jammu & Kashmir, Tamil Nadu and Andhra Pradesh although some other states have made some progress in this direction under their development plans. These five major mulberry silk producing states collectively account for more than 80% of the total area under mulberry cultivation and 97% of raw silk production in the country. Now, as a result of growing realization, sericulture is gaining ground in non-traditional areas too.

Vanya (Non-mulberry) silk comprising Tasar, Eri and Muga are produced in Jharkhand, Chattishgarh, Madhya Pradesh, Orissa, Bihar, West Bengal, Assam, Meghalaya, Manipur and Nagaland. The different types of Vanya silk production areas are as follows:

Tasar Silk – Tasar silk is produced by the silkworm, *Antheraea mylitta*, which mainly thrives on the food plants such as Asan and Arjun. The rearings are conducted in natural conditions on the trees. Tasar silk is mainly produced in India in the states of Jharkhand, Chattisgarh, Orissa, Maharashtra, West Bengal and Andhra Pradesh. Tasar culture is the main stay for many tribal communities in India.

Eri Silk – Eri silk is the product of the domesticated silkworm, *Philosamia ricini* that feeds mainly on castor leaves. Eri yarn is produced in Assam, Bihar, Manipur, Meghalaya, Nagaland and West Bengal. Unlike other kind of silk, this cannot be reeled and hence it is only spun. It has natural copperish colour.

Muga Silk - It is silk produced only in Assam from cocoons of silkworms belonging to saturniidae family, which are fed on Som and Soalu leaves. It has a rich golden colour.

**Nepal:** In Nepal, the initiation of sericulture was done in 1911. Although the annual demand for silk thread in the domestic market is roughly around 200 tonnes, only half ton is produced within the country. Of the 11 districts that are involved in silk production, the key silk producing districts are Chitwan, Makwanpur, Ilam, Shyangja, Dhading and Tanahun. In all there exist seven industries, which are involved in production of silk. From farming to fabric, round-about 7,500 people are employed in silk sector. The agro climatic conditions of 38 districts of the Central Midlands of the Mid Hills altitude ranging from 750 to about 1500 metre, the slopes and valleys between the Mahabharat range and Shiwalik ranges (Kathmandu and Pokhara valleys) are very suitable for sericulture. The low lands of Terai and the inner Terai (Dang and Chitwan valleys) ranging from 100 to 750 metre are ideally suited for the development of the sericulture industry in Nepal. It has been proved by different studies that were carried out in co-operation with KOICA, JICA and FAO that the agro- climatic conditions of Nepal are very suitable. The vision for sericulture development in Nepal is based upon suitable socio-economic and natural environment of the country and comparative advantages in rural development, poverty reduction, environment protection, rural industrialization, income generating employment opportunities, food security and socio-economic upliftment of women and marginal farmers. The strategies envisaged are to promote mulberry based sericulture in potential areas of hills for the development of extra income generating opportunities. To promote tropical sericulture in potential terai areas to increase the production for export and to enhance mass production and production by mass theory.

**Pakistan:** Sericulture in Pakistan is still an industry of nomads which could not expand on large scale due to a number of reasons among which lack of research and trained personnel is a major factor (Ashfaq and Aslam, 2006). Pakistan makes



its own yarn from the imported cocoons that come from China. The yarn is reeled in areas like Orangi town and Shershah which is then sold to the weavers. For the year 2000-01, the imports, of silk yarn remained at \$524 million as against the imports of \$406 million in the previous year. Pakistan imported silk yarn worth \$211 million.

In Bhutan, Sri Lanka and Maldives sericulture activities are still in primary stage and among them, there are reports of silk production in Bhutan.

### **Strategy for sericulture revival and development**

First and foremost strategy should be to recognize sericulture as a specific and cultural industry. It is compulsory to support financial assistance from government for sericulture farming. Creation of a common institution to facilitate and expedite regional collaboration. Proper funding of project of sericulture industries need to be prioritised *i.e.*, finding proper donor, development of methods and means for innovation of the cocoon/silk production & processing technique and technology. Making bilateral and multilateral contracts between the countries of region about exchange of genetic resources of silkworm and mulberry, scientific and technical, technological and other helpful information, providing overseas training, creating modern laboratory facilities and equipment *etc.*, The local governments/sericulture institute experts need to conduct feasibility studies to plan new production areas for exploiting commercial silkworm hybrids, promote development of traditional silk handcraft production as value added products and additional way to utilize the locally produced cocoons/raw silk and provide income resources.

Each country should develop a national strategy for sericulture revival and development and integrate it in their national development plans and promotion of foreign investments in sericulture industry should be some of the strategies for rejuvenation and promotion of sericulture. Through continued efforts in R&D sector, the productivity and quality of silk needs to be enhanced significantly thereby improving the livelihood earning of the people already engaged in the industry.

The women participation in sericulture and silk industry is about 60%. By introducing the sericulture industry to larger areas, more women and family members will be able to generate substantial income for the family. Many of the studies undertaken in China, Thailand and India proved that the sericulture industry is an ideal tool for women empowerment and gender equality.

The sericulture is an agro based industry where the food plants of the silkworm need to be cultivated for undertaking the silkworm rearing activities. Since, most of the food plants are perennial in nature, the cultivated area gives substantial green cover. The industry is labour intensive and hence carbon emitting in the

production process is very minimal. The industry need not compete with other agricultural crops as the land unsuitable for food crop cultivation could be used for sericulture. Thus, the industry can contribute for the sustainability of environment like, eco-friendly production process, increasing green cover, soil conservation and preventing soil erosion.

Around 50% of the people in Asia-Pacific region are engaged in agriculture and related activities. The increasing threats on account of biotic and abiotic stresses and declining natural resources necessitate adoption of modern technologies to accelerate development of high yielding and nutritious crop varieties that can also withstand environmental stresses. Develop capacity of governments and civil societies for introduction and implementation of policy recommendations and good practices to policymakers, opinion leaders and civil societies. The Silk Industry plays a major role in creating global partnerships for development in various regions. The prime advantage of the silk industry is that the major consumers of the silk are from the developed countries and the affluent people of the other regions whereas the major silk producers are from the developing countries comprising the poor farmers, reelers and weavers. This would enable flow of equity from rich to poor.

### **Conclusion**

The above analysis brings out the differential levels of manifestation of socio-economic mobility among different sections of rural people who have adopted or associated with sericulture. The impact of sericulture, with a high degree of change in living conditions, has been highly evident among progressive sericulturists, who mostly but not always, belong to the medium land-holder category. The marginal and small land-holding categories too, experience the impact of sericulture and have been on the path of socio-economic mobility by improving their labour status and stabilising their economic life. The rural poor, mainly comprising landless labourers and marginal landholders, reap the benefits of sericulture, though marginally, either directly by adopting sericulture, if equipped with the necessary resources or indirectly by wage labour, after the successful adoption of sericulture. However, the lower proportion of marginal farmers as sericulturists, as compared to that of higher land owning classes is mainly found to be due to certain resource constraints, which put most of them at the same disadvantaged position as of the landless, except for their access to land. Among all of them, whoever is able to adopt sericulture and relatively sustain in it for a considerable period do manifest a better living status and social identity than non-sericulturists among them.

With regard to women, though female labour requirement is more in sericulture, their activities in sericulture are hardly perceived to be highly-skilled. Nevertheless, the value of family female labour is more realised in sericulture than in traditional agriculture, while those who shoulder the sericulture responsibility naturally get recognition that is reflected in crucial decision making. Thus, sericulture, as an agro-industry, undoubtedly proves to be a viable strategy of rural development with equity objectives, with varying impact and implications for different sections of the society in general and the weaker sections in particular. Appropriate interventions and strategic approaches would go a long way in converting this strategy as one of the sustainable forces of rural development.

South Asian countries should work for building production network in different sectors using intra and extra-regional trade and investment. This could be done under the aegis of institutional structure of the SAARC. In this context, a separate independent body can be formed focusing on the promotion of intra-regional and extra-regional investments. The scope of the initiative can comprise working with member country governments as well as with the private sector trade bodies for considering new policy options. It can also take initiatives to identify barriers for investment within the region, support private sector with market related information and set agenda for discussions and negotiations at various levels with a view to strengthening regional investment cooperation in a sustained manner. Rapid sericultural growth can stimulate and thus sustain the pace of industrial growth, thus setting into motion a mutually reinforcing process of sustained economic growth. Recently, many South Asian countries have started undertaking institutional and policy reforms with a hope that a healthy interaction between agricultural and rural development with industrial and service sectors will enhance and sustain long-term development of South Asian economy.

# **Establishment of Silkworm Seed Production Network in SAARC Countries**

**B. S. Angadi**

Director, Central Silk Board, Government of India: Ministry of Textiles  
Bangalore, Karnataka, India. bsangadi@gmail.com

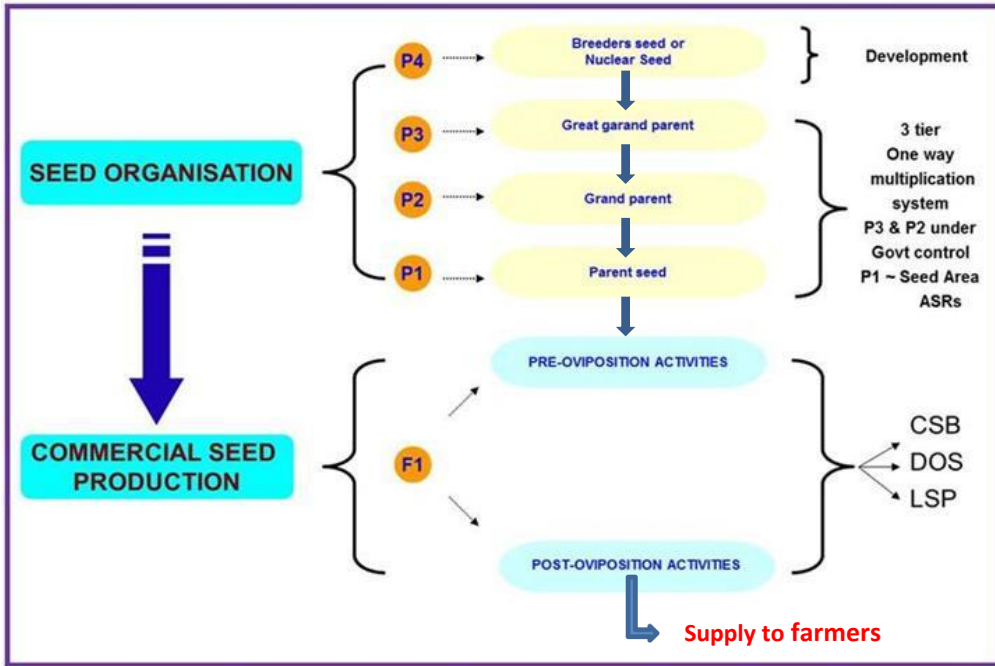
## **Introduction**

Universally, it is an accepted fact that the seed is a forerunner for an orderly development of any agricultural avocation. Sericulture too is no exception and hence silkworm seed plays a vital role in stabilising the industry. Silkworm seed is the carrier of technology improvement resulting from the silkworm breeding research, and is now a recognised means to improve productivity.

Good quality seed acts as a catalyst for realising the potential of all other inputs in sericulture. Without good quality seed, the investments made on fertilisers, rearing facilities, irrigational facilities, disinfectants and other inputs will not pay the desired dividends. And also without quality seed the impact of high yielding varieties and improved production technology in boosting productivity cannot be realised. Importance of the seed has gone up and up with the passage of time. Farmers having taken up mulberry cultivation on their own or due to the persuasion of government organisations look towards grainages for the effective supply of good quality seeds. Any lapse in this regard can be detrimental to the industry. Therefore availability of quality seed of improved varieties to the farmers at an affordable price and in time is considered crucial for enhancement and sustenance of silk productivity and economic growth of the sericulture industry.

Thus the silkworm seed production and supply would become a challenge and obligation to the governmental and private agencies of all the SAARC countries, which are looking at sericulture as a most potential agricultural avocation for poverty alleviation and generation of gainful employment. There is a need for bilateral and multilateral collaborations among the SAARC countries to meet this basic requirement. Among the SAARC countries, India which has taken a quantum jump in the silk production in the recent years, and emerged as a leader, has established replicable commercial silkworm seed production model, backed up by a sound seed organisation.

## Seed Organisation



Heterosis, the genetic principle on which hybrids are based is now a widely practised means to boost silk productivity. The prime objective of every silkworm breeder is to develop superior, high yielding and robust hybrid varieties and make them available to the needy farmers in time for commercial exploitation. This necessitates the production of parent seed cocoons in large scale without losing their genetic purity, vigour, viability, vitality and integrity. The concept of producing such dependable parent seed cocoons and supplying them to commercial silkworm seed production centres for the production of hybrids embodies a delicate scientific and skilled technical network called as ‘**Seed Organisation**’.

Seed organisation involves maintenance of breeders stock and its multiplication at different stages for the ultimate production large quantity of commercial hybrid seeds. Sound seed organisation, which forms the backbone of the sericulture industry, is efficiently followed in all the sericulturally advanced countries falling in both the tropical and temperate regions.

Commercial silkworm hybrid seed production is preceded by the maintenance of breeds and generation of quality parent seed cocoons. Starting from (P4) the breeders stock, a three tier multiplication system (P3, P2 and P1) is followed for the production of commercial hybrids. The pedigree system of organised system of seed production is depicted below

### **Programme for basic seed production.**

Programme of seed organisation and its structure differs from country to country and within the country depending on the local prevailing conditions. The size of the seed organisation is determined based on:

- ❖ The target of production or requirement of commercial silkworm seed ( hybrids)
- ❖ The requirement of commercial silkworm seed is estimated based on the physical availability of mulberry acreage, leaf yield and the consumption of disease free laying/acre/year.

Based on the above, three tier multiplication system is established for both multivoltine and bivoltine races and the pedigree system or organised system of seed production is followed.

### **Commercial silkworm seed production**

Massive and consistent requirement of dependable commercial silkworm seed in the form of single hybrids or polyhybrids, throughout the year itself speaks of the magnitude of planning and precautions required to ensure systematic production and timely supply, so that the envisaged quality and quantity in the production of silk could be achieved. The success of the commercial silkworm seed and in turn the industry depends on six critical issues as indicated below. All these factors need to be addressed by the SAARC countries for establishing an efficient silkworm seed production network in their respective countries.



Though understanding the quality of silkworm seed appears complex, from the seed producers' and farmers' point of view it is just simple. Quality silkworm seed is expected to:

- be free from all the diseases
- lead to hatching on a single day
- be a genuine hybrid
- result in stabilized cocoon crop
- result in higher economic returns

Multiple factors such as newer technologies adopted by different members in the value chain and the nature in which various procedures are followed contribute to the quality of the silkworm seed. In a way, seed quality is a cumulative effect of all the inputs right from the generation of dependable parent seed cocoons, to the supply of incubated and black boxed seeds to the farmers. It will be a cardinal error if it is attributed to just one factor, one technology or to a single stratum in the production ladder. Obviously, such quality eggs can be produced on a continuous basis if only the laid out procedures are followed at every stage of production clubbed with a Total Quality Management System.

### **Backward linkages**

The source of genetic potential and quality of the F1 seed produced in the grainages is primarily from the two parent races utilized to produce that hybrid. It is the combination of this and various other factors that ultimately decide the quality of the hybrid seed produced. Hence the purity of the parent races and maintenance of their vigour and vitality is of utmost importance until the final segment of seed organization is reached. To ensure this;

1. Hybrid seed production has to be backwardly integrated through reproductive seed maintenance and multiplication by drawing the annual program of Basic seed farms keeping in view the requirement of seed cocoons of the grainages.
2. Seed sector has to strictly adhere to one way multiplication system from P4 to P1 to avoid repeated multiplication of the same stock, to retain the purity and vigour. Of the basic stock.
3. Emphasis must be given for pupation rate in addition to other cocoon characters at all levels from P4 to P1.
4. Production of P4 to P1 dfls (disease free layings) has to be restricted only to the favourable months in the selected basic seed farms.
5. Adopt experienced farmers for generation of the required quantities of all the bivoltine parent seed cocoons.
6. Seed production centres have to monitor the inflow of quality seed cocoons and regulate their supply.

### **Infrastructural facilities**

Depending on the demand for commercial seeds, the production capacity of the grainage is decided and based on the production capacity necessary infrastructural facilities in the form of building (space), equipment's and man power has to be created.

Grainage building should be constructed in such a way that it would be easily possible to fulfil the following requirements (Model building plan for production of 20,000 boxes is depicted at Annexure 1).

- Maintain required temperature, humidity and photoperiod conditions during the production cycle with adequate ventilation.
- Make the room dark whenever required and avoid pests and rodents.
- To exhaust moth scales and avoid contamination.
- Carry out all the technical operations in separate rooms/areas.

Besides, uninterrupted power supply and continuous water availability are the two very essential basic requirements for smooth conducting of all the delicate technical activities.

It is necessary to equip the grainages with modern gadgets to facilitate implementation of all grainage technologies meticulously. Uninterrupted power supply should also be ensured by providing generators to each grainage. Importance is given to the availability of following critical items in the grainages.

- ✓ Male moth preservation chamber.
- ✓ Egg preservation chamber.
- ✓ Incubation chamber.
- ✓ Room heaters with thermostat.
- ✓ Humidifiers with humidistat.
- ✓ Moth crushing units/ crushing mixies.
- ✓ Centrifuges.
- ✓ Microscopes.

### **Variety**

In all the sericulturally advanced countries only the polyhybrids are used for commercial exploitation, which are also suitable for all the SAARC countries. The only problem envisaged is proper maintenance of four involved races and avoid mixing at all the higher levels of multiplications. The polyhybrids have the following other advantages over the single hybrids.

- Parents of the polyhybrids are very easy to rear because of the inbuilt heterosis as they are the crosses of two races.



- Egg yield in the grainages per kg of seed cocoons used is 10-15% more.
- Non-occurrence of unfertilised eggs in both direct and reciprocal crosses.
- Have better tolerance to the fluctuating conditions and the survival is high

Some of the hybrids developed in India and produced in large quantities are as indicated at Annexure 2.

### **Trained man power**

Silkworm seed production is a technical job which requires a systematic and scientific approach. Hence the technicians and the workers must be properly trained in the following techniques.

1. Disinfection
2. Parent seed cocoon generation
3. Incubation technologies
4. Seed cocoon handling
5. Loose egg production
6. Mother moth examination
7. Cold storage management and cold preservation of bivoltine seed

Silkworm Seed Production Centre, Bangalore that has got state of the art facilities trains the personnel involved in the seed production in all the related activities, supported by the Silkworm Seed Technology Laboratory. All the SAARC countries can avail this facility. The duration of the training is around three months for the fresher's.

