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Annual Report
2015-16



केन्द्रीय रेशम बोर्ड

वस्त्र मंत्रालय - भारत सरकार
कॅरेबो काम्प्लेक्स, बी टी एम लेआउट
बेंगलूरु - 560 068, भारत

CENTRAL SILK BOARD

Ministry of Textiles - Govt. of India
CSB Complex, B T M Layout, Madiwala
Bengaluru - 560 068, INDIA

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Introduction

India has the unique distinction of being the only country producing all the five known commercial varieties of silks in the world namely, mulberry, tropical tasar, oak tasar, eri and muga of which muga with its golden yellow sheen is unique and prerogative of India. The highlights of achievements of the industry during 2015-16 is elucidated below:

Sl.No.	Particulars	2015-16
A	Area under Mulberry (ha)	208947
B	Mulberry Raw Silk (MT)	
	Bivoltine	4613
	Cross Breed	15865
	Sub-Total (B)	20478
C	Vanya Silk (MT)	
	Tasar	2819
	Eri spun silk	5060
	Muga	166
	Sub-Total (C)	8045
	Total (B+C)	28523

Source: Compiled from the reports received from the State Sericulture Departments

PERFORMANCE OF SERICULTURE INDUSTRY

A Bird's Eye View

- Bivoltine raw silk production increased to a record level of 4,613 MT in 2015-16 from 3,870 in 2014-15 achieving a growth of 19.2% over previous year. However, the mulberry raw silk production in the country decreased by 4.3% from 21,390 MT in 2014-15 to 20,478 MT in 2015-16.
- The raw silk production in the country has reduced by 0.6% from 28,708 MT in 2014-15 to 28,523 MT in 2015-16.
- The production of Vanya silk during 2015-16 was 8,045 MT, compared to 7,318 MT in 2014-15, which shows an increase in production of 9.9%. Tasar, Eri and Muga silks achieved record production of 2819 MT, 5060 MT and 166 MT, respectively during 2015-16.
- The export earnings from silk goods during 2015-16 was Rs.2495.99 crores (US\$ 389.53 million) compared to Rs.2829.94 crores (US\$ 471 million) in 2014-15, indicating a decrease of 11.80% in terms of Rs. and 17.29% in terms of US\$.
- The U.A.E., the U.S.A., the U.K. and Nigeria are the major importers of Indian silk goods. During 2015-16, the export earnings from the top ten importing countries put together accounted for 69.29% of total exports.

Research and Development

Mulberry:

- Released a new mulberry variety MSG2, for cultivation in semi-arid regions, where soil moisture stress is a limiting factor for sericulture. It has a leaf yield potential of 22-23 MT/ha/yr as compared to the existing S13 variety (13-16 MT) and is suitable for growing as small trees under protective irrigation.
- A new mulberry variety PPR-1 with the advantages of early sprouting, greater rooting efficiency and enhanced leaf yield was released for temperate regions of Jammu and Kashmir.
- Four new mulberry varieties viz., C2038, G4, Suvarna-2, Tr-23 were evaluated under All

India Coordinated Experimental Trials. In South G4 and in East and North C2038 and in hilly areas Tr-23 performed better than other varieties.