### **Rational management system**

The sericultural progress of any country can be measured by the quality of its seed production and the quantity consumed by the farmers. As the silkworm seed production depends on various factors like efficient maintenance and multiplication system, demand for seeds, advanced technologies implemented, egg handing etc., efficient management of the grainage holds the key for success. Following are important components of the grainage management.

- Equipment management
- Personal management
- Technical management
- Financial management
- Crisis management
- Extension management

Even though, the above said classifications are theoretically independent, but when quality of the layings production, sustainability of unit and business promotion are considered truly on commercial lines, all the above said items have to interact, intertwine and follow the specified object of farmers and reelers interest. Independently, they have no meaning and together they give purposeful direction to quality, productions and sale.

### **Appropriate technology implementation**

Implementation of the following technology time tested technologies will help to maintain the quality of the silkworm seeds and in turn enhance the productivity.

1. Follow 18 hours light and 6 hours darkness during incubation of P1 dfls until head pigmentation stage.
2. Black box the P1 dfls when more than 50-60% of the eggs attain head pigmentation stage.
3. Supply only the incubated P1 dfls in black boxed stage on the day of hatching or a day before hatching to the adopted seed rearers.
4. Conduct larval examination at least four times during the seed crop rearing to ensure Pebrine freeness.
5. Procurement of the seed cocoons based on the pupation rate, and quality linked pricing system.
6. Maintain all the required micro-climatic conditions during seed cocoons preservation.
7. While preparing the bivoltine hybrids resort to pupal sex separation carried out based on physical observation of sex mark.
8. Provide 10 hours light and 14 hours darkness for pupae while preparing bivoltine hybrids.
9. Avoid refrigerating female pupae or moths; synchronize the emergence by adjusting the room temperature.
10. Use bivoltine male moths only once during bivoltine hybrid preparation and twice for CB preparation.
11. Preserve male moths in 7-9° C and wet cloth in the chamber to maintain humidity.
12. Adopted Fujiwara's method of mother moth examination for certification of disease freeness.
13. Loose egg production for the supply of superior quality seed
14. Control the water temperature between 24 to 26°C, for all operations in the grainage.
15. Incubate all the F1 dfls and supply them in black boxed condition.

### **Forward linkages**

To ensure crop success in the field the commercial seed production has to be backed up by a strong extension system for dissemination of advanced technologies. For consistency of the crop 100% supply of certified chawki worms has to be ensured.

### **Way forward for SAARC countries**

Until the SAARC countries possess appreciable area of established mulberry acreage, they may depend on the advanced country like India for meeting their commercial seed requirements. Before that they need to conduct trial rearing of the prolific hybrids produced in India and ascertain their performance at laboratory/field level, before large scale rearings are taken up by the farmers. However, Research Institutes engaged in the sericulture related projects may take up development of breeds suitable to their local conditions. Take up collaborative research projects for the overall development of the industry.

### **Export/Import procedure**

Liberalisation policy of the Government of India has paved way for export of commercial silkworm seed both by the government and private Registered Seed Producers (RSPs), with strict regulations to ensure that there is no compromise on quarantine procedures. The conditions stipulated and essential requirements for export as follows.

1. Exporter should be a person registered with the Registration Committee paying the stipulated fee and submitted an undertaking in the prescribed form. The exporter should apply in the prescribed form, for the export permit, to Officer-In-charge of Quarantine Centre, ten days in advance of the actual date of inspection and get the export permit (Annexure-9).
2. Inspection for export shall be carried out and certificate issued only by the technically qualified and duly authorized officers working in institutions established or accredited by the committee subject to fulfilment of the conditions laid down.
3. The exporter shall obtain necessary quarantine certificate (Annexure-10) for each consignment.
4. No consignment shall be exported without the quarantine certificate by the authorized person and the export permit issued by the competent authority.
5. All the silkworm seeds meant for export should be prepared as loose grains of 50 layings, of uniform weight as per the standard prescribed.

6. Only authorized hybrids are permitted for export.
7. The exporter should deliver the entire consignment at the specified quarantine centre, at his own expenses as per the conditions laid down.
8. The exporter should arrange and present the products for the purpose of inspection and drawing samples to the authorized person in accordance with the specified sampling schedule.
9. The exporter should extend labour and material support required for handling the boxes.
10. The Quarantine Officer shall seal the consignment after inspection. The seal shall bear the markings as inspected and certified.
11. After inspection, the exporter should clear the consignment on the same day from the premises of the inspection laboratory.
12. After certification, the exporter shall not in any manner alter the contents of the consignment and shall not distort or damage the quarantine seal.
13. The Quarantine Centre shall bear no responsibility to any infestation and infection that may occur after the consignment has been inspected and duly certified.
14. No suit, prosecution or other legal proceedings shall lie against any person, for anything done in good faith or intended to be done under quarantine law / procedure.

#### **Issue of Quarantine Certificate**

Quarantine Certificate is the certificate to ensure that the eggs which are intended for export are free from Pebrine disease or any other disease or pests. If the sample eggs tested are free from Pebrine disease, the Quarantine Certificate will be issued by the Designated Inspecting Authority (DIA), (SSTL for southern state, Maharashtra and Orissa & CSRTI, Berhampore for the remaining States in the case of Mulberry silkworm). The DIA for Tasar silkworm shall be Central Tasar Research & Training Institute (CTRТИ), Ranchi and that for Eri and Muga silkworm shall be Central Eri and Muga Research & Training Institute (CMERTI), Lahdoigarh. The Scientists of Silkworm Pathology Laboratories of the respective Institutes will be the authorized quarantine inspecting officers, who conduct the quarantine inspection at their Laboratory.

Flow chart of the export procedure is furnished at Annexure 5.

#### **Conclusion**

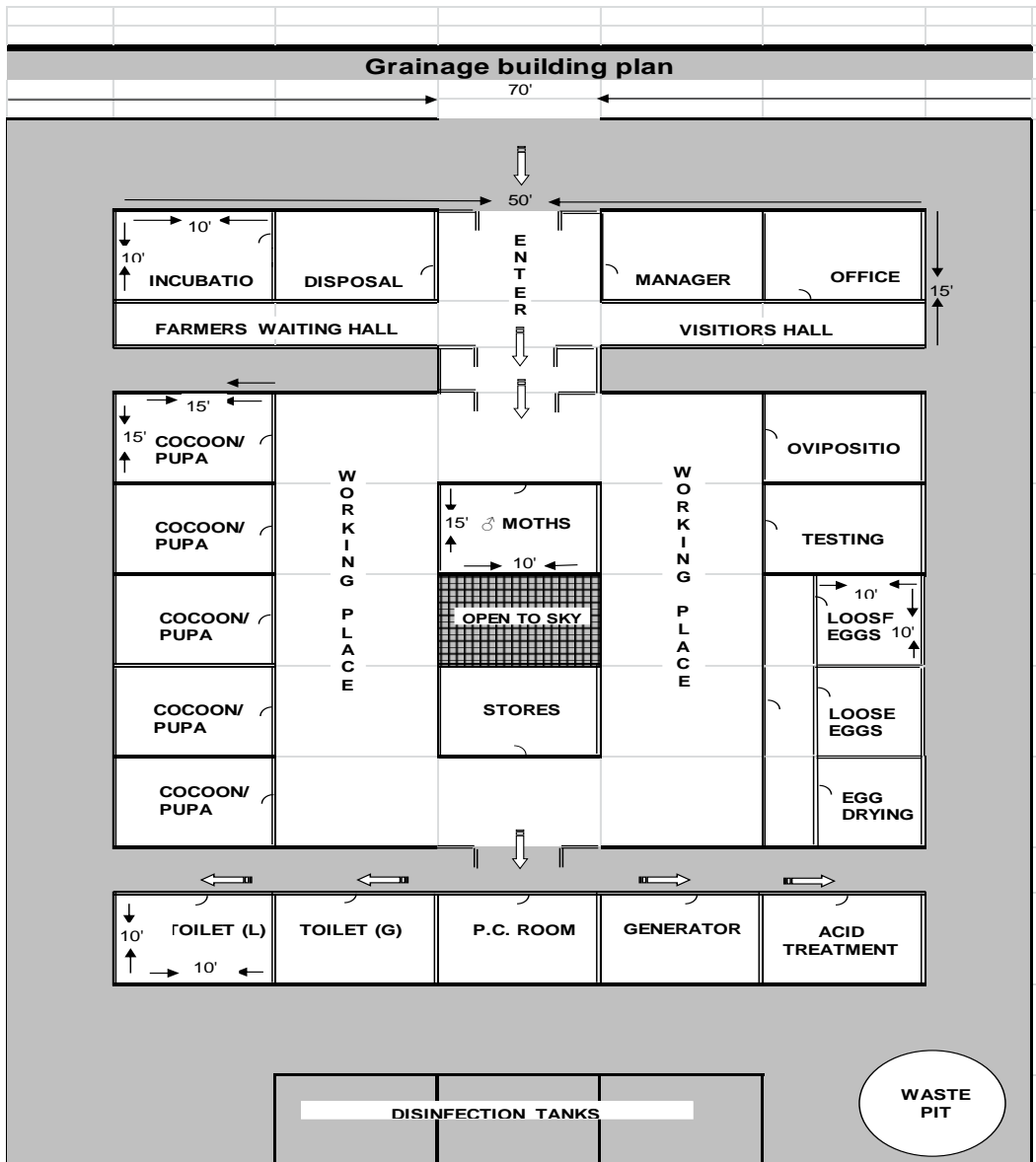
The fact that a genetically potent seed alone could increase cocoon production by more than 20 percent and provide tolerance to diseases and abiotic stress, states

the importance of this basic input in sericulture. Though, technology has different meaning to industry and sericulturists, as far as the farmer is concerned, all the scientific innovations are of little value unless he gets 'Zero defect' seeds, which are genetically potent (true hybrid) and possess other desired qualities namely, high hatching percentage and vigor, disease freeness etc. When the farmers do not get seeds possessing these qualities the yield they obtain may not be satisfactory. Only seeds with assured quality can be expected to respond to other inputs in a desired manner.

Hence, without an efficient silkworm seed production and supply network, efforts made by the SAARC countries and the initiatives taken by the low income or low middle income group farmers to propagate sericulture for poverty alleviation and improving the socio-economic status, will go futile. For a better start and converting the challenge of developing sericulture industry as an opportunity, SAARC countries may adopt the following strategies.

- ✓ Sensitize the higher ups, technocrats involved in the development of silk sector and the lead farmers through an exposure visit to the sericulture areas of India.
- ✓ In order to cover all the activities such as seed production, commercial cocoon production, reeling and other post cocoon activities, SAARC countries could develop a structured institution with overall responsibility in their respective countries.
- ✓ Considering the domestic demand and its development, create commensurating production models starting from the requirement of basic and commercial silkworm seed, mulberry acreage and other relevant factors.
- ✓ Conduct diagnostic studies, identify the potential Clusters/areas for cultivation of mulberry and silkworm rearing, create all the backward and forward linkages for ensured outputs.
- ✓ India with large sericulture base and technical expertise can extend hand holding to the SAARC countries in training of stake holders, supplying of commercial silkworm seed, establishment of seed production units when the need arises, through bilateral and multilateral collaborative projects.

**Annexure 1**



Administrative block - 750 sq.ft  
 Operational area - 3750 sq.ft  
 Sanitary, PC, ATB and Generator - 500 sq.ft

Manager	10' x 10'	1	Loose eggs	10' x 15'	1
Office	10' x 10'	1	Loose eggs	10' x 15'	1
Disposal	10' x 10'	1	Egg drying	10' x 15'	1
Incubation	10' x 10'	1	Gents toilet	10' x 10'	1
Cocoons			Ladies toilet	10' x 10'	1
or pupa	15' x 15'	5	P.C	10' x 10'	1
Male moth	15' x 15'	1	Generator	10' x 10'	1
Stores	15' x 15'	1	Treatment	10' x 10'	1
Oviposition	15' x 15'	1	Testing	15' x 15'	1

## Annexure 2

### **Silkworm hybrids for different agro-climatic conditions**

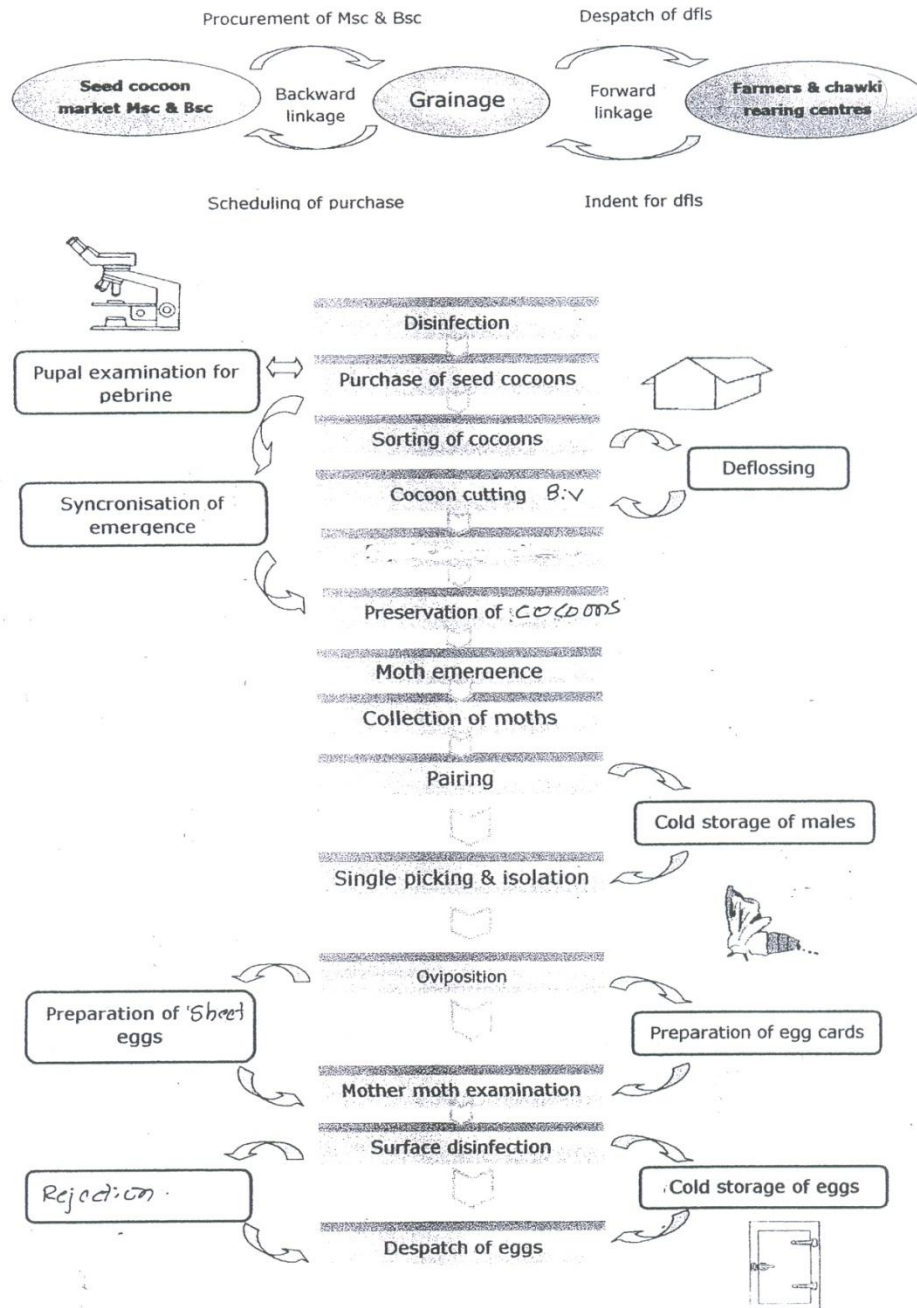
<b>Hybrid</b>	<b>Economic Characters</b>	<b>Season/ climatic condition</b>
<b>Multi x Bivoltine cross breeds</b>		
PM x CSR2	High survival rate of >85% Yields 55 kg/ 100 dfls Moderate cocoon weight 1.7 - 1.9g Non gradable silk	Suitable to varied climatic conditions (high temp. & low humidity) and moderate quality leaf
N x (SK6xSK7)	High survival rate >85% Moderate cocoon weight 1.6- 1.8g Non gradable silk	Tolerant to high temperature and high humidity
<b>Bivoltine Hybrids</b>		
CSR2 x CSR4	Cocoon yield 60-65 kg /100 dfls. High cocoon weight 1.9 to 2.0 g , shell percentage 23-24 % , raw silk recovery 19-20 % filament length 1000 to 1150 produces 3A gradable silk.	Recommended for Temperate/ Sub-tropical regions
FC1xFC2	Yields 65-70 kg cocoon/ 100 dfls cocoon weight 1.9 to 2.0 g, shell percentage 23 -24 % , filament length 1100 to 1200 m, raw silk recovery 19-20% , renditta 5.0 - 5.5 and produces 3A gradable silk.	More genetic plasticity to buffer against adverse climatic conditions and thereby resulting in crop stability than single hybrid.
FC3xFC4	Cocoon yield 65-70kg /100 dfls. High cocoon shell ratio (22-24%) and raw silk recovery (19-20%). High silk quality (~3A grade)	Better genetic plasticity to adjust with varying climatic conditions can be easily handled by farmers under moderately hygienic conditions
CSR16xCSR17	Yields 65-70 kg cocoon/ 100 dfls cocoon weight 1.9 to 2.0 g , shell percentage 23 -24 % , filament length 1000 to 1100 m,	Suitable to all seasons in south India and during favourable months in other states.

	raw silk recovery 19-20% , Produces 2A to 3A gradable silk.	
Gen2xGen3	Yields 60 – 63 kg cocoons /100dfls Seasons Gradable silk 2A-3A	Can be reared in both favourable and unfavourable seasons
G11xG19	Yields 65-70 kg cocoons/100 dfls, More than 95% pupation, 22-23 SR% 2A-3A grade silk	High temperature tolerant can be reared throughout the year under different agro-climatic conditions better digestibility and survivability even with poor quality of mulberry leaf
CSR50xCSR51	Cocoon yield 65-70 kg/100 dfls. cocoon weight 1.9 to 2.0 g , shell percentage 23 -24 % , filament length 1100 to 1200 m, raw silk recovery 19-20% , produces 2A to 3A gradable silk.	Tolerant to high temperature



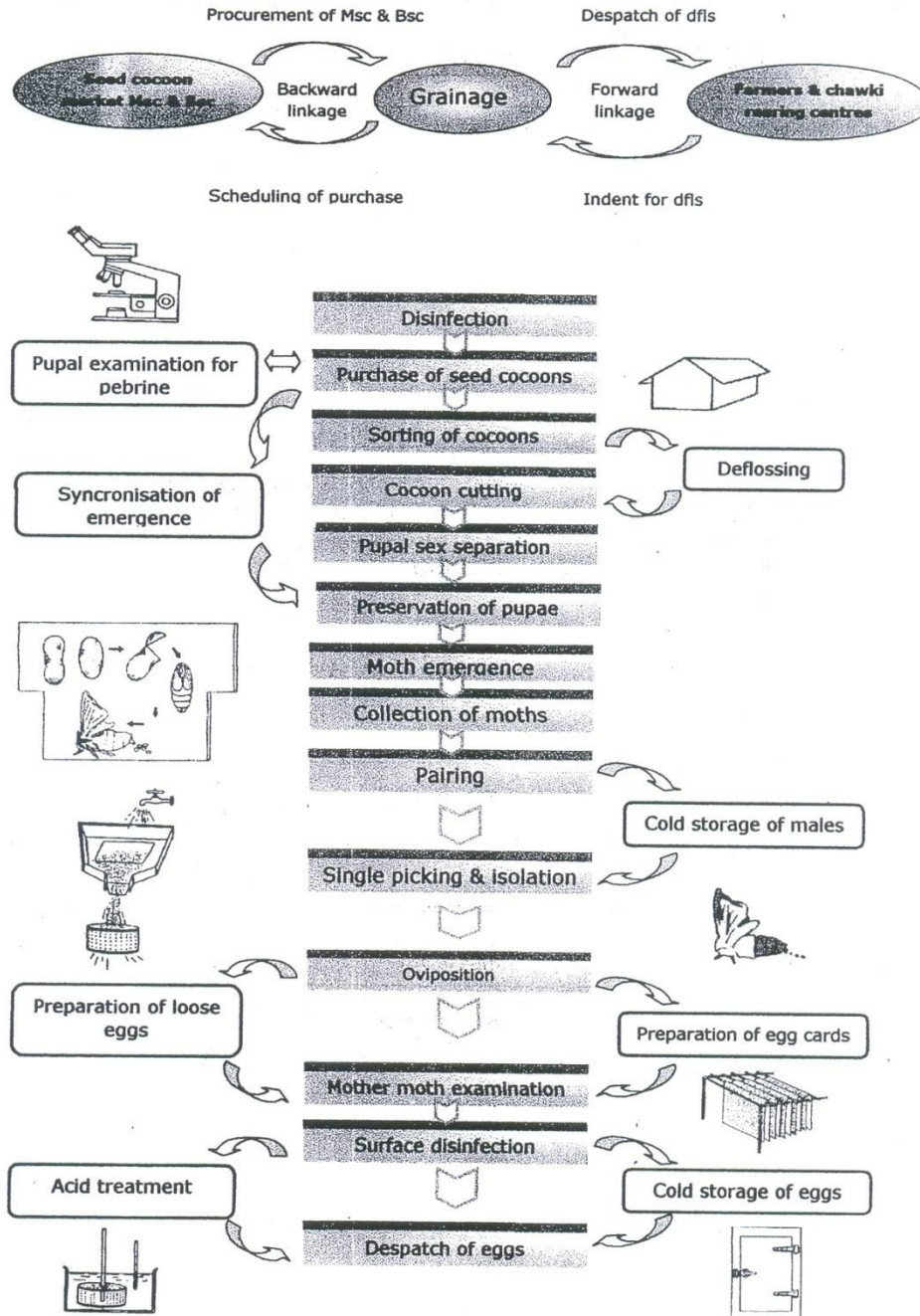
Annexure 3

**CROSS BREED DFLs PRODUCTION FLOW CHART**



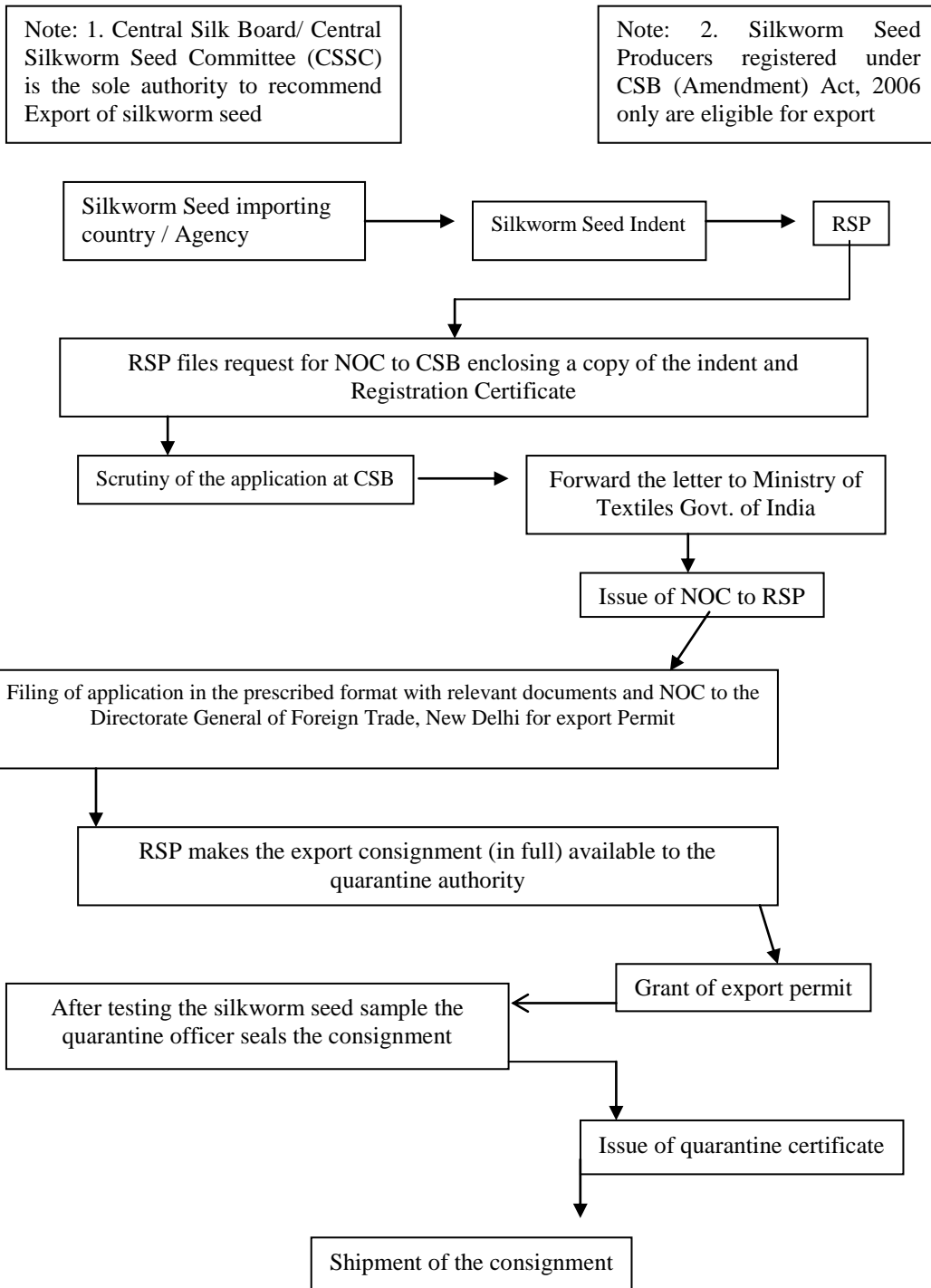
**Annexure 4**

**BIVOLTINE LOOSE EGG PRODUCTION FLOW CHART**



**Annexure 5**

**Export of commercial silkworm seed**



# **Strategy to Replicate the Successful Model of Sericulture Practice Developed in India to other SAARC Countries**

**V. Sivaprasad**

Director, Central Sericultural Research & Training Institute (CSRTI)  
Mysore-570 008, India

Mulberry silk sector contributes about three-fourths of the total silk production in India. The country is on the threshold of an unprecedented growth rate to produce 23000 MT of mulberry raw silk including 5000 MT of bivoltine silk. The mulberry raw silk production during the year 2014-15 was 21272MT, which is just a tad (7.5%) away from the target set for 2016-17. This remarkable progress is attributed largely to the breakthroughs in R & D like improved mulberry varieties and silkworm hybrids; mulberry cultivation practices and silkworm rearing management including chawki rearing; disease and pest control strategies; efficient transfer of technology systems and capacity building of stakeholders. Current mulberry raw silk production trends are indicative of successful implementation of well-planned technological strategies for the quantum jump in mulberry silk productivity in India and its sustenance.

Well planned and coordinated strategies and efficient execution systems, led to the successful delivery of cutting edge technologies by Central Silk Board and State Department of Sericulture. Timely problem solving and demand driven requirements have been successfully addressed leading to sustainable silk productivity in diverse agro-climatic conditions. The pivotal role played by JICA (Japan International Cooperation Agency) in the popularization of bivoltine sericulture to meet the national demands for quality silk is commendable in sharing of scientific expertise for effective transfer of technologies for production of quality silk including tropicalization of temperate sericulture, development of productive silkworm hybrids, effective rearing technology and extension mechanism. These initiatives/strategies were later expanded in major Indian states like Karnataka, Tamil Nadu, and Andhra Pradesh under mission mode approach for technical inputs, quality silkworm seed supply, cultivation of improved mulberry varieties, chawki worm supply, infrastructural facilities for cocoon & silk processing. These flagship programmes, Cluster Promotion Programme (CPP) and Institute Village Linkage Programme (IVLP), were monitored and coordinated successfully by CSB, with active participation from well-informed farmers for a decade.

The SAARC nations represent diverse cultural and socio-economic groups and basically very similar to India. India is a vast country and different agro-climatic

conditions prevail in tropical, sub-tropical and temperate regions. The Indian subcontinent represents almost all the geographical and climatic situations existing in the SAARC region. Afghanistan, Bhutan, and Nepal are landlocked with hilly terrain and climatic conditions by and large match with northern parts of India like Jammu & Kashmir, Himachal Pradesh and Uttaranchal. Similarly, the climate of Pakistan, Bangladesh, Sri Lanka and Maldives is sub-tropical/tropical and is comparable to India's major silk producing states like Karnataka, Andhra Pradesh, Tamil Nadu and West Bengal. Sericulture activities in SARRC nations are not on industrial mode and are still in primordial stage, which can be pursued actively for poverty alleviation and rural development empowering the marginal and small farmers to earn a living. The scope for effective dissemination of ready-to-use technologies for sustainable sericulture practices in India could be translated to other SAARC countries to strengthen the regional cooperation and for mutual benefits. The key components of successful Indian Sericulture Model in India are as follows:

### **Indian Sericulture Model - Important Strategies**

#### **Mulberry Productivity Improvement**

Nearly 60% of mulberry plantation in the country is with V1 variety, which has the leaf yield potential upto 60 MT/ha/yr and another popular variety particularly in Eastern India is S1635. In addition, several productive and stress-adaptive mulberry varieties such as Vishala (fast growing), S13 & Anantha (rained conditions), RC1 & RC2 (resource constraints), G2 (chawki garden) and G4 (late age rearing) were developed to meet the specific requirements of agro-climatic zones for improvement in leaf productivity. Supplementing the improved mulberry varieties, efficient package of practices for mulberry cultivation: wider spacing (improved productivity), drip irrigation (water conservation), nutrient supplements (Poshan), integrated nutrient management (bio-fertilizers, vermicomposting, green manuring, trenching & mulching) were utilized to improve leaf productivity. These practices resulted in minimizing the application of chemical fertilizers and yet improved soil health and fertility. Eco- and user friendly pest and disease management practices in mulberry such as Navinya (root rot), Nemahari (root knot) and Nursery guard (nursery diseases) played a vital role in further augmenting the mulberry productivity. The utilization of biocontrol agents: predatory beetles (*Cryptolemus montrouzieri* or *Scymnus coccivora*) for tukra, egg parasitoid (*Trichogramma chilonis*) for controlling leaf roller and Bihar hairy caterpillar and exotic parasitoid, *Acerophagus papayae* for the management of papaya mealy bug resulted in preventing huge crop losses due to mulberry pests.

### **Supply of healthy and scientifically reared young age silkworms**

Chawki rearing or young silkworm larvae supply units in almost all the states in India are playing an important role in providing healthy and scientifically reared young age silkworms to the farmers and besides ensuring successful crop harvests and maximizing the time, resources and returns to the farmers. Large numbers of such commercial units are set up by private individuals at village level and represent new set of entrepreneurship in silk value chain and became integral part of sustainable and cost effective silk cocoon production. These units are regulated by stringent crop monitoring and certification of the silkworm batches for the benefit of the farmers. Trends reveal several more units would be established to meet the raw silk production targets and indicating successful entrepreneurship of the activity.

### **Silk Productivity Improvement**

Majority of the mulberry silk production (90%) is based utilizing the multivoltine hybrids [PM x CSR2 and Nistari x (SK6xSK7)]. Utilization of improved crossbreeds (APM1 x APS8, APDR15 x APDR115, MH1 x CSR2, PM x FC2, L14 x CSR2) led to the production of improved quality silk (2A-3A) suitable for power looms. Recently developed improved crossbreed, Cauvery Gold (MV1 x S8) has the potential to yield higher and produce quality silk to meet the requirements of the processing industry. Bivoltine silk production is realized through rearing of CSR2 x CSR4 as well as the double hybrid, FC1 (CSR6 x CSR26) x FC2 (CSR2 x CSR27) throughout the country. The popularization of improved silkworm hybrids such as CSR16 x CSR17 and SSBS5 x SSBS6 (productive), DUN16 x DUN17 & DUN6 x DUN22 (temperate zones), APDR105 x APDR126 (disease resistant), GEN3 x GEN2 (suboptimal conditions), Chamaraja - CSR50 x CSR51 (thermo-tolerant) and the double hybrids, Jayachamaraja (CSR50 x CSR52) x (CSR51x CSR53) and G11 (GEN1 x2C) x G19 (4D x 4S) augur well for the sericulturists for maximizing productivity and improvement in quality silk production. In the Eastern zone, the bivoltine silk production has taken wings through the utilization of foundation crosses *viz.*, SK6 x SK7 and B.Con1 x B.Con4 with improved cocoon yields.

The comprehensive rearing technology package for bivoltine silkworms including egg incubation, chawki rearing, shoot-cum-shelf rearing and improved mountages etc. resulted in increasing the silk productivity. Innovations like loose egg incubation frames, rotary mountages, cocoon harvesters etc., have contributed greatly for the efficient management of bivoltine crops. Several disinfectant formulations (Chlorine dioxide, Decol, Asthra etc.) and silkworm body and rearing seat disinfectants (Reshamkeet oushadh, Vijetha, Ankush etc.) to prevent silkworm diseases during rearing have drastically reduced the crop losses. The development of eco-friendly IPM technologies for silkworm pest especially

tachnid uzifly through the hymenopteran parasitoid, *Nesolynx thymus* along with uzitrap resulted in preventing serious economic loss (4-7%) to the sericulturists.

### **Mechanization of Sericultural Activities**

Sericulture is labour intensive and the labour costs account for nearly half of the cost of cocoon production. Efforts made to design, develop and adopt tools, equipments and machines for mechanizing mulberry cultivation, silkworm rearing and silkworm egg production have resulted in the development of several devices and machines for reducing the labour inputs and cost of production with minimum effort. Machines for mechanization in pruning, preparation of cuttings, shoot crushing, leaf chopping; electric sprayers for disinfection, tray washing, litter separator, mature silkworm separator, bed disinfectant powder duster, cocoon deflossing, cocoon cutting and cocoon harvesters, resulted in reducing the drudgery ensuring timeliness of sericulture operations with precision and high capacity.

### **Effective Transfer of Technologies**

The transfer of technology plays a decisive role in development of farm based activities including sericulture. Recently, novel approaches like Cluster Promotion Programmes (CPP) and Institute Village Linked Programmes (IVLP) in association with the State Sericulture departments have been instrumental in sensitizing the stake holders and substantially increasing the adoption level of technologies for effective implementation of bivoltine silk production programmes. Besides undertaking demonstration of technologies, periodical crop monitoring, interaction with farmers on various issues relating to silkworm hybrids, rearing, mounting and harvesting, marketing is necessary to identify the suitability of the technology.

### **Best sericulture practices**

Successful adoption of cutting edge technologies vital for tropical bivoltine sericulture in Indian states like Tamil Nadu, Karnataka and Andhra Pradesh increased the bivoltine silk production and attained improved productivity levels. Besides, strategic implementation of silkworm seed/breed supply, mulberry cultivation technology and other crop protection measures, technological resources, additional major practices include:

***Water conservation and efficient maintenance of mulberry garden:*** Adoption of water conservation measures (micro irrigation system, farm ponds, mulching); mechanization and integrated nutrient management for maintenance of soil health and fertility.

***Identification of potential areas:*** Assured irrigated areas are identified to stabilize bivoltine silk production in addition to the consolidation of traditional areas.

**Rain water harvesting:** Establishment of rain water harvesting structures and rain water conservation through farm ponds and trenches.

***Efficient methods of egg handling:*** Chawki rearing centers follow recommended practices of egg incubation and black boxing; Maintenance of temperature and humidity.

***Capacity Building:*** Establishment of forward linkages in silk value chain especially the silk reeling units (MRM & ARM) and post-cocoon processing facilities is very important to reap benefits of local cocoon production and improved economic returns to the farmer instantaneously. Imparting required skills to all the stakeholders in sericulture activities is an important component for improved productivity and economic returns.

### **Scope of development in SAARC countries**

Majority of the population reside in the countryside of SAARC nations and creation of rural employment has been main strategy to mitigate the poverty and address the developmental concerns. Improvement of rural economy by agriculture in SAARC nations has been constrained by several factors like small land holdings, inadequate infrastructure, lower capital investment, marketing problems etc. In this backdrop, sericulture provides an excellent opportunity for generation of rural employment, empowerment of women and income generation.

The R & D Institutes of CSB possess required expertise for supporting such developmental needs of SAARC countries both in terms of strategic research and technical cooperation. The major areas could as well be: Consultancy (planning and coordination of programmes), Research and Development (collaborative research projects on identified thrust areas), Supply of commercial hybrids (silkworm hybrid seed and establishment of seed production centers) and HRD (Training in seed production, commercial chawki rearing, silkworm rearing, cocoon and silk processing, fabric manufacturing and value added products).

The specific requirements of each SAARC member country needs to be considered to draw country-wise strategy for translating successful Indian model based on the available infrastructure (forward and backward linkages) for silk production, man power and scale of operation.