- A new mulberry genotype C-13, having leaf yield potential of 1.27 kg/plant/yr with 18.8% yield improvement over S-1635 (1.066 kg) was developed.
- Low temperature stress tolerant mulberry genotypes with high leaf yield viz., C-108 (15.4 MT), C-384 (9.7 MT) and C-212 (9.2 MT) were identified.
- C-2028, a water logged tolerant mulberry variety is being popularized in West Bengal, Assam and other Eastern and North-eastern states.
- Developed Distinctiveness, Uniformity, Stability (DUS) guidelines for Mulberry.
- 1269 Mulberry Germplasm accessions are being conserved in the *ex situ* field gene bank.
- Moderate tillage with grass cover was found to be highest leaf producer (38.7 MT/ha/yr) having the maximum “Carbon Sequestration Potential” of 6.9 MT/ha/annum with 40.1 mg /ha/annum Soil Organic Carbon Stock (SOCS).
- Application of Geo-Spatial technology on mulberry area digitalization was conducted in West Bengal in collaboration with the North-Eastern Space Application Centre (NESAC), Shillong, Meghalaya.
- Forewarning system for mulberry diseases along with ready reckoner for application of fungicides was developed for Eastern and North-eastern India.
- For effective management of mulberry pests, a mulberry pest incidence calendar for different agro-climates of Eastern and North-eastern regions was developed.
- Field evaluation of “Nemahari”, a bio-nematicide resulted in the reduction of root knot disease up to 80% with an improved leaf yield (15-18%).
- A new formulation consisting of botanicals and alternative fungicides was developed against root rot disease with an efficacy of 88-94% disease suppression.
- A highly productive single hybrid, S8 x CSR16 was developed with cocoon yield potential of 70-80kg/100 dfls and was characterized by high reelability, neatness, raw silk recovery and renditta, and is ready for large scale testing.
- New Bivoltine silkworm hybrid Gen-3 x SK6 having cocoon yield potential of 50-55 kg yield/100 dfls and Multivoltine x Bivoltine silkworm hybrid M6DPC x (SK6 x SK7) with 45-50 kg yield/100 dfls were developed for Eastern region.
- Field evaluation of the newly developed improved crossbreed (MV1 x S8) recorded an average yield of 60-65 kg/100 dfls.
- Four thermo-tolerant silkworm lines were developed utilizing SSR markers (LFL0329 and LFL1123) associated with thermo-tolerance.
- The NPV tolerant bivoltine silkworm hybrid MSN4 x CSR4 is performing better than control under field testing.
- The hybrids identified through Post Authorization Programme, such as CSR16 x CSR17, MH1 x CSR2 in South zone, FC1 x FC2, M.con1 x B.con4, M.con4 x B.con4,

- M.con1 x M.con4 in East and North-East, CSR46 x CSR47, FC1 x FC2 and APS5 x APS4 in North and North-West were popularized for commercial exploitation.
- Bivoltine hybrids, FC3 x FC4 and CSR50 x CSR51 were subjected to popularization trials, which recorded an average yield of 68.18 and 67.11 kg/100 dfls, respectively.
 - Two new bivoltine hybrids viz., G11 x G19 and B.con1 x B.con4 with better yield and adaptation are in the 2nd year of the authorization trials.
 - The field trial of improved L14 x CSR2 hybrid recorded cocoon yields up to 63kg/100 dfls at farmers level.
 - Evaluation trials confirmed the safe employment of the 4, 6, 8 and 10 months hibernation schedules for preservation of the bivoltine silkworm breeds SK6 and SK7 and tropical univoltine race, Barpat.
 - 466 silkworm germplasm stocks (81 Multivoltine, 365 Bivoltine and 20 mutants) were maintained true to type as per passport data.
 - A new, easy to maintain and cost-effective PVC rearing racks have been developed for shoot feeding method.
 - A new silkworm bed disinfectant 'Ghar Sodhon' has been formulated and tested in West Bengal, Jharkhand, Jorhat, Ranchi and Odisha that obtained cocoon yield gain of 3-4 kg/100 dfls over the control.
- Vanya Silk**
- Tasar Daba bivoltine silkworm 'BDR-10' and Eri silkworm breed 'C2' are under popularization.
 - A new, high fecundity line of tropical Tasar silkworm - CTR-14 and two superior Muga silkworm lines CMR-1 and CMR-2 are under field testing.
 - Based on characterization, evaluation and categorization of wild sericigenous insects, *Antheraea frithi* has been selected as the future prospective species of the North-eastern region.
 - Field trial of eri eco-race SR-025 at semi-arid conditions of Andhra Pradesh has been initiated.
 - Insect Repository has been established at CMERTI, Lahdoigarh.
 - Collapsible strip type mountage for mounting of ripened eri silkworms has been developed.
 - The Prototype machine for Tasar egg washing and surface sterilization has been designed and fabricated.
 - Muga silkworm egg preservation schedules to facilitate uniform hatching has been developed.
 - An alternative food plant *Lagerstroemia speciosa* for Tasar silkworm rearing has been identified which is easy rooter and fast growing. Trials are on to validate the rearing performance.
 - Package of practices for the efficient utilization of Sal flora in Jharkhand and also to improve the productivity of Laria on Sal were recommended.
 - Two Som accessions (S3 & S6) resistant to leaf spot disease, leaf blight and rust are being popularized in the field.

- INM package developed for castor cultivation is under field testing.
- *Ailanthus grandis* (Borpat) has been identified as the best perennial host plant for eri silkworm rearing.
- A new tasar cocoon cooking recipe i.e., a combination of Borax and Sodium Bicarbonate developed for Daba, Raily and Modal cocoons found to be technoeconomically are feasible with 67% silk recovery and 33% reelability.
- A new wooden collapsible strip type moutage has been developed for Eri silkworm cocooning.