# **Strategies for adoption of appropriate innovations and technologies for the development of sericulture in SAARC countries**

**S. Nirmal Kumar**

Ex-Director, Central Sericultural Research and Training Institute  
Berhampore, West Bengal, India

Sericulture industry stands for livelihood opportunity for millions owing to high employment oriented, low capital intensive and remunerative nature of its production. The very nature of this industry with its rural based on-farm and off-farm activities has attracted the attention of the planners and policy makers to recognize the industry as one of the most appropriate avenues for socio-economic development. The sericulture industry comes with potential advantages offering higher return per acre of land and higher share of value chain for the farmers. Short gestation periods, higher number of crops, robust demand & sustainable market for silk, women friendly, intercropping and economic potential of by-products are the other advantages. Sericulture provides economic development and improvement in the quality of life to the people in rural area and plays an important role in anti-poverty programme and prevents migration of rural people to urban area in search of employment.

Addressing new challenges for the development of any sector requires the adoption of appropriate innovations and technologies and sericulture is no exception. Sericultural development depends to a great extent on how successfully knowledge is generated and applied. Indeed knowledge intensiveness has featured prominently in most strategies to promote sericultural development. Yet the changing context for sericultural development has highlighted a strong need to understand and adopt innovation systems thinking. An innovation system can be defined as a network of organizations, enterprises and individuals that focuses on bringing new products, new processes and new forms of organization into economic use together with the institutions and policies that affect their behaviour and performance. The innovation systems concept extends beyond the creation of knowledge to encompass the factors affecting demand for and use of knowledge in novel and useful ways. Innovation systems not only help to create knowledge but also they provide access to knowledge, share knowledge and foster learning.

Technology can be termed as the application of knowledge for practical purposes. The ideal technology should be efficient, practical and cost effective. The technology is a link that connects sustainability with enhanced productivity,

where resource productivity is efficiently maintained by carefully planning the conservation and exploitation of resources such as soil, water, plants and insects. The tasks of transferring existing technology and development of cost-effective and environment-friendly technology should be taken simultaneously. The sustainability factor should be looked at the ability of sericultural land to maintain acceptable levels of production over a long period of time. In this context, technology allows people to become more efficient or to do things that were not possible before. The productivity increase is possible through environment-friendly and profitable technologies. Not necessary all the profitable technologies are adopted since barriers to practice new technologies for environmental attributes associated can limit their effectiveness. The adoption and diffusion of alternative practices are also influenced by the factors such as, the size of the farm, economic risk and geographical location. This should be one of the important issues for policy consideration.

SAARC region is broadly classified as low-income or low-middle income category in global parlance. Agriculture remains the predominant sector of the region's economies. A vast majority of population in the region lives in rural areas and depends upon agriculture for livelihood and sustenance. Growth of sericulture sector is also important to livelihood security, reduction in hunger and promoting sustainable and inclusive growth. Sericulture farming in South Asia is dominated by small holdings, small-sized farms face serious constraints in adopting modern technology and in marketing their produce. To some extent, the size disadvantage can be obviated through contract and cooperative farming. Small size of holding is reflected in very low land to labour ratio. Another serious disadvantage faced by the farmers in the region is heavy dependence on rain. Region-wise sericulture is facing several challenges, threatening its growth and sustainability. The physical and economic environment in which sericultural activities are undertaken is changing rapidly and getting complex. This necessitates preparedness to face upcoming challenges and unfolding new reality.

Sericulture is based on dynamic biological, physical & chemical systems and farmers live in a constantly changing economic, social, and political environment. Given this scenario it is illogical to believe that there is a "magic bullet" to deliver sustainable sericulture to all farming locations. Sericulture being one of the sector of rural economy in SAARC countries, the empowerment of the farmers in taking initiatives and decisions will help in shaping the future of the farmers economy. Farmers as producers of cocoons and reelers as producers of silk must have an enabling environment for access to know-how and do-how for realizing the full potential of modern sericultural technology. In most of the projects the primary beneficiaries are the individual farmers (small and marginal) and farm women besides the progressive farmers.

### **Farmers' perceptions and adoption of new sericulture technologies ex**

The sericulture technologies developed particularly in India for both mulberry and silkworm can be broadly classified as technologies for-

- ❖ Enhancing and sustaining production and productivity.
- ❖ Conservation and efficient use of land and water.
- ❖ Rational/balanced use of sericulture inputs.
- ❖ Prevention of pre and post-harvest losses.
- ❖ Post cocoon technologies.

As sources of technology information and agents of technology transfer, farmers assess the characteristics of new technologies, test, evaluate and find them to match their preferences thereby setting into motion an endogenous process of technology diffusion. Farmers' subjective preferences for characteristics of new sericultural technologies are very important determinants of adoption behaviour. An advantage of the approach is that it is possible to identify the characteristics of technologies that need to be targeted for improvement if adoption is to be achieved. In recent years, SAARC countries have realized the need to revive sericultural extension services to promote pro-poor growth, reach poor and small marginalised farmers and address new challenges on sustainability, environmental degradation and climate change. It is widely recognised that innovation comes from multiple sources, including farmers and how the agendas of different stakeholders are represented affects the 'appropriateness' of new technology developed. Farmer participation in technology development and participatory extension approaches have emerged as a response to such new thinking. New approaches such as Farmer Field Schools (FFS) have been introduced.

### **Evolving concepts and approaches to extension management system**

A major role of sericultural extension in SAARC countries has been to disseminate technologies generated by public sector research organisations through appropriate dissemination strategies such as demonstrations, field visits, farmers' meetings, use of media *etc.*. Diffusion studies have helped to show sericultural extension workers how to communicate new technologies to farmers and thus how to speed up the diffusion process. The model of technology transfer is often viewed as the linear model as it assumes a linear relationship between research, extension and farmer with organised publicly funded science as the source of innovation. While the practice of extension may have stuck in technology diffusion, more general thinking on the nature of sericultural technology development and promotion has advanced considerably in the last two decades. Direct farm level links are to be stressed between researchers and farmers. Addressing new challenges requires extension to play an expanded role

with a diversity of objectives, which include linking farmers more effectively and responsively to domestic and international markets, enhancing crop diversification, coupling technology transfer with other services relating to input and output markets, poverty reduction and environmental conservation. Viewing sericulture, as part of rural development process, which includes enterprise development & non-farm employment, capacity development in terms of strengthening innovation process, building linkages between farmers & other agencies and institutional development to support the bargaining position of farmers.

### 1. Sericultural innovation system

Advancing sericultural innovation means building institutionally sustainable innovation systems, which can be gauged by growing interrelations between the participants in the innovation system, an intensive communication between all stakeholders and a strong social embedding.

### 2. Pluralistic extension system

Sericultural extension services can be potentially provided by three main groups: the public sector, the private non-profit sector and the private for-profit sector. The public sector includes Ministries and Departments of sericulture and Sericultural research centres. The private non-profit sector includes local and international NGOs, foundations, community boards and associations, bilateral and multilateral aid projects and other non-commercial associations. The private for-profit sector consists of commercial production and marketing firms (such as input manufacturers and distributors), commercial farmer or farmer group operated enterprises where farmers are both users and providers of sericulture information, agro-marketing and processing firms, trade associations and private consulting and media companies. With changing environment of sericultural extension, institutional pluralism and bottom up participatory approaches are necessary to address new challenges. The public sector may still need to play an important role in providing sericultural extension services due to its 'public good' nature but its role should be changing in the face of increasing role of private and NGO sector and additional responsibilities of extension services. Entry of actors such as the private sector and NGOs in delivery of such services should be relaxed and creation of innovative public-private partnerships (PPP) in extension should be facilitated and promoted.

### 3. Demand-driven extension system

The concept of demand-driven extension emphasizes the need to provide services that meet needs and priorities of farmers in the context of changing domestic and international environments for sericulture. It is linked to a paradigm shift in public sector reform towards responsive governance. However, it remains a major challenge to identify the options for extension reform that are likely to make

extension more demand driven, especially given the situation that market failures in sericultural services are widespread. To make extension more demand driven, the following strategies can be considered:

- Decentralisation, to make public agency more responsive to local needs.
- Contracting, to overcome some of the state failures and generate incentive.
- Cost recovery, to improve financial sustainability and demand orientation.
- Participatory extension approaches, to encourage farmer participation.

### **Experiences of key countries**

Extension arrangements in South Asian countries have a large degree of similarities in terms of its organisation and underlying conceptual framework. Inadequate technology adoption has been attributed to existing weakness in research extension linkages, although several measures have been taken to address this problem in the last two decades. But these measures have neither challenged the role of extension nor its relationships with research. Countries increasingly realize the need for extension to engage with a wide range of issues beyond disseminating technologies. These include markets, inputs and environment. This has raised the need for better qualified and specialized extension staff and experimentation with institutional arrangements. Similarly it is now recognized that there is need for extension to play a greater adaptive research role to better target technologies at the field level and to provide organisational and marketing support to farmers.

It is observed that the prospects of sericulture and allied activities in South Asia require adoption of established technological inputs to primary producers and mechanisms for evolving and establishing new systems of organizing production and marketing. The trend of total raw silk production and mulberry area in major South Asian countries possesses non-uniformity in the mechanism of productivity and economic outcome. Notably, India among the major silk producing countries has added a pace of momentum in increasing productivity and quality of raw silk in the world by adopting the appropriate strategic technologies in mulberry production, silkworm rearing and post cocoon technology. Today's silk industrial regions need a generic silk promotion campaign which could be a solution to the challenges. These concerted efforts from silk producers, converters and traders to improve the image of silk in international markets would take the sericulture industry to the glorious heights not only in India and Asian region but in the entire globe. A campaign should aim to reposition the image of silk, capitalize on new technologies and changing market demands and to encourage silk production. As campaigns require both coordination & investment and may take time before they

have an effect. An effective approach may be to work through industry associations to craft national campaigns in the largest consumer markets. SMOI in India is an attempt towards this direction.

There is a need to conceptualize innovation policy differently with sharper focus on linkages among stakeholders. The policy need is to ascertain ways of enhancing complementarities and support all kinds of innovations. Adoption of innovative technologies can lead to sustainable utilisation of labour particularly in the arid and semi-arid regions. A holistic and system-wide approach is required in the diagnosis of constraints and opportunities for productivity improvement, employment generation and poverty reduction. Sericultural intensification is to be done, *i.e.* bringing more land under cultivation and cultivation in more than one season. R&D, extension and diffusion of new technologies should focus for addressing productivity problems as well as problems of coping with drought, water scarcity, poor soil quality, nutrition, market demand *etc.* Addressing issues of factor endowment – irrigation, labour, credit, external inputs (fertilizers, seeds, pesticides) *etc.* should culminate in yield increase and productivity.

### **Failures and Policy implications**

It is difficult to assess the impact of extension services as the indicators (*e.g.* adoption of technology and farm productivity) are also influenced by many other factors that have compounding effects. The effectiveness of extension in many low income countries is highly contingent on relaxing wider barriers to the successful development of the sericultural sector as a whole, including such potentially limiting factors as credit, technology, input supplies, price incentives, institutions and human resources constraint. Public extension services are under pressure for their own low performance. Extension services have low coverage, often working with no more than 10 percent of potential clients of which a small minority are women. Another problem is financial sustainability, especially if cost recovery is not pursued. After donor-funded programs end, extension agencies are left with an increased number of agents, which often leads to budget reduction and ultimately ineffective extension services. One important strategy to address these failures in sericultural extension is to involve NGOs, farmer based organisations and private sector agencies in the management and execution of extension services.

The policy implications should be to

- Ensure local innovations are valued and incorporated in the innovation system.
- Stimulate local experimentation and facilitate exchange of local innovations.
- Allow small funds for more flexibility in research than expensive projects.

- Incorporate lessons learnt from small projects into the bigger ones.
- Regular learning opportunities and monitoring need to be undertaken to change scientists and ‘extensionists’ mindsets to listen to farmers and work with them.
- Communication with stakeholders need to stimulate the multiple actors to appreciate such innovations
- Farmers should be involved in the development of farmer and education tools and communication strategies.

### **Key findings**

- It is essential to ensure that existing and new knowledge will be used more effectively to enhance productivity.
- Research and researchers are not the only contributors to innovation and change –rather innovation and innovation systems require different sets of actors.
- Improved communication, information and interaction through the internet and other channels to be used for disseminating new ideas and knowledge from various sources. It is imperative to identify ways for this kind of knowledge to be brought into the change process.
- Large gaps exist between what can be attained at farmers’ fields with adoption of improved technology and what is obtained with the existing practices followed by farmers. Potential for raising output through effective dissemination of technology is considerable. It is constrained owing to absence or weak Research-Extension-Farmer linkages. As public extension system is proving increasingly inadequate for dissemination of technology, there is a need to involve private sector in this endeavour. This would require increased public–private sector participation through appropriate returns and incentives for the innovators and disseminators.
- Better technologies and efficient ways of managing water and modern farm inputs are now available to make sericulture farming more sustainable. But their widespread adoption is hindered by inappropriate pricing policies, insufficient training of farmers and a failure to manage negative externalities. Many opportunities exist to harness sericulture’s potential as a provider of environmental services. The emergence of new markets and programs like ‘carbon credit’ for payments for environmental services and ‘green energy’ manifests high promise and should be pursued by local and national governments across the region.
- Resource-conserving technologies are now available for various ecological regions. These can be very helpful to save water and energy, reduce cost and

increase farmers' income. Adequate emphasis and investments are required to harvest and conserve rain water and optimally use available water. As water is emerging as the main constraining factor, particular attention needs to be given to check its wastage. Rainwater going waste needs to be harvested and conserved. Major emphasis is needed on water conservation and recharging schemes, including restoration and renovation of traditional water bodies, as an integral part of watershed development with the involvement of local communities and NGOs. A paradigm shift is needed in promoting sericultural productivity – not only per unit of area but also per unit of water and time.

In summary, the innovation systems approach recognizes the importance of technology but focuses on innovation, widens the range of actors involved, highlights the institutional context and the environment that promotes dominant interests and underscores those innovation systems as social systems. The concept of sustainable sericulture is difficult to deal where farmers have few resources and little flexibility to change their practices and where the risks of failure often have tragic consequences. Additionally, sustainability in sericulture is a complex "moving target". Technology is the prime mover for growth. Considering the costs and constraints of resources *e.g.* water, nutrients and energy, genetic enhancement of productivity should be coupled with 'input use efficiency'. This can be made possible only by utilizing full potential of the existing improved technologies and by developing newer technologies.

### **Technology delivery system**

Sericulture is fast becoming more knowledge-intensive, market-oriented and demand-driven. Extension is thus required in a systemic perspective from production to consumption in a value chain mode. Conventional systems of technology transfer are inadequate. Diversified nature of farming demands, against economic liberalization and globalization is radically changing the spectrum of service providers to farmers. Indeed, the private sector, farmers' organizations, cooperatives, self-help groups, para-professionals, non-governmental organizations, input suppliers and small agri-businesses are increasingly engaged in providing information and services. Increased reliance on private sector extension, however, does not imply a complete withdrawal of the public sector – which must continue to finance public extension and information services and coordinate extension activities. There is a need to have a re-look at the basic extension strategy considering the strengths of both public and private sector. The extension system has to capitalize on the complementarities and harness coherent synergies between public and private sector. Further, 'Research–Education–Extension–Marketing' needs to be in a continuum.

Rapid development of Information & Communication Technology (ICT) and telecommunication network have paved way for creation of information network,



knowledge pool and services on new sericultural technology, products and marketing of produce. These need to be used intensively. It's necessary to develop farmer-friendly information network /tools to provide whole range of information leading to delivery of knowledge of new sericultural technology, products, procedures and related services – to enable them to take control of their farming environment. In this direction CSB, India has successfully designed and introduced the Sericulture Information Linkages and Knowledge System (SILKS) for exclusive benefit of stakeholders. In future, SAARC countries should focus on new ICT-mediated engagements in Research-Education-Extension continuum that promote greater ease of technology exchange among relevant entities and with farmers while improving farmers' opportunities for improved income and livelihood security.

### **Capacity Building**

Development of institutional capacities for facing sericultural challenges and harnessing opportunities differ across SAARC countries. Some countries do not have sufficient trained manpower and institutional capacity to implement required programmes for achieving the objectives. Thus, mechanisms should be put in place for these countries in capacity development for manpower and institutions.

### **Regional Complementarities and Collaborations**

Few evolved challenges *e.g.* spread of plant and insect pests and diseases, climate change require cooperation – both at regional and global levels. While there already exists intra-regional cooperation in core areas of agriculture and livestock in training and the same is required for sericulture also for sharing of best practices and capacity building. Further, there is a need to strengthen and harmonize the existing SAARC institutional mechanisms. Upon finding answers to the questions, SAARC countries would have to identify policy interventions that help in achieving optimal results. These policies would relate inter alia to investments, credit, incentive structure, trade, marketing, risk and insurance, technology and institutions.

- Creation of a common institution to facilitate and expedite regional collaboration.
- Development of methods and means for innovation of the cocoon/silk production and processing technique and technology.
- Making bilateral and multilateral contracts between the countries of region about exchange of genetic resources of silkworm and mulberry, scientific and technical information, providing overseas training, creating modern laboratory facilities and equipment *etc.*
- The local governments/sericulture institutes experts exploiting commercial silkworm hybrids to make feasibility studies to plan some new production

- areas, promotion development of traditional silk handcraft production as value added products and additional way to utilize the locally produced cocoons/raw silk and provide income resources.
- Each region country should develop a national strategy for sericulture development and integrate it in their national development plans and promotion of foreign investments in sericulture industry.
  - Underscore the importance of education, in developing comprehensive linkage among research, extension and farmers.
  - The role of private sector, input dealers, farmers' organizations, civil societies and media also to be recognized.
  - Research systems should accord high priority to frontier technologies to attain genetic improvements with desired traits.
  - Towards effective research-extension-farmer (R-E-F) linkages, a set of specific national priorities and actions: strong support of the Governments in terms of enabling policy frameworks and provision of adequate resources, competence building in research and extension personnel with an emphasis on creating right type of mindset and attitude.
  - Knowledge-based technology forecasting keeping in consideration emerging paradigm shifts due to WTO and new IPR regime, ICT-based, low cost, personalized seri-advisory systems.

### **Road Ahead**

Global community is witnessing strong surge of regionalism. As a consequence, countries in the neighbourhood are contemplating different ways of cooperation to maximize benefit from available options and ways to face new challenges and harness the opportunities arising. Thus, the number of regional groupings is rising and regional cooperation is deepening. Growing interdependence among countries is putting further catalysing such cooperation. Regional cooperation in sericulture should focus around the identified challenges and opportunities. To that end, on a priority basis, a consensus is to be arrived at on identified areas for cooperation in sericulture and then form partnership and institutional mechanisms to operationalise regional cooperation. Concrete areas for cooperation and action in sericulture sector within the existing SAARC arrangements should be put in place with focused strategy.

### **Conclusion**

Farmers do not always ask for sustainable solutions, neither are they aware of the full range of solutions. SAARC sericultural research centres have a role to play in generating pro- poor technologies but their role in strengthening extension and

service providers has hardly been articulated. While the recent focus in sericultural innovation system thinking contributes to making research more relevant and forging partnerships with non-traditional partners, the development and testing of pro-poor uptake pathways, processes and mechanisms remain by and large unaddressed by current research management schemes. Donors want to see impact of research. Development returns to donor investment in research will only be boosted if linkages between multiple actors in the innovation system are strengthened.

To move beyond the islands of success of participatory research and interventionist reflections on innovation systems, more resources will need to be allocated to a different type of research, including research on pro-poor and gender-sensitive extension tools, mechanisms and alliances. Without this, innovation systems thinking are unlikely to make a difference for poor farmers in SAARC countries. Donors have a part to play in supporting organizations equipped to strengthen the quality and effectiveness of the multiple extension and service providers. There is no controversy in developing sericulture to obtain higher yield and increased income of the farmer without affecting the environment. This approach in fact, is sustainable sericulture. Sustainability has been given due consideration because in South Asian countries land use has been intensified and problems such as, unplanned exploitation of the natural soil and water resources have been realised. The skyrocketing costs of energy and agricultural inputs have reduced profitability, which has severely damaged the environment. This necessitates the proper assessment of the constraints and potentials of natural resources by examining policies of respective governments and appropriateness of sericulture technologies.

# **Need for establishing Post Cocoon facilities for the introduction of sericulture industries in SAARC countries**

**Subhas V. Naik**

Director, Central Silk Technological Research Institute., Central Silk Board  
Ministry of Textiles, Govt. of India, BTM Layout, Bangalore-560068

## **Introduction**

Silk is a highly valued textile fiber of animal origin used almost entirely for the production of high quality textiles. Silk is the most elegant textile in the world with unparalleled grandeur, natural sheen, and inherent affinity for dyes, high absorbance, light weight, soft touch and high durability and known as the “Queen of Textiles” the world over. The production of silk commencing from silkworm rearing right up to weaving is mainly a rural, labour-intensive activity requiring relatively low investment and offering high profit potential and foreign exchange. Though silk accounts for less than 1% by volume of world fiber production, its relatively high value makes sericulture an important industry in the developing countries. Silk production and trade in most of the major producing countries are subject to close government control. Sericulture and production of silk goods are a complex agro industrial process needing considerable agricultural, processing and organizational skills.

Sericulture is not just restricted to the agricultural activities of mulberry cultivation, silkworm rearing and seed production, but opens up into the sectors of silk reeling, twisting, weaving, dyeing, printing and garment manufacture. These activities in turn support the ancillary enterprises of machine manufacture and by-product utilization including spun silk yarn manufacture and pupae oil extraction, thus providing employment for the skilled and unskilled labour force and nurtures entrepreneurship right across the country. The progressive movement along the chain of activities is not just limited to conversion of form, but value addition as well. While, the farmers in the rural areas practice sericulture for producing cocoons, silk reeling/spinning and weaving activities are concentrated in semi-urban areas, towns and cities.

Thus establishing the post cocoon industries in SAARC is essential for the development of sericultural industry on one side and provide tremendous scope for employment generation on the other side besides opening of lot of small ancillary industries.

## **Global Silk Industry**

The major silk producing countries in the world are; China, India, Uzbekistan, Brazil, Japan, Republic of Korea, Thailand, Vietnam, DPR Korea, Iran, etc. At present, 159718 MT of silk is produced globally (2013). While the major producers are in Asia (90% of mulberry production and almost 100% of non-mulberry silk), sericulture industries have been lately established in Brazil, Bulgaria, Egypt and Madagascar as well. China is the world's single biggest producer and chief supplier of silk to the world markets. India is the world's second largest producer. China produces nearly 84% of the total silk produced in the world followed by India with 12%.

### ***Silk in SAARC countries:***

**South Asian Association for Regional Cooperation (SAARC)** is an economic and geopolitical organization of eight countries that are primarily located in South Asia or Indian subcontinent. The member states are Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. The silk industry scenario in these countries are given below.

**Afghanistan** has a long history in the national and international silk production and silk carpet markets. Balkh and Kunduz provinces were major silk producers in the North of Afghanistan 30 years ago. Though it has potential due to continuous the years of conflict, the production level of silk cocoons decreased because producers of silk products were unable to continue their business, so there was less demand for cocoons and silk thread. Presently, **Afghanistan** is producing about 1.00 MT of silk.

In **Bangladesh** sericulture is an important rural industry with around 6.50 lakhs people involved in sericulture. An appreciable amount of 50 MT of silk yarn is produced in Bangladesh (ISC, 2013). The Bangladesh Sericulture Board (BSB) located at Rajshahi provides services to people engaged in sericulture industry. Sericulture activities are implemented in 48 districts and 202 upazilas in the country and about 10 million mulberry have been planted. These activities have generated employment for more than 5 million people and produces 1 million Kg Cocoon (BSB, 2013).

In **India**, Sericulture is mostly a village-based industry providing gainful occupation to around 7.5 millions in the rural and semi urban areas, which represent the economically weaker sections of society. There is substantial involvement of women in this Industry. Although Sericulture is considered as a subsidiary occupation, technological innovation has made it possible to take it up on an intensive scale capable of generating adequate income. It is also capable of providing continuous income to farmers. India continues to be the Second largest

producer of silk in the World and produces 19476 MTs of mulberry raw silk. India has the unique distinction of being the only country producing all the five kinds of silk – Mulberry, Eri, Muga, Tropical Tasar and Temperate Tasar.

In **Pakistan** sericulture is still the industry of nomads, which could not expand on large scale due to a number of reasons among which lack of research and extension activities and training. Presently, **Pakistan** is producing about 0.50 MT of silk.

In **Nepal**, the initiation of sericulture was done in 1911. Although the annual demand for silk thread in the domestic market is roughly around 200 Tonnes, only 1.5 MT is produced within the country. Of the 11 districts that are involved in silk production, the key silk producing districts are Chitwan, Makwanpur, Ilam, Shyangja, Dhading and Tanahun. In all there exist seven industries, which are involved in production of silk. From farming to fabric, round-about 7,500 people are employed in silk sector.

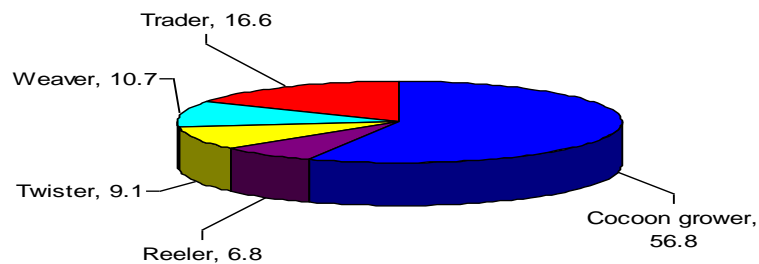
In **Bhutan, Sri Lanka and Maldives** sericulture activities are still in primitive stage and among there are reports of silk production in Bhutan.

***1. Why post cocoon sector is important for the overall development of sericulture?***

Sericulture is an agro industry where in the agriculture produce of cocoon is converted to the usable yarn or fabric in the industry. Cocoon has a value only when it is converted into yarn and fabrics. Hence, the sustenance as well as the development of the sericulture sector is very much depends on the development of the silk industry sector. The post cocoon sector is the silk industry segment comprising of silk reeling, twisting, designing, silk weaving, dyeing and finishing etc. The post cocoon sector interface the silk industry with the consumer and provides the necessary impetus to the entire sericulture.

The following details provide the glimpse of the contribution of PCT sector in the entire value chain.

**% Share of income to different groups in Sericulture/Silk Industry**



### **Sericulture and rural development**

Silk industry stands for livelihood opportunity for millions owing to high employment oriented, low capital intensive and remunerative nature of its production. The very nature of this industry with its rural based on-farm and off-farm activities and enormous employment generation potential has attracted the attention of the planners and policy makers to recognize the industry among one of the most appropriate avenues for socio-economic development of a largely agrarian economy like India.

There is a very high value addition in the silk industry to the tune of 10-30 times. When the cocoons are sold at around Rs. 300/= per kg, the Raw silk is sold at Rs.3000/- per kg and some varieties of silk saree are sold at Rs. 10,000/- Rs. 20,000/- per saree. Even certain sarees are sold at Rs.1.00 lakh also. Hence, the industry can offer high wages to the artisans. Thus, large chunk of income goes back to the villages from the cities.

### ***Sericulture and women empowerment***

Sericulture is an ideal avocation for women because; it needs less specialized skill and suits women well; mostly indoor activities; less physical strain; manual labour; work is evenly spread over during the day with intermittent gaps, offering leisure time and proximity of living place. Women involvement in all the different activities of the sericulture is about 53%. Sericulture generates employment @ 11 man-days per kg of mulberry raw silk production (on and off-farm activities) through the year.

### ***Strategies for development of Post Cocoon Sector in SAARC countries:***

Reeling forms a vital link in converting the agricultural produce viz., Cocoons into an industrial product - the yarn. Hence, for sustained sericultural activity, it is important to have the vibrant reeling sector as the cocoon is a perishable commodity.

Therefore, in any country, the development of post cocoon sector begins with the development of the reeling sector and this is the case with the SAARC countries also as the sericulture is in nascent stage.

Reeling involves a series of intricate process converting the cocoons into raw silk. The reeling employs a variety of reeling devices viz., Charka, cottage basin, domestic basin, multi-end reeling machinery and Automatic silk reeling technology. At the bottom level we have Charkas, in the intermediate level, we have cottage basin/Domestic basin reeling devices, while at the upper-end, there are multi-end reeling machines and automatic reeling machines.

The raw silk yield, productivity and its quality are significantly influenced by the following factors.

1. Cocoon quality
2. Reeling machineries
3. Reeling process parameters
4. Human skill in various operations
5. water quality

To begin with SAARC countries can start with the establishing the cottage basin units /and multiend reeling units in order to convert the cocoons into raw silk. The sericulture farmers generally wants to get better price for their produce ie cocoons vis-à-vis other commodities and this is possible when the reeling units are in a better position to offer better price for the cocoons. Such scenario of competitive pricing for reeled silk is possible when the reeled yarn is in demand for its conversion into fabric by the vibrant weaving and wet processing industry making the silk products needed by the consumers.

In most of the SAARC countries, the entire value chain is in nascent stage, the governments initially have to establish/ support the entire value chain of activities so that the entire industry is sustained. Such nurturing is very much essential till the industry is able to stand on its own. Simultaneously the govt. also has to develop the pvt sector through various entrepreneurial programmes.

Based on the quantum of the cocoons produced, the government has to establish the matching reeling, twisting, weaving and dyeing infrastructure so that the finished fabrics is coming out of the value chain for selling and its realization. In this manner, the entire value chain is sustained. Government should also create the marketing entities so that the finished goods are sold to the consumers. In this regard, it is pertinent to note that sericulture and silk industry have been developed in the non-traditional states of India by following the strategy mentioned above. Hence, the government should take the initiative for the creation of the infrastructure under the post cocoon sector so as to make the sericulture thriving.

Further support services like testing of cocoon, yarn & fabrics have also to be created. The skill of the workers play vital role and hence, suitable training facility have to be established.

In this regard, India can provide the necessary assistance in the following manner:

1. Formulating country specific projects
2. Providing required machineries / equipments
3. Capacity building through Training the manpower (both managerial as well as operatives)
4. Transfer of technologies

***Government system/support for the development of silk industry:***

As the sericulture industry is in nascent stage in most of SAARC countries, it is essential to have necessary policies and framework in place so that the support of the government is provided seamlessly. Such governmental support is possible when an apex body is created to formulate the necessary framework and oversee the overall orderly development of silk industry. In this regard, a leaf out of Indian sericultural administrative setup may be noted for formulating similar approach in respective SAARC countries.



By realizing the importance of sericulture industry way back in 1949 itself, Govt. of India constituted an 'Apex Agency' - the **Central Silk Board (CSB)** in April 1949 by an Act of Parliament, to function under the administrative control of the Ministry of Textiles, Govt. of India, to monitor and oversee the overall development of Sericulture and Silk industry,.

The mandated activities of CSB are i) Research & Development, Training & IT initiatives, ii) Seed Organization/ Coordination and Market Development (HRD) iii) Quality Certification System iv). Brand promotion & Technology up gradation. Apart from this, CSB has also been implementing a Centrally Sponsored Scheme viz .Catalytic Development Programme (CDP) with the aim of synergizing and disseminating technologies, innovations developed by its R&D units and incentivizing investments among the stakeholders to enhance production, productivity and quality of silk.

Through the sustained support of the government through Central Silk Board, the Indian silk industry has become vibrant. There has been paradigm shift in the productivity & quality of the products and income level of the stakeholders. In this regard, it is worthwhile to mention that the Indian sericulture has progressed steadily from mere 1,500.00 MTs of raw silk production during early 1950s to over 26480 MT in 2013-14 and productivity from 14.29 kg silk/ Ha to over 95.00 kg silk per hectare. In the similar lines, SAARC countries can also create appropriate apex body so that the long term support and interest of the silk industry is taken care of in their respective countries.

CSB has established CSTRI, an exclusive research institute for the overall development of PCT sector (Silk industry). Some of the important R & D developments made by the CSTRI which can be useful for the SAARC countries, are given below:

- a. Improved Cottage Basin Reeling Technology Package & Processes
- b. CSTRI Multiend silk reeling technology package
- c. Machinery package for effective utilization of byproducts of reeling industry
- d. Improved silk handlooms and allied equipments
- e. Silk power loom package
- f. Various dyeing machineries for yarns & fabrics
- g. Standardized the processing parameters of the each processes of silk industry

***Scope of Sericulture industry in the SAARC countries:***

There is a tremendous scope for the development of sericulture industry in the SAARC countries. As the Sericulture industry has huge potential, it will help the SAARC countries in employment generation, poverty alleviation, providing livelihood and women empowerment. The other SAARC countries share many

commonalities with India where the Sericulture industry is thriving. Agrarian economy, presence of textile and handloom sector, suitable conditions etc, are the some of the commonalities. For the rural population especially women, the sector provides huge opportunities. Hence, the SAARC countries have to develop the PCT sector for the overall development of Sericulture. India has gone through such phases and has different models and technologies to offer. From the traditional charkha to the modern Multiend machinery package and ARM package in silk reeling sector and other technologies in the weaving and wet processing sector are present in the basket of technologies available with CSTRI.

It is also observed that the sericulture farmers get the higher rates for their cocoons when large no of reelers participate in the cocoon market. Hence, a thriving PCT sector particularly, reeling industry is essential for the growth of Sericulture.

### **Conclusion**

The SAARC countries share many commonalities like climate, agriculture based economy, youth population, women population etc., with India and they can go for the development of sericulture sector. For the vertical and horizontal growth, the presence of PCT sector is essential so that the development is sustained and improved. The value addition takes place significantly in the PCT sector and the SAARC countries can exploit this for their advantage. The Indian experience in the development of silk sector may be emulated for similar out come.

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CSTRI Annual Reports

# **Strategic Approach for Establishing Market Linkages in SAARC Countries**

**P. Kumaresan**

Scientist-D, Central Silk Board, Bengaluru, India

Silk is the most elegant textile in the world with unparalleled grandeur, natural sheen, and inherent affinity for dyes, high absorbance, light weight, soft touch and high durability and known as the “Queen of Textiles” the world over. On the other hand, it stands for livelihood opportunity for millions owing to high employment oriented, women friendly, less capital intensive and remunerative nature of its production. Therefore, many developing countries consider sericulture as an important tool for economic development.

However, the success of introduction of sericulture in a particular region or a country depends on many factors, of which the success of integrating the sericulture and silk production enterprises with local, national, regional and global markets is of paramount importance. In this context, the project which deals with introduction of sericulture must have a clear market outlook by answering the queries such as (i) Is it designed to produce raw silk for export or for the use in the local textile industry?; (ii) Is the ultimate objective to produce raw silk or fabrics or garments? etc. The answers to these questions will determine the nature and the scope of the project and consequently the level of investment required for the project. Ultimately integrating the silk markets in the local, regional and international perspectives ensures the success of any silk project.

## **Global Demand and Supply of Raw Silk**

There is a clear distinction between silk producing and consuming countries. The major consumers of the silk products are Western European countries and the United States of America (USA). These countries do not produce raw silk. However, the European countries like France, Germany, Italy, the United Kingdom (UK) and Switzerland import raw silk and convert it into finished products for their domestic as well as export requirements. While China, India and Thailand have a strong production base of raw silk and facilities for converting the raw silk into fabrics and other finished products for domestic as well as export markets, countries like Brazil, Uzbekistan and Viet Nam produce raw silk mainly for export purpose.

China and India are the major global raw silk producers. In the global raw silk production of 1,59,776 MT during 2013, China’s raw silk production accounted for 81.36% (1,30,000 MT) and India’s share was 16.61% (26,538 MT) (Table 22).

Apart from India, the SAARC countries, which include Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan, and Sri Lanka, though have a tradition of production and domestic consumption of natural silk, are not major players in the production or trade in raw silk and fabrics.

**Table 22. Global Production of Raw Silk during 2008 to 2013**

Country	Raw Silk Production (MT)						% to total (2013)
	2008	2009	2010	2011	2012	2013	
China	98620	84000	115000	104000	126000	130000	81.36
India	18370	19690	21005	23060	23679	26480	16.57
Uzbekistan	771	780	940	940	940	980	0.61
Thailand	1100	665	655	655	655	680	0.43
Brazil	1177	811	770	558	614	550	0.34
Vietnam	NA	NA	550	500	450	475	0.30
North Korea	NA	NA	NA	300	300	300	0.19
Iran	180	82	75	120	123	123	0.08
Bangladesh	NA	40	38	42.5	43	44.5	0.03
Japan	96	72	54	42	30	30	0.02
Turkey	15	20	18	22	22	25	0.02
Madagascar	15	16	16	16	18	18	0.01
Indonesia	37	19	20	20	20	16	0.01
<b>Total</b>	<b>120396</b>	<b>106170</b>	<b>139100</b>	<b>129662</b>	<b>152846</b>	<b>159776</b>	<b>100.00</b>

**Note:** NA- Information not available; **Source:** International Sericulture Commission, <http://www.inserco.org/en/statistics>

### Global Trade in Silk Goods

The global trade in silk goods amounted to US\$ 5507 million during 2013, which accounted for mere 0.72% of the global trade in Textiles & Clothing (T&C) (Table 23). The value of the trade in silk goods reduced from US\$ 6007 million in 2008 to US\$ 5507 million in 2013 registering a negative compound growth of -1.44% per annum. As silk goods are associated with luxury and the demand for silk is highly income elastic, the economic recession in the USA and European countries from 2008 to 2013 affected the trade in raw silk and silk goods.