Post-cocoon

- Indigenous Automatic Silk Reeling Machine was developed with a mechanical brushing unit to produce superior quality import substitute silk and is being demonstrated.
- Muga cocoon stifling technology is developed and is being popularized in the field.
- Machine for the production of novel yarn using cocoon entanglement system is designed, fabricated and tested.
- Fabrics have been developed using novel yarn as weft.
- Demonstration of Pellade extraction and pupa separation machine to remove pellade layer from spent silkworm cocoon after the reeling.
- Three varieties of Chanderi sarees (Silk x Silk) are developed.
- Mulberry, Tasar, Muga & Eri silk fabric are developed with reinforced fibroin matrix.

Patents

During the year, patents were obtained for three technologies viz., (1) Peddle operated composite cocoon harvester, (2) Moutage used for production of cocoon and (3) Manually operated matured silkworm separator and collector, while applications were filed for the following six technologies with National Biodiversity Authority.

1. Preparation of pupa powder
2. Culturing of Cordyceps
3. Use of spent silkworm moths
4. Pupae for human food
5. Preparation of pupae oil and
6. Preparation of silkworm powder

Commercialization of Technologies

- MoUs are entered with the manufacturers of Samruddhi, Serimore and Sanitech Super for the commercial utilization after thorough technical evaluation.
- Aroma finishing on silk
- Slub catcher
- Technology package for proper handling and processing pupae by-product for effective utilization
- SERI FIT- a new disinfectant and NEMAHARI- a bio-nematicide formulation were released for commercial production

Transfer of Technology (TOT)

During 2015-16, in all, 2,154 TOT programmes were organized and 47 technologies were transferred effectively to the user level. Further,

1,10,210 cocoon and silk samples have been tested under post-cocoon technology.

Training

During the year under report, 13,986 persons (farmers, industry stakeholders and departmental candidates) were trained under various programmes through skill seeding and skill development approaches.

Under the restructured Central Sector Scheme (CSS), a new component entitled - Information Education and Communication (IEC) has been initiated for supporting capacity building and training initiative by way of printing information brochures, technical course materials, instructional videos, sericulture films and documentaries.

The construction of Centre of Excellence for post-cocoon technology started during 2014-15 is nearing completion for running industry aligned PCT courses during 2016-17.

IT Initiatives

- SMS services were introduced on day-to-day market rates of raw silk and cocoons for farmers and other stakeholders.
- 3700 bivoltine cluster farmer profiles were updated into SERI5K database.
- During the year, 5,83,398 timely and relevant advisory SMS messages were sent to farmers in local language, using mkisan portal. These SMSs contain 196 advisories.
- Video Conferencing facility was established at CSRTI, Mysuru, Berhampore, CTRTI, Ranchi, CMERTI, Lahdoigarh and Regional Office, New Delhi.

- Major CSB research Institutes (CSTRI Bengaluru, CSRTI Mysuru, CTRTI Ranchi and CMERTI Lahdoigarh) obtained National Knowledge Network (NKN) connection for sharing and facilitating research materials among scientists.
- CSB Secretariat has hosted bi-lingual website www.csb.gov.in for dissemination of up-to-date information to the public. The research units of CSB have also created websites to give research and scientific information.

Seed Organization

Mulberry Seed

The Seed organization of Central Silk Board continued to support various sectors by supplying quality silkworm seed. National Silkworm Seed Organisation (NSSO) produced 410.50 lakh dfls against a target of 375 lakhs dfls. Out of this 309.79 lakh dfls of bivoltine hybrids were produced against target of producing 275 lakhs dfls.

Vanya Seed

Tropical tasar seed: In Tasar sector, Basic Tasar Silkworm Seed Organization (BTSSO) through its network of BSM & TCs produced 39.50 lakh Dfls for supply to different tasar states. The initiative taken by BTSSO for promoting private participation in seed production resulted in significant production of 7.08 lakh dfls through private graineurs.

Oak tasar seed: The Oak Tasar units of CSB located in 6 states produced 0.44 lakh dfls.

Muga seed: The Muga Silkworm Seed Organisation (MSSO) through its P4, P3 units & SSPC produced 7.45 lakh Muga dfls.

Eri seed: In Eri sector, the Eri Silkworm Seed Organization (ESSO) with its 5 SSPCs (one in traditional and four in non-traditional states) produced 5.75 lakh dfls for distribution to various states.