**Table 23. Silk Exports by Major Countries during 2008 to 2013**

Year	Value of Silk Trade* (Mn.US\$)						Global T&C Trade (Mn.US\$)	% of silk in Global T&C Trade
	China	Italy	France	India	Hong Kong	World		
2008	1988	1145	339	529	411	6007	308800	1.95
2009	1733	834	271	436	322	4791	526740	0.91
2010	2101	857	293	476	354	5264	605313	0.87
2011	2238	964	364	410	345	5529	711917	0.78
2012	2210	939	368	307	316	5458	706731	0.77
2013	2225	959	424	301	290	5507	766166	0.72
% to total (2008)	33.09	19.06	5.65	8.81	6.84			
% to total (2013)	40.41	17.42	7.70	5.47	5.27			
CAGR %	1.90	-2.91	3.78	-8.97	-5.65	-1.44	16.35	-15.29

**Note:** \* - The export value pertaining to the items falling to HS codes of Chapter 50, 610620, 621410 and 621510 only; CAGR- Compound Annual Growth Rate; **Source:** COMTRADE database for the statistics related to silk trade and International Trade Statistics (various issues), WTO, Geneva for the statistics related to global trade in T & C

Silk is traded in five main product categories namely raw material, fabrics, garments, accessories and furnishings. Garments form the largest portion in value terms accounting for one third of the trade, while raw material forms the largest part in volume terms. The trade in raw silk has been showing a constant decline in the past few years, as China, which is the dominant exporter of raw silk with a share close to 75 % of the world market, focuses more on exporting value added products. India, on the other hand, is the largest importer in this category as it imports high volumes of yarn from China.

The major exporters of silk fabrics are China, Italy, India and France. The world trade in silk garments is dominated by China and the major market is the USA. Silk blouses are the largest category of exports within garments. The world trade in silk accessories is dominated by Italy followed by China. The major market for silk accessories is the USA.

If we look into the country-wise export details, China, with its huge silk production is undoubtedly world leader in silk trade. It has almost 40% of the share in the global trade in silk products followed by Italy, France and India (Table 2). While world trade has been shrinking in the period between 2008 and

2013, China and France could expand their trade in silk thereby they could increase their market share.

As India has very strong domestic demand for silk especially for saree, it consumes almost 85 % of its production within the country and the export surplus is limited. As sericulture industry in Brazil, Thailand and Vietnam is shrinking, their role in the world silk trade is also reducing.

The USA is the largest net importer of silk and silk products with the value of imports of silk products increasing at a growth rate of 2.30% per annum during the period between 2008 and 2013 (Table 24). Among the European countries, Italy is the top importer of silk and silk products followed by France, Germany and the United Kingdom (UK).

**Table 24. Silk Imports by Major Countries during 2008 to 2013**

Country	Value of Imports* (Mn.US\$)						CAGR %
	2008	2009	2010	2011	2012	2013	
USA	719	727	715	611	597	824	2.30
Italy	578	538	590	452	377	560	-0.53
Japan	382	367	378	323	292	389	0.30
France	341	315	298	257	271	325	-0.80
Hong Kong	269	275	302	345	300	397	6.70
India	239	329	352	375	395	376	7.88

**Note:** \* - The import value pertaining to the items falling to HS codes of Chapter 50, 610620, 621410 and 621510 only; CAGR- Compound Annual Growth Rate; **Source:** Compiled from COMTRADE database

Japan imports substantial quantity of raw silk and finished silk products from China and other countries, as the silk production has reduced significantly in the country due to industrialization. India also imports a sizeable quantity of raw silk, since the domestic silk production does not meet the industry demand.

### **Silk Production and Trade in SAARC Countries**

The SAARC, which comprises Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka, have a long tradition of production and consumption of silk. However, among SAARC countries, only India plays a significant role in global production and trade of silk. Apart from India, the details pertaining to annual silk production are available only for Bangladesh (45 MT) and Nepal (3 - 4 MT).

The extent of import dependency in the trade in silk and silk goods of the SAARC countries could be examined by computing Export/Import Dominance (EID) and Balance of Trade (BOT) indices. The EID Index is obtained by dividing imports by exports for clusters or industries. A ratio of greater than one indicates high import dependency and relative competitive weakness. Similarly the Balance of Trade (BOT) is calculated as the difference between exports and imports for clusters or industries.

It can be inferred from Table 25 that all the SAARC countries except India have deficit in the BOT in silk goods. India has a large import dependency in raw materials especially raw silk. Yet, it is an export dominant country having trade surplus with than one EID value and positive BOT in silk products. The EID values are very high for Afghanistan, Bhutan and Pakistan, as the proportion of import value of silk goods are much higher than the value of exports. Maldives did not export any silk item but imported silk goods resulting in negative BOT.

**Table 25. Export/Import Dominance (EID) Index and Balance of Trade (BOT) for SAARC Countries' Trade in Silk Goods with World**

Country	Export-Import Dominance (EID) Index*				Balance of Trade** (BOT) in Silk (Million US\$)			
	2010	2011	2012	2013	2010	2011	2012	2013
Afghanistan	NT	NT	NT	1176.88	0	0	0	-9.41
Bangladesh	3.63	2.84	14.73	13.91	-9.12	-6.56	-7.06	-8.45
Bhutan	115.50	607.00	59.50	NE	-0.46	-0.61	-0.12	-0.12
India	0.79	0.86	1.07	0.79	100.39	58.44	-21.34	62.48
Maldives	NE	NE	NE	NE	-0.04	-0.07	-0.07	-0.13
Nepal	3.41	3.88	NT	4.11	-3.11	-4.28	0	-2.64
Pakistan	35.89	62.81	34.16	10.11	-39.85	-35.17	-33.03	-22.27
Sri Lanka	4.18	3.97	3.23	3.66	-3.70	-7.18	-4.60	-2.59
SAARC	0.91	0.99	1.21	0.94	44.12	4.58	-66.21	16.87

**Note:** \*  $\frac{\text{Export}}{\text{Import}}$  Dominance (EID) Index =  $\frac{\text{Imports}}{\text{Exports}}$ ;

\*\* Balance of Trade (BOT) = Exports - Imports      No trade in silk; NE- No Exports

If we look into the details of value of exports of silk goods from each SAARC country in 2013, India's exports alone accounted for about 98% (US\$ 301.21 million) out of the total SAARC countries' export value of US\$ 301.21million (Table 26). Woven fabrics of silk or of silk waste (HS code 5007) and shawls, scarves, mufflers, mantillas, veils and similar articles of silk or silk waste (excl.

knitted or crocheted) bearing HS code of 621410 were the major items of exports from SAARC countries.

**Table 26. Value of Silk Exports from SAARC Countries during 2013**

HS Code	Product description	Value (Million US\$)						Total
		Afghanistan	Bangladesh	India	Nepal	Pakistan	Sri Lanka	
5001	Silkworm cocoons	0.00	0.00	0.02	0.00	0.00	0.00	0.02
5002	Raw silk (not thrown)	0.00	0.00	0.67	0.00	0.00	0.00	0.67
5003	Silk waste	0.00	0.00	19.91	0.00	0.14	0.00	20.05
5004	Silk yarn (other than yarn spun from silk waste)	0.00	0.00	0.70	0.00	0.12	0.00	0.83
5005	Yarn spun from silk waste, not put up for retail sale	0.00	0.00	2.80	0.00	0.00	0.00	2.80
5006	Silk yarn & yarn spun from silk waste, put up for retail sale	0.00	0.00	1.32	0.00	0.00	0.00	1.32
5007	Woven fabrics of silk or of silk waste	0.00	0.09	138.87	0.00	1.56	0.01	140.53
620610	Silk Women's/girl's blouses and shirts	0.00	0.33	36.24	0.41	0.58	0.96	38.52
621410	Silk Shawls, scarves and veils	0.01	0.18	100.45	0.44	0.04	0.01	101.12
621510	Silk Ties, bow ties and cravats	0.00	0.05	0.22	0.00	0.00	0.00	0.27
	<b>Total</b>	<b>0.01</b>	<b>0.66</b>	<b>301.21</b>	<b>0.85</b>	<b>2.44</b>	<b>0.97</b>	<b>306.13</b>
	<b>% to total</b>	<b>0.00</b>	<b>0.21</b>	<b>98.39</b>	<b>0.28</b>	<b>0.80</b>	<b>0.32</b>	<b>100.00</b>

Source: COMTRADE database

All the SAARC countries imported silk goods during 2013 (Table 27). The major items of imports were raw silk yarn (not thrown) bearing the HS code of 5002 and woven fabrics of silk or of silk waste (HS code 5007). India was the largest importer of silk and silk goods followed by Pakistan, Afghanistan and Bangladesh.



**Table 27. Silk Imports by SAARC Countries during 2013**

HS Code	Product description	Value (Million US\$)								
		Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka	Total
5001	Silkworm cocoons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5002	Raw silk (not thrown)	0.00	6.22	0.00	165.95	0.00	0.05	0.61	0.00	172.83
5003	Silk waste	0.00	0.06	0.00	4.79	0.00	0.01	0.02	0.00	4.87
5004	Silk yarn (other than yarn spun from silk waste)	0.00	0.16	0.00	8.85	0.00	2.18	3.60	0.04	14.82
5005	Yarn spun from silk waste, not put up for retail sale	0.00	0.00	0.00	5.48	0.00	0.04	5.43	0.00	10.95
5006	Silk yarn & yarn spun from silk waste, put up for retail sale	0.00	0.00	0.00	1.09	0.01	0.17	0.00	0.02	1.29
5007	Woven fabrics of silk or of silk waste	4.41	0.96	0.12	49.60	0.10	0.31	14.98	3.42	73.90
620610	Silk Women's/girl's blouses and shirts	5.01	0.00	0.00	0.72	0.01	0.06	0.00	0.04	5.83
621410	Silk Shawls, scarves and veils	0.00	1.03	0.00	0.82	0.01	0.61	0.00	0.01	2.47
621510	Silk Ties, bow ties and cravats	0.00	0.69	0.00	1.44	0.01	0.06	0.07	0.05	2.30
<b>Total</b>		<b>9.42</b>	<b>9.11</b>	<b>0.12</b>	<b>238.73</b>	<b>0.13</b>	<b>3.49</b>	<b>24.71</b>	<b>3.56</b>	<b>289.26</b>
<b>% to total</b>		<b>3.25</b>	<b>3.15</b>	<b>0.04</b>	<b>82.53</b>	<b>0.04</b>	<b>1.21</b>	<b>8.54</b>	<b>1.23</b>	<b>100.00</b>

Source: COMTRADE database

### Sericulture Development in SAARC Countries

The analysis of exports and imports of silk goods by SAARC countries clearly shows that though SAARC countries consume silk, they are not producing adequate quantity of raw silk to meet their requirements, which makes them more of import dependent. Therefore, there is a scope for development of sericulture in SAARC countries. They have suitable agro-climatic conditions, market and

tradition to produce silk to meet their domestic requirement as well as earn foreign exchange by exporting the silk and silk products.

While formulating a plan for development of sericulture in a country, a number of market oriented aspects as discussed below are to be considered in addition to production and technical aspects.

A serious plan stretching over for several years is essential for making a new sericultural venture to be successful. The plan must start from marketing outlook rather than from a simple production objective. The plan should clearly spell out whether the silk produced will be marketed within the country or exported. It should also be decided whether the raw silk produced will be converted to fabric.

The gestation period i.e., establishment period for mulberry plantation for taking up silkworm rearing is six months to one year in tropical conditions and three to seven years in sub-tropical and temperate climatic conditions. Thus it takes a substantial period to expect the returns from sericulture. Mr. Ronald Currie<sup>1</sup>, Director General of erstwhile International Silk Association, Lyon, France in a book opines that a country with no sericultural tradition, which decides to undertake a sericultural project, will require a minimum of ten years to produce any tangible results, at least in terms of exportable products. Ten years is a long period to get a return on investment made on a project.

Silk industry encompasses a wide spectrum of activities right from farming for cultivation of food plants for silkworm and rearing of silkworm to produce cocoon to reeling of raw silk from cocoon and further to processing, weaving, making garments etc., till the final product reaches the consumers in the domestic or export market. Thus the silk industry has a complex and value addition at different levels along the supply chain. Value propositions in each layer need to be ensured in such a way that all stakeholders garner desired benefits without affecting others. In this regard, suitable strategies are to be formulated to integrate different segments of the industry with the local, regional, national and international markets.

The quality of silk and price play an important role when a country produces raw silk. The modern weaving machines require higher quality raw silk of 2A and above. China is almost monopoly in the international trade of raw silk, as the silk production from the other major suppliers of raw silk namely Brazil, Viet Nam etc., has been dwindling. The Chinese silk price is, therefore, the *de facto* international price. If a country produces silk at a cost significantly higher than the Chinese raw prices, it will not have any comparative advantage in the trade in silk either in domestic or in international market.

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<sup>1</sup> Ronald Currie (2001) "Silk", in (eds.) R. R. Franck, Silk, Mohair, Cashmere and other Luxury Fibres, Woodhead Publishing Ltd, Abington Hall, Abington, Cambridge University Press, England, pp. 41.

### **Marketing of cocoon**

The farmers take up the activity of cocoon production mostly in a small-scale, as silkworm rearing is a highly labour oriented activity. Different models of the production such as individual farming, contract farming, cooperative/community farming, etc., can be explored for sericulture. In India, different systems of market for cocoon namely, direct marketing, Government regulated markets and also markets organized by co-operative societies and private parties (Mandi) are in operation, each system has its own advantages and disadvantages. As cocoon is a perishable agricultural commodity produced by a large number of farmers, a market condition of oligopsony prevails. In such cases, the buyers have major advantage over the sellers. They can dictate exact specifications to suppliers for delivery schedules, quality and also pass off much of the risks of overproduction, natural losses and variations in cyclical demand to the suppliers. In order to insulate the farmers from the price risk, the Government may formulate price support schemes/mechanism.

Input market is another critical area, which is to be ensured for the success any sericulture project. A farmer needs timely supply of certain variable inputs such as silkworm seed/chawki reared larvae, room and bed disinfectants, mulberry cuttings/saplings etc., and fixed inputs like rearing appliances, mountages, tools and equipment for cultivation of mulberry and silk worm rearing etc. A well established extension and input support system is essential to deliver the inputs in right quantity and quality at right time and educate the farmers on optimum use of inputs.

### **Marketing of silk**

Silk is reeled from cocoons using a variety of reeling devices namely, charkha, cottage basin, multi-end and automatic reeling machines. Charkha and cottage basin reeling are older technologies, which can be used to reel only the less quality silk mostly from multivoltine and/or crossbreed cocoons, whereas higher grade bivoltine silk can be reeled in multi-end and automatic reeling machines. Silk is reeled in larger sized factories in China, Japan, Brazil etc., whereas it is produced in smaller or medium scale units in India.

Silk is traded in commodity exchanges regulated by State Governments and also through direct selling in India. The State Government has established Karnataka Silk Marketing Board (KSMB) in Karnataka, which is the major silk producing state in India, to ensure the stabilization of raw silk prices. Silk is also traded futures markets in China.

If the sericulture project intends to produce raw silk mainly for export markets, the cost of production of the silk should be comparable with that of major silk producing countries like China, India, Thailand, Brazil etc. Apart from India,

Japan and the European countries such as France, Germany, Italy, Switzerland and the United Kingdom import a bulk quantity of raw silk for value addition, but of 3A and above grade silk, as the modern textile machinery used in Europe and Japan requires raw silk of a very high quality. India imports majority of 2A and 3A grade silk. The quality, price and volume are the key elements in export market.

Many SAARC countries import raw silk among which India alone accounts for about 96% of total SAARC countries' imports and 41% of globally traded raw silk during 2013 (Table 28). Bangladesh also imports a sizeable quantity of raw silk, as the country is not able to produce the required quantity of raw silk domestically. The SAARC countries thus with 43% of the global trade in raw silk have a sizeable market for silk among themselves.

**Table 28. Raw Silk Imports by SAARC countries during 2010 to 2013**

Country	Raw silk Imports* (MT)				% share (2013)	
	2010	2011	2012	2013	SAARC	World
India	5915	5597	5235	3609	96.21	40.92
Bangladesh	517	486	105	113	3.01	1.28
Pakistan	202	72	36	24	0.64	0.27
Nepal	3	10	-	5	0.13	0.06
Sri Lanka	8	12	-	0.01	0.00	0.00
SAARC	6645	6177	5376	3751	100.00	42.53
World	12404	12386	9182	8820	-	100.00

**Note:** \* - Pertains to HS code 5002: Raw Silk (Not Thrown)

**Source:** COMTRADE database

### **Marketing of value added products**

The finished goods of silk are marketed in the form of fabrics, sarees, garments, accessories like bags, belts, ties, handkerchiefs, scarves, stole and shawls and furnishing items like bed spreads, cushion covers, quilts etc.

All SAARC countries have traditionally a silk weaving base. Therefore, there is a lot of scope for utilizing raw silk produced among SAARC countries for value addition purpose. India has many world famous silk handloom and power loom weaving clusters like Dharmavaram, Pochampalli, Sualkuchi, Bhagalpur, Surat, Srinagar, Bangalore, Champa, Chanderi, Raigarh, Kancheepuram, Tanjavur, Varanasi, Murshidabad etc. Silk production and processing were once popular in Heart and Mazar-e-Sharif in Afghanistan, which are located on the ancient Silk Road, but have lost sheen due to civil war in the last couple of decades. Similarly,

Rajshahi silk of Bangladesh, silk pashmina of Nepal, silk batik sarees of Sri Lanka etc are some famous silk products produced in SAARC region.

Silk is a luxury and fashion oriented fibre. Its demand in the international market highly depends on many economic and technical factors like price, fashion, trend, income level of the consumers, substitutes etc. If export markets are targeted, fashion, technology, quality and services are the critical factors, which are to be concentrated to compete in the major silk consuming markets. The exporting countries can also actively participate in trade fairs, conduct personal visits and concentration on Customer Relationship Management (CRM) with the buyers for promoting their products in the international market.

Now e-commerce is becoming popular and cost effective. As e-marketing does not have any territorial limit as in the case of retail shops, it can be effectively utilized for marketing of silk products for reaching a larger area in a cost-effective manner.

As silk is a generic product, improving the brand image and promoting the usage by educating the users about advantages of silk is also important in the domestic and export markets.

### **Conclusion**

The SAARC countries have a long tradition of production and consumption of silk. But all the SAARC countries except India are import dependent and have deficit in the BOT in silk goods. As all SAARC countries have agro-climatic conditions similar to the silk producing regions of India, there is a scope to increase the silk production in the SAARC region, which would not only help to increase the BOT in silk goods favour of silk producing country in the SAARC region, but also support for rural development.

Any project formulated for silk production needs a clear market outlook and strategies for catering to the needs of local, regional, national and international markets for its success. Keeping this in mind, markets for cocoon, raw silk, silk fabrics, finished products and by-products should be developed in the supply chain in such a way that each stakeholder gets desired margin without affecting the interest of others.

India is the largest importer of raw silk, as demand for silk outmatches the domestic production. Therefore, the raw silk and value added silk products produced by other countries in the region have ready market within the region. The free trade agreement under South Asian Preferential Trade Arrangement (SAPTA) can facilitate the trade in silk and silk products produced within the region.

**Minutes and Recommendations of the  
Regional Consultation on “Sericulture scenario in SAARC  
region – a re-emerging industry for poverty alleviation in  
SAARC Region”**

**A. Recommendations**

**1. Amendment of Draft SAARC-ISC MoU (*Annexed-Revised document*)**

- a. Article 6.i. Regular review of progress and recommendations for improvement thereof; at least once in a year.
- b. Article 6. (addition): Promote product development and diversification for better value realization.
- c. Article 8. (addition): enhanced value realization .

**2. Policy**

- a) Initiate program for sharing seric-genetic resources among SAARC Member countries under the provisions of SAARC-MTA (Material Transfer Agreement).
- b) Create a separate institutional entity at National and Provincial level to introduce and promote Silk Industry in SAARC countries.
- c) Promote sericulture as an environment friendly sustainable economic activity .
- d) Promote conservation of silkworm and its host plant bio-diversity.
- e) Formulate perspective plan for integrated development silk industry for next 10 years (2016-2025) and action [plan for next two years by 31<sup>st</sup> March 2016 for the SAARC Region.
- f) Nepal, Bhutan, Pakistan, Srilanka, and Maldives were requested to join International Sericulture Commission as Member Countries.

**3. Research**

- a) Depute experts to the SAARC countries and utilize their services for feasibility/project formulation/institutional study on non-currency exchange basis,
- b) Establish a sericultural technology validation laboratory in all countries ,
- c) Prepare multilateral collaborative research project under the aegis SAARC-ISC MoU,
- d) SAARC and ISC may initiate donor funded Sericulture promotional project in the region .

#### **4. Extension**

- a) Consolidate the available technologies and disseminate through cluster approach in the identified potential pockets,
- b) Organize training on sericulture and silk industry for the trainers from SAARC countries,
- c) Establish Common Facility Centre both for pre and post cocoon (responsibility of that particular country) to enhance access to resources and support,
- d) Develop Government support mechanisms in terms of subsidies and incentives, and
- e) Sourcing of extension publication materials.

#### **B. Minutes of the meeting**

##### *Inaugural Session*

Mr. K.K. Shetty, Officer-on Special Duty, International Sericultural Commission extended warm welcome to Professor K.S.Rangappa, Vice Chancellor, University of Mysuru who graced the inaugural session as the Chief Guest. Reiterating the importance of the meeting, Mr. Shetty also welcomed all the dignitaries and specially the delegates from SAARC Member States, SAARC and ISC Officials and experts from Central Silk Board, India.

Professor Rangappa in his inaugural remarks, highlighted the importance and relevance of silk industry in India and the region. He applauded the work done by sericulture scientists in India and mentioned the enormity of resources available in India that could be shared with the SAARC countries to develop sericulture in the region. Explaining the role of University of Mysuru in Sericulture, he extended the support of the University to all the Member States in human resource development.

Presenting the Keynote address, Dr. Nirmal Kumar, Ex-Director, CSRTI, Berhampore gave an elaborate presentation on the prospects of sericulture in SAARC countries. He provided the complete scenario of sericulture in the region and explained the potential for the industry in the region. His talk also covered on the strategic tips for enhancing sericulture industry through government support. It was also highlighted that the need for closer networking, exchange of technical information, technology and expertise across the region. He concluded the presentation by emphasizing the greater need for trade improvement and engagement of public and private institutions.

Dr. S.M. Bokhtiar, Director, SAARC Agriculture Centre (SAC) as the Guest of Honour gave a brief overview of the role of SAC in this initiative and the situations in the SAARC region. Emphasizing the need for alleviating poverty in

the region, he indicated the role of sericulture which can be utilized in improving the economic situation in the region. On behalf of the SAARC, he assured that SAC is fully committed to the outcome of the meeting and facilitate the Member States to achieve the goal of developing sericulture industry in their respective countries. He acknowledged the support and partnership of ISC which has helped in organizing this first Regional Consultative Meeting on sericulture for SAARC Member States which is fully represented. Mentioning about the future course of actions, he mentioned that SAARC and ISC is in the process of finalizing the MoU for sericultural research and development in the region. The activities proposed can be expedited once the MoU is formalized and signed.

Dr. B.S.Agnadi, Director, CSB expressed the delight of CSB and India to have all the eight SAARC Member States in one platform to discuss and take forward the sericulture development in the region. Appreciating the initiative of ISC and SAC in bringing together the nations, he committed that CSB with its institutions spread across India will be always there to support the Member States.

Dr. V.Sivaprasad, Director, CSRTI, Mysore proposing the vote of thanks, appreciated the kind consent of Professor Rangappa to inaugurate Consultative Meeting inspite of his busy schedule. He thanked all the SAARC delegates, dignitaries, faculty members from University of Mysuru, and officials and scientists from CSB for having found time to attend this important meeting.

#### *Technical Session I: Country Presentation*

**Afghanistan:** The country report of Afghanistan was presented by Mr. Md. Sarwar Anwari. He reported that the country has a long history and tradition of sericulture. There are about six farms engaged in sericultural activities. Mulberry is grown as trees in the farms for rearing silkworms. One of the major sericulture farm namely Darulaman has been established in 35 acres of land with four blocks for silkworm rearing, one cold storage unit and a laboratory. The production capacity of the farm is about 20,000 commercial 12 g egg boxes and 1000 egg sheets for mother stock maintenance and breeding. About 90,000 mulberry trees were planted in the farm for silkworm rearing. Mr. Anwari opined that there is an urgent need for transfer of technology in sericulture to the country for promoting silk production. Private participation in sericulture needs to be encouraged in the country. Further he suggested for revival of existing sericulture farms for development of sericulture in Afghanistan.

**Bangladesh:** Dr. Md. Saidur Rahman presented a country report on sericulture scenario in Bangladesh. Bangladesh has a long history of sericulture and almost on par with development of the silk industry in West Bengal, India. For the extension of sericulture industry in the country, Bangladesh Sericulture Board was established in 1978 and later renamed as Bangladesh Sericulture Development Board in 2013. The presentation highlighted the potentiality for



extending sericulture in the country, considering the favourable soil and climatic conditions, unemployment among rural masses and availability of low cost labour and women workforce. There is an annual demand of 300 MT of raw silk against the present production of 41.60 MT. However some of the challenges facing the industry are: lack of improvement in cocoon productivity, need for enhancing mulberry and cocoon productivity during adverse climatic conditions, disease control measures, improvement of renditta and establishment of a stable marketing system. The presentation stressed the need for orderly development of sericulture enterprise considering the socio-economic conditions, unemployment and huge demand-supply gap of raw silk existing in the country.

**Bhutan:** Mr. Dawa Penjor presented the country report of silk scenario in Bhutan. Presently, the country does not have silk production. However, some weaving communities use silk produced elsewhere and imported to the country. But, Bhutanese have mastered the art of weaving and dying of silk. Bhutanese silk textiles represent the rich and complex repository of a unique art form. The famous Kushuthara (fine silk) is a silk weaving technique with intricate hand laced patterns is a unique product of the country. The presentation also highlighted the collection of wild silk cocoons from the forest which are reeled and the end produce subsequently used for making ceremonial scarves and dresses. Hence there is ample scope exists to utilize the Bhutanese silk weaving art for export of textile products thereby significantly enhance the income generation of the rural people in the country. There is also tremendous scope for the development of ericulture (to produce non-violent silk) with the focus of becoming an organic country before 2020.

**India:** An elaborate country report on Indian sericulture was presented by Mr. K.K. Shetty. India is the leading nation among SAARC counties with the silk production of about 28,700 MT India produces all five types of silk and is next only to China in mulberry silk production at global level. About 75% of the total raw silk production is accounted by mulberry silk. About 8.28 Million people are involved in sericulture industry. India has made huge investment for the development of sericulture industry in the country. The concerted R&D effort of the Central and State Government Agencies was able to produce region specific mulberry and silkworm breeds, organise seed supply system , developed suitable post cocoon technologies, coordinated cocoon and raw silk marketing systems and an effective extension system to extend support and assistance to the grassroot level stakeholders. India is also a world leader in tropical sericulture. India has developed technology for sericulture enterprise for each and every situation which can be suitably replicated for the development of sericulture in SAARC member countries. The country has also developed adequate infrastrure for training and capacity building catering to the need of primary stakeholders. Therefore, the sericulture industry has emerged as a high employment generating

occupation with remunerative returns contributing to the national economy of the country. The resources and technologies available in the country could be now disseminated to other countries for replicating the results. The Government of India is willing to help and support all SAARC member countries in this direction.

**Maldives:** The country report was presented by Mr. Abdul Latheef Moosa. The presentation provided general information of the country like geographical area, population, climate, rainfall pattern *etc.* At present there is no sericulture activities reported from the nation. However, there is a good demand for silk in weaving industry which is being met through import. Therefore, there is ample opportunity to establish sericulture as there is a high demand for silk coupled with good price. Sericulture is also likely to generate employment to the people of Maldives. But considering the geographical terrain of the islands, a pilot study can be taken up for introduction of sericulture in suitable farming islands. Further, the art of weaving of silk can be exploited for higher income generation through the export of the finished products.

**Nepal:** The country report on Nepal was presented by Mr. Jagadish Bhakta Shrestha. Sericulture has a long history in Nepal. About 65.7% of the population depend on agriculture which contributes to 38% of the GDP. Nepal has currently established the Directorate of Industrial Entomology for sericulture enterprise. There are number mulberry varieties being grown for sericulture. The climatic condition including temperature, rainfall pattern and humidity are ideal for mulberry cultivation and bivoltine silkworm rearing. Presently the income from sericulture is about Nepalese Rs. 78,000/- from 0.5 hc., of mulberry from 4<sup>th</sup> year onwards. Mr. Shrestha reported a serious problem of mortality of silkworms in 4<sup>th</sup> and 5<sup>th</sup> larval stages due to which the sericulture industry has declined the country. There is a strong need for training and human resource development in Nepal's sericulture sector. Further, he stressed the need for technical and financial support to Nepal from the Indian Government in strengthening of sericulture industry in similar lines to the extension of JICA support to India in the recent past.

**Pakistan:** Dr. Attaullah Khan presented a comprehensive paper on sericulture in Pakistan. He highlighted how in Punjab province of Pakistan, sericulture activities were introduced under Forest Department, Govt. of Punjab since 1975. He indicated that most of the farmers involved in this enterprise are illiterate. This industry is further characterized by inappropriate rearing sheds, complete lack of extension service, dependence on government forests for mulberry leaves, facing peak season shortage, supply of poor quality silkworm seed and improper processing and marketing facilities. Labour share more than 70 percent of the total cost of production and however promises reasonably high return on

investment. Stochastic production frontier analysis indicates that the sericulture enterprise faces increasing returns on scale. Average technical efficiency is found to be 0.88 with a minimum of 0.37 and a maximum of 0.98 leaving significant scope for improvement in productivity and thus profitability.

**Sri Lanka:** The country report was presented by Mr. S. Sivakumar. He gave a bird's eye view of sericulture in Sri Lanka. The sericulture industry in the country is being promoted and regulated by SAPDA. The popular mulberries cultivated are Local Variety and Kanva-2. The silkworm breeding stock comprised of 46 pure lines which include multivoltines, bivoltines and univoltines. These races were introduced from Japan, Korea and India. There are several constraints being faced by Sri Lankan sericulture industry. Major ones are: lack of suitable silkworm breeds and mulberry varieties for different areas, issue of productivity and quality of silk cocoons, non availability of work force and lack of R&D system for sericulture development in the country. In the past, sericulture industry collapsed due to religious sentiments of not accepting the killing of large number of pupae in the production of silk. However, there is a good scope for silk production in terms of favourable climatic conditions in certain pockets, fertile soil-land availability and low cost labour. In Sri Lanka, there is a huge demand for silk for the production of ceremonial dresses and other garments. The speaker is of the opinion that the country is bestowed with required climate and natural resources for successful development of Sericulture industry.

#### *Technical Session II: Special Papers*

Paper 1: Establishment of Silkworm Seed Production Network in SAARC Countries. - Dr. B. S. Angadi, Director, Central Silk Board, Bengaluru, India

The presentation highlighted the role of seed and its timely availability at an affordable price in stabilising economic growth of sericulture industry. He emphasised the critical role of quality disease free seed in realizing the potentials of all other inputs like mulberry variety, trained man power, infrastructure facilities, forward and backward linkages, rational management system and appropriate technology implementation. National Silkworm Seed Organization (NSSO), a dedicated scientific and skilled technical network ensures production of dependable parent seed cocoons and supply them to commercial seed production centres, is a challenge and an obligation of the government and private sectors. The time tested system of seed organization and commercial seed production being practiced in India was discussed in detail. The importance of backward linkages up to reproductive seed maintenance, retaining purity and vigour, adequate infrastructure facilities to ensure optimum environment and hygiene for seed production, effective extension system for dissemination of the appropriate technologies in achieving sustained silk production was highlighted.

The expert emphasised that till the SAAC countries possess appreciable area of established mulberry acreage, they may depend on the advanced country like

India for meeting their commercial seed requirements. Due to its liberalisation policy India can export commercial silkworm seed both by Government or private registered seed producers. The hybrids produced in India could be tested for their performance in laboratory followed by large scale rearing. Research and development projects for developing region specific races/hybrids could be taken up either independently or in collaboration among the SAARC countries for overall development of the industry.

Further he emphasised the need for sensitizing policy makers, technocrats and lead farmers through exposure visits to the sericulture areas of India, developing a structured institution and production models, conducting diagnostic studies for identification of clusters and creating forward and backward linkages.

Added to this, he also called upon the SAARC countries to make use of large sericulture base and technical expertise available in India for training their stakeholders, supply of commercial silkworm seed, and establishment of seed production units as and when the need arises, through bilateral and multilateral collaborative projects.

**Paper-2:** Strategy to replicate the successful model of sericulture practice developed in India to other SAARC countries. - Dr. V. Sivaprasad, Director, CSR & TI, Central Silk Board, Mysuru, India

The presentation largely underlined the contributions of improved technologies on the various aspects of the industry like; crop improvement, production, protection, extension management and human resources development in bringing India to the threshold of unprecedented growth rate in raw silk production.

He underlined that the well planned and coordinated strategies and efficient execution of projects by CSB and the Departments of Sericulture in the Provinces have led to successful delivery of cutting edge technologies. The industry has also been benefited by the programmes for popularization of bivoltine sericulture with assistance from JICA and flagship programmes like the Institute Village Linkage Programme [IVLP] and Cluster Promotion Programme [CPP] that were monitored and coordinated successfully by CSB.

Since the Indian subcontinent represents almost all the geographical and climatic situations that exist in SAARC nations, there is immense scope for effective dissemination of ready-to-use technologies for sustainable sericulture development in the region, the expert opined. The speaker went on to briefly present salient technologies in the areas of mulberry varieties for varied agro-climates, cultivation packages, mulberry and silkworm crop protection measures with special emphasis on biological control of pests and diseases, young-age silkworm [Chawki] rearing technology, silkworm races and hybrids with improved productivity and silk quality, silkworm rearing technology, mechanization in sericulture, etc.

Dr. Sivaprasad also laid emphasis on effective transfer of technologies by adopting CPP / IVLP approach, popularizing water conservation and rain water harvesting techniques and establishing forward linkages through establishing post cocoon processing units to reap the benefits of local cocoon production.

In light of the potential of sericulture in generating rural employment, empowerment of women and income generation, he opined that India could meet the strategic and research and technical needs of the SAARC countries through ; Consultancy (planning and coordination of programmes), Research and Development (collaborative research projects on identified thrust areas), Supply of commercial hybrids (silkworm hybrid seed and establishment of seed production centers) and HRD (Training in seed production, commercial chawki rearing, silkworm rearing, cocoon and silk processing, fabric manufacturing and developing value added products).

The specific requirements of each SAARC member country need to be considered to draw country-wise strategy for translating successful Indian model based on the available infrastructure (forward and backward linkages) for silk production, man power and scale of operation.

**Paper-3:** Strategies for adoption of appropriate innovations and technologies for the development of sericulture in SAARC countries. – Dr. S. Nirmal Kumar, Former Director, CSRTI, Berhampore, West Bengal, India.

The speaker highlighted the nature of sericulture like employment oriented, low capital intensive, high returns per unit area, large share of value chain for cocoon producers, short gestation period, robust demand and sustainable market for silk, women friendly, etc., that has made it one of the most appropriate avenues for socio-economic development.

Adopting appropriate innovations and technologies is imperative for the development of any sector. There is a strong need to understand and adopt innovation system in sericulture development, where a network of organizations, enterprises and individuals focus on bringing new products, processes and new forms of organization into economic use together with the institutions and policies that affect their behaviour and performance. This helps create knowledge, provide access to knowledge, share knowledge and foster learning.

He emphasised that the technologies should be efficient, practical and cost effective apart from being environmental friendly. The adoption is influenced among several factors by size of farm, economic risk and geographical location. Although size disadvantage that exists in SAARC region can be obviated through contract or cooperative farming, heavy dependence on rain is a serious disadvantage. Empowerment of the farmers in taking initiatives and decisions will help in shaping the future of the farmers' economy. Farmers as producers of cocoons and reelers as producers of silk must have an enabling environment for

access to know-how and do-how for realizing the full potential of modern sericulture technology.

While innovations come from many sources, how the agenda of different stakeholders are represented affects the appropriateness of the technology. This has led to emergence of farmer participatory technology development and extension approaches. Instead of limiting the role of extension to technology diffusion, there is a need to expand its role with a diversity of objectives like linking farmers effectively and responsively to domestic and international markets, enhancing crop diversification, coupling technology transfer with services related to input and output markets and environmental issues.

He further stressed the need to build institutionally sustainable innovation systems, institutional pluralism and bottom up participatory approaches in extension, creating environment for ease entry of private sector, NGOs and creation of innovative PPP in extension.

Discussing the experiences of key countries, the expert stressed on the need to ensure effective use of available technology, involving different sets of actors in the innovation process, improved communication, strengthening research-extension-farmer linkages through involvement of private sector, promoting resource conserving technologies, intensive use of advanced information and communication technology and capacity building in terms of manpower to address the challenges.

He stressed that strong intra regional cooperation is required for sharing best practices and capacity building. Creating a common institution to facilitate and expedite regional collaboration for bilateral and multilateral contracts in exchange of genetic resources, scientific and technical information, training etc., development of national strategy for sericulture development were among the key points discussed by the expert.

**Paper-4:** Need for establishing Post Cocoon facilities for the introduction of sericulture industries in SAARC countries - Dr. Subhas V. Naik, Director, CSTRI, CSB, Bengaluru, India

The expert presented a brief scenario of post cocoon activities in the SAARC nations, emphasising why post cocoon sector is important for overall development of the industry. The post cocoon sector comprises of silk reeling, twisting, designing, weaving, dyeing and finishing. The raw silk yield, productivity and its quality are significantly influenced by cocoon quality, reeling machines, reeling process parameters, human skill and quality of water.

SAARC countries have a tremendous scope for the development of silk industry because of their agrarian economy, presence of textile and handloom sector and suitable conditions. Development of silk industry also helps in poverty alleviation through generating employment and empowering women.

The expert suggested that the countries where the industry is in its nascent stage, strategies adopted to develop the industry in the non-traditional States (Provinces) of India can be followed wherein, post cocoon activities started with establishing cottage basin and multiend reeling units by government and private sectors through entrepreneurial programmes. Based on the quantum of the cocoons produced, the agencies established matching reeling, twisting, weaving and dyeing infrastructures. Besides, creating the marketing entities for selling of finished goods, services like testing of cocoon, yarn & fabrics are also vital.

India can support SAARC countries by formulating country specific projects, providing required machinery / equipment, capacity building through training the manpower (both managerial as well as operatives) and transfer of technologies. He also emphasised the need for adopting suitable policy framework so that the support of the governments is provided seamlessly.

**Paper-5:** Strategic approach for establishing market linkages in SAARC countries - Dr. P. Kumaresan Scientist-D, Central Silk Board, Bengaluru, India.

The paper underlined the need for a clear market outlook in any developmental project that aims at introducing/ developing sericulture. Integrating sericulture enterprises with local, national, regional and global markets are of paramount importance. The expert presented an elaborate picture of the global demand and supply of raw silk and trade in silk goods to show the current trends in production and consumption of silk and silk goods among the major producer and consumer countries. China, India and Thailand produce raw silk and convert them to physical goods for both domestic and export consumption. European countries and USA do not produce raw silk. They import raw silk and convert to finished products for domestic as well as export requirements.

Silk trade happens in 5 categories mainly raw material, fabric garments, accessories and furnishings. Garment accounts for 1/3 of trade in terms of value where as raw material in terms of volumes, raw silk trade is declining because of Chinese focus on exporting value added products. India imports high volume of yarn from China. China dominates export silk fabric mainly to USA. World trade in silk accessories is dominated by Italy followed by China marketed mainly to USA. China being world leader in silk production is also major exporter (40 %) followed by Italy, France and India. India has a strong domestic demand mainly in terms of saree (85%). Sericulture in countries like Brazil, Thailand and Vietnam is shrinking thereby reducing their role in world trade. USA is the largest net exporter of silk and silk products followed by Italy, France, Germany and United Kingdom.

Further, he presented the data on silk production and trade in SAARC countries that showed the extent of import dependency in terms of Export/Import Dominance [EID] and Balance of Trade [BOT]. Among the SAARC countries,

India's export value accounts for 98% of the total value of USD 301.21 million during 2013. All SAARC countries imported silk goods during 2013 which valued at USD 289.26 million, India being the largest importer [USD 238.73 million].

The data indicate greater scope for developing sericulture in the region, by formulating suitable plans considering the market oriented aspects such as, whether the silk produced can be marketed within the country or exported; ensuring value propositions in each stage of production, i.e. from cocoon till the product reaches the consumer, so that all stakeholders garner desired benefits without affecting others; insulating stakeholders from price risks through price support schemes/mechanisms; establishing input support systems; promoting participation in trade fairs; e-marketing and improving the brand image.

It is quite evident that the raw silk and value added products produced by SAARC countries already have a ready market within the region. The free trade agreement under South Asian Preferential Trade Arrangement [SAPTA] also facilitates trade in silk and silk goods produced within the region.

#### **Side events**

##### **26<sup>th</sup> August 2015: Visit to CSRTI, Mysore**

Dr. Sivaprasad, Director, CSRTI organized a guided tour for all the participants to mulberry varietal trials plots, engineering, pathology laboratory, silkworm breeding, training and product development sections of the Institute. Interaction with local trainees in the rearing centre was very useful to understand the whole process and how entrepreneurial training is organized.

##### **27<sup>th</sup> August 2015: Visit to Silk Factory and Farmers Field**

The SAARC delegates visited Karnataka Silk Weaving Factory on 27.08.2015. The Deputy Manager of the facility took the delegates around the factory showing all the stages of weaving. It was a highly educative tour for the delegates to see how labour intensive and intricate the silk weaving technology.

Visit to farmer field in Srirangapatna was also extremely educative where farmers have started chawki rearing centre with government support . Mr. Chandrashekar an enterprenuer has built 3 rearing houses which is fully equipped with wooden rake and nets.

In the evening the team visited the Vindravan Garden followed by dinner hosted by Director, CSRTI.

##### **28<sup>th</sup> August 2015**

The team enroute to Bangalore visited Cocoon market in Ramanagaram. The Deputy Director, Cocoon Market took the team through the process and explained



in detail how the market is operated. He explained that apart from the clean bidding system, there is also online system to help buyers to monitor the price and bid. Sample quality of cocoons tested by the Testing unit of CSRTI also provides help to both seller and buyer to assess the quality of the cocoon thereby realize better prize to the coccons. The delegates were impressed on how efficiently and transparently the market has been organized. The team then visited Automatic Reeling Machine operated by a private entrepreneur.

At 2:30 pm the team was received by Dr. BS Angadi, Director, CSB and Dr. P Jaya Prakash, Director, National Silk Seed Organization at the Silkworm Seed Production Centre, Bangalore. Dr. Angadi explained the complete process of silkworm seed production and quality control. The team visited all the laboratory and sections. At 4:00 P.M; Dr. Subas V Naik, Director, Central Silk Technology Research Institute (CSTRI) demonstrated the machinaries developed by them for the entire post-cocoon processing from cocoon to till finishing .

In the evening, Dr. Nagesh Prabhu, Secretary General Elect, ISC and Member Secretary, CSB received the team in ISC Secretariat. A short interaction of between the SAARC delegation, ISC Officials and senior Officers of CSB was organized in the Board Room. Some of the points discussed are given below:

- The SAARC-ISC MoU which is in the final stage will be finalized at the earliest possible so that collaborative programs can be initiated at the earliest,
- If the SAARC countries so desire, ISC can organize advance training on sericulture production for the technical staff who can after the training start programs in their respective countries,
- An immediate action to study the sericulture situation of SAARC countries should be undertaken by engaging ISC volunteer experts . Towards this purpose, the SAARC Member Countries states with support from SAARC need to host the experts, however no consultancy fee need to paid to the volunteers.
- ISC in collaboration with SAC may have to organize an visit for senior management (Minister or Secretary level) officials from SAARC countries to Mysore and Bengaluru to experience the development of sericulture industry in India. This would help the senior country representatives to initiate sericulture developmental programs in their respective countries and also get convinced in enrolling as Members of ISC.

ISC hosted a grand dinner in honour of the SAARC delegation.

### **29<sup>th</sup> August 2015**

While delegates from Afghanistan, Bangladesh, Maldives and Nepal left early morning, the remaining team visited the Silk Emporium of the Uttarkhand in Bangalore.

## List of Participants

- 1 Mr. Mohammad Sarwar Anwari, General Manager, Sericultural Project, Directorate of Livestock and Animal Health, Ministry of Agriculture, Irrigation and Livestock
- 2 Dr. Md. Saidur Rahman, Senior Research Officer, BSRTI, Rahshahi, Bangladesh  
Tel: +8801720297932. Email:msrahman57@yahoo.com
- 3 Mr. Dawa Penjor, Program Director, National Mushroom Centre, Department of Agriculture, Thimphu, Bhutan
- 4 Shri KK Shetty, Joint Secretary (Tech), Central Silk Board, CSB Complex, BTM Layout, Madiwala, Bangalore- 560068, India. Mobile 00 91 9945260302.  
email: kks.csb@nic.in
- 5 Mr. Abdul Latheef Moosa, Agriculture Officer, Ministry of Fisheries and Agriculture, Tel; (+9661 7905771 . Email: lathyf.musa@gmail.com
- 6 Mr. Jagadish Bhakta Shrestha, Program Director, Directorate of Industrial Entomology Development, Nepal. Cell #: 9841268265. Email: jagadishbshrestha@gmail.com
- 7 Dr. Attaullah Khan, Director, Arid Zone Research Institute (PARC), Umerkot, Pakistan, attaulahg@gmail.com
- 8 Mr. S.Sivakumar, Provincial Director of Agriculture (NP), Sri Lanka. Email: npagriculture@gmail.com
- 9 Dr. SM Bokthiar, Director, SAARC Agriculture Centre, Dhaka, Bangladesh  
sac@saarcagri.org
- 10 Dr. H. Nagesh Prabhu, Member Secretary, Central Silk Board, Bengaluru, India
- 11 Dr. BS Angadi, Director, CSB, Bangalore, India
- 12 Dr. S. Nirmal Kumar, Director (Rtd.), Expert
- 13 Dr. Subash V. Naik, Director, CSTRI, Bangalore, India
- 14 Dr. P. Kumaresan, Scientist-D, CSTRI, Bangalore
- 15 Dr. V. Sivaprasad, Director, CSTRI, Mysore
- 16 Mr. Dileep Kumar R, Secretary to SG-ISC
- 17 Ms. Kalaiarasi R. Executive, ISC
- 18 Mr. Rajashekar K, Scientist-D, CSRTI, Mysore
- 19 Dr. GS Geetha, Scientist-D, CSRTI, Mysore

- 20 Dr. V, Girish Naik, Scientist-D, CSRTI, Mysore
- 21 Dr. Vineeth Kumar, Scientist-D, CSRTI, Mysore
- 22 Dr. T. Thippeswamy, Scientist-D, CSRTI, Mysore
- 23 Dr. S. Manthira Moorthy, Scientist-D, CSRTI, Mysore
- 24 Shri Devaraj, Technical Assistant, CSRTI, Mysore
- 25 Shri Mrinthyunjaya Rao, Technical Assistant, CSRTI, Mysore
- 26 Shri Srinivas, ISC, Bangalore
- 27 Mr. Justin Kumar, Technical Assistant, CSTRI, Mysore
- 28 Dr. Tayan Raj Gurung, Senior Program Specialist, SAARC Agriculture Centre,  
Dhaka, Bangladesh. tayangurung@yahoo.com

**Regional Consultative Meet on “Sericulture scenario in SAARC region – a re-emerging industry for poverty alleviation in SAARC region” during 24-28 August 2015 at Mysore**

Date: 24-28 August 2015;

Venue: Hotel Regaalis, Mysuru, India

<b>PROGRAMME</b>		
Day 1 (24.08.2015)	All participants arrive in Mysore Reception	
Day 2 (25.08.2015)	Meeting	Venue: Darbar Hall, Hotel Regaalis, Mysore
09 00 AM	Registration by all participants	
09 30 AM	Arrival of Chief Guest	Prof. K. S. Rangappa, Vice Chancellor, University of Mysuru
09:45 hrs	Indian National Anthem	
09:50 hrs	A video film on "Intrinsic Strength of India"	
09:55 hrs	Welcome address	Mr. K. K. Shetty Officer on Special Duty International Sericultural Commission
10:05 hrs	Inauguration of the Meeting by lighting the lamp	Prof. K.S. Rangappa Vice Chancellor University of Mysore
10:10 hrs	Inaugural Address	Prof. K.S. Rangappa Vice Chancellor, University of Mysore
10:20 hrs	Keynote Address	Dr. S. Nirmal Kumar Director (Retd.) Central Silk Board
10:40 hrs	Address by Guests of Honour	Dr. Shaikh Mohammad Bokhtiar Director, SAARC Agriculture Centre Dr. B.S. Angadi Director, Central Silk Board
10:52 hrs	Vote of thanks	Dr. V. Sivaprasad Director, Central Sericulture Research and Training Institute, Central Silk Board, Mysore
10:55 hrs	Tea and Photo session	
11 15 AM	Technical Session - I : Country Presentation	

Country Set A		
<i>Chair</i>	<i>Director, SAC</i>	
<i>Rapp:</i>	<i>Dr. Girish Naik, Sci-D and Dr. Vineeth Kumar, Sci-D - CSR&amp;TI, Mysore</i>	
11 20 AM	Opening remarks by the Chairperson	
Country Paper - Set A		
11 30 AM	Country presentation	Afghanistan
11 45 AM	Country presentation	Bangladesh
12 00 Noon	Country presentation	Bhutan
12 15 PM	Country presentation	India
12 30 PM	Discussion	
12 45 PM	Closing by the Chairperson	
01 00 PM	Lunch	
Country Paper - Set B		
<i>Chair</i>	<i>Secretary General, ISC and Director-SAC</i>	
<i>Rapp:</i>	<i>Dr. Girish Naik, Sci-D and Dr. Vineeth Kumar, Sci-D - CSR&amp;TI, Mysore</i>	
02 10 PM	Opening remarks by the Chairperson	
02 20 PM	Country presentation	Maldives
02 35 PM	Country presentation	Nepal
02 45 PM	Country presentation	Pakistan
03 00 PM	Country presentation	Sri Lanka
03 15 PM	Discussion	
03 30 PM	Closing by the Chairperson	
03 45 PM	Tea	
Technical Session - II- Special papers - Introspection of Sericulture Industry and way forward		
<i>Chair</i>	<i>Secretary General, ISC and Director-SAC</i>	
<i>Rapp:</i>	<i>Dr. Rajashekar, Scientist-D and Dr. Geetha, Scientist-C</i>	
04 00 PM	“Establishment of Silkworm seed production network in SAARC countries”	Dr. B.S. Angadi
	Discussion	
04 30 PM	“Strategy to replicate the successful model of sericulture practise developed in India to other SAARC countries”	Dr. Sivaprasad
	Discussion	

05 00 PM	“Adoption of appropriate innovations and technologies for the development of sericulture in SAARC countries”	Dr. Nirmal Kumar
	Discussion	
05 30 PM	Closing by the Chairperson	
07 30 PM	Welcome Dinner at Hotel Regaalis, Mysuru	
Day 3 (26.08.2015)	Introspection of Sericulture Industry and way forward	Venue: Board Room, Hotel Regaalis
Technical Session - II- Special papers (Continue)		
<i>Chair</i>	<i>Member Secretary, CSB and Director, SAC</i>	
<i>Rapp:</i>	<i>2 Officers from CSRTI</i>	
08 45 AM	All participants report to the venue	
09 00 AM	Need for establishing post cocoon facilities for the introduction of sericulture industries in SAARC countries	Dr. Subas V Naik
	Discussion	
09 30 AM	Strategic approach for establishing marketing linkages in SAARC countries	Dr. P. Kumaresan,
	Discussion	
10 00 AM	Tea	
Technical Session III - Working Group Session		Facilitated by Dr. Tayan
Briefing on the Working Group Session - Group division and Topics		
10 30 AM	A: Policy	
	B: Research	
	C: Extension and Development	
01 00 PM	Lunch	
Closing Session		
<i>Chair</i>	<i>Member Secretary, CSB and Director, SAC</i>	
<i>MC</i>	<i>Mr. KK Shetty, OSD, ISC</i>	
02 00 PM	Presentation by Group 1	
02 15 PM	Presentation by Group 2	
02 30 PM	Presentation by Group 3	
02 45 PM	Workshop recommendation	SAC

03 00 PM	Presentation of Mementoes to participants	Chair
03 15 PM	Closing Remarks	Director-SAC
03 30 PM	Closing Remarks	Member Secretary, CSB and Director, SAC
<i>Chair</i>	<i>Member Secretary, CSB and Director, SAC</i>	
<i>MC</i>	<i>Mr. KK Shetty, OSD, ISC</i>	
04 00 PM	Tea	
04 30 PM	Visit to CSRTI, Mysore	CSRTI
07 30 PM	Closing Dinner	
Day 4 (27.08.2015)	Field visit and Sight Seeing	
	Industries, Cooperatives and farmers field in Mysore	
Day 5 (28.08.2015)	Travel to Bengaluru	
	Leave to Bengaluru.	
07 00 AM	Leave to Bengaluru.	
09 30 AM	Visit Automatic Reeling Unit, Chennapatna	
10 30 AM	Visit Ramanagara Cocoon Market	
01 00 PM	Arrive CSB complex and Lunch	
02 00 PM	Visit Silkworm Seed Production Centre, Bangalore	
03 00 PM	Visit Central Silk Technological Research Institute and Product, Design, Diversification and Development Cell, Bangalore	
04 00 PM	Visit to the office of International Sericultural Commission	
04 30 PM	Meeting between the country representatives and Central Silk Board delegation led by Dr. H. Nagesh Prabhu, CEO & Member Secretary	
05 30 PM	End of the Program	
08 00 PM	Dinner hosted by Central Silk Board, Bangalore	
Day 6 29.08.2015	All participants travel back to their country or visit in Bangalore	
	Coordinators:	
SAARC	Dr. Tayan Raj Gurung, Senior Program Specialist, SAARC Agriculture Centre, Dhaka, Bangladesh	tayangurung@yahoo.com Cell (India) +91-9650362491; Cell (Bangladesh) +880-1966184916
ISC	Mr. Dileep Kumar R, Secretary to Secretary General Ms. Kalaiarasi R Executive International Sericultural Commission, Ground Floor, Central Silk Board Complex, B.T.M. Layout, Madiwala, Bengaluru- 560068. INDIA.	Mob: 00 91 9036536134 Mob: 00 91 8694949595 Tel: 00 91 80 26680162 / 26681663; Fax: 00 91 80 26681663 Email: iscbangalore@inserco.in

## Photo Gallery



**Photo 1: Guests with SAARC Delegates**



**Photo 2: Meeting in session\_SAARC Delegates**



**Photo 3: Working Group in Session**





**Photo 4: Director, SAC and Member Secretary, CSB Chairing a session**



**Photo 5: Visit to CSRTI, Mysore**



**Photo 6: Visit to Cocoon Market in Ramanagaram**



**Photo 7: Visit to Central Silk Board**



**Photo 8: Visit to Office of the Secretary General, ISC**



**Photo 9: Meeting with the officials of Central Silk Board of India**