Under NERTPS, initiatives were undertaken to strengthen the Muga and Eri Seed infrastructure by establishment of three P3 Basic Seed Stations and one SSPC in Muga sector and one SSPC under Eri sector.

Major Events

- A “National Workshop on Innovative Technologies and Best Practices in Sericulture” was held during November 17-18, 2015 at CSR&TI, Mysuru. Shri Santosh Kumar Gangwar, Union Minister of State for Textiles, Shri A. Manju, Minister for Animal Husbandry and Sericulture, Govt. of Karnataka, Shri Pratap Simha, Member of Parliament, Mysuru, Shri S.K. Panda, IAS., Secretary to Govt. of India, Ministry of Textiles graced the occasion. During the event, 54 sericulturists from 27 states who excelled in their performance as sericulture entrepreneurs were felicitated and the foundation stone for Mega Silk Cluster project at Mysuru was laid.
- CSB extended local support for organization of a 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 Mysuru, wherein all the eight SAARC nations participated.
- A Silkworm Breeders Meet was organized at CSRTI, Mysuru on 29th September, 2015

to finalize the action plan for breeding programmes in mulberry, eri, tasar and muga silkworms to be undertaken in the next two years.

- Third Sub-Committee of the Parliament Standing Committee on Official Language visited Regional Office of CSB, New Delhi on 12th February, 2016 for an interaction review meeting with officers of the MOT and CSB and held discussions on the progress made towards implementation of Official Language by CSB.

Special Releases

- “*Awardees of Excellence in Sericulture 2015*”: A special booklet was brought out on the occasion of “National Workshop on Innovative Technologies and Best Practices in Sericulture” held during November 17-18, 2015 at CSR&TI, Mysuru. This booklet dovetails information on success stories of sericulturists from 27 states who excelled in their performance as sericulture entrepreneurs and became role models for others. This booklet was released by the Union Minister of State for Textiles during the inaugural session of the workshop.
- Special booklet “*Glimpses of Achievements 2014-15*”: The CSB has brought out a special booklet on the glimpses of major achievements of the Indian sericulture sector during 2014-15 and the contribution of CSB in this direction. This booklet highlights the importance of Indian sericulture and silk industry and the initiatives of CSB in ensuring all round development of the industry and its

support to the social cause and propagating sericulture as an effective tool for inclusive growth.

- > **NERTPS Brochure:** This brochure dovetails on the umbrella scheme launched by the Ministry of Textiles, Govt. of India for implementing textiles sector development projects in the North-eastern states laying special emphasis on strengthening the sericulture sector and creating a strong visibility of the silk of North-eastern region *i.e.*, *Vanya Silks*, worldwide by improving quality standards and increasing the production.

Accolades and Awards

During 2015-16, CSB units received the awards for accelerating the progressive use of Hindi for official purposes. NSSO, Bengaluru received Rajbhasha Shield for 2014-15 and Third Prize for Regional Official Language the year 2014-15. CSR&TI, Berhampore received Third Prize for Regional Official Language the year 2014-15 while CMER&TI, Lahdoigarh received a TOLIC shield for 2014-15. MSSO, Guwahati, Regional Office, Guwahati and CSTRI, Bengaluru received citation from respective TOLIC and Regional Office, Chennai received consolation shield for 2014-15.

Visit of CSB Team abroad

- a. A three-member delegation comprising of Dr. V. Sivaprasad, Director, Central Sericultural

Research and Training Institute, Mysuru, Dr. B.S. Angadi, Director (Tech), CSB, Bengaluru and Dr. G.V. Kalpana, Scientist-D, P4 Basic Seed Farm, Hassan visited National Institute of Agro-biological Sciences (NIAS), Japan from 15th to 17th July 2015 to discuss and finalize collaborative research programme on silkworm breeding between India and Japan.

- b. Dr. A.R. Pradeep, Scientist-D, SBRL, Kodathi presented a research paper in the 4th International Congress on Analytical Proteomics held in Caparica, Lisbon, Portugal during 7th to 9th September 2015.

Visits

- a. Shri Giriraj Singh, Hon'ble Union Minister of MSME visited CSB Secretariat, CSTRI and SSPC, Bengaluru on 11th March 2016.
- b. Shri S.K. Panda, Secretary (Textiles) visited CSB Secretariat, CSTRI, SSPC, Bengaluru on 19th September, 2015 and also took a review meeting on CSB activities.
- c. Smt. Rashmi Verma, Secretary (Textiles) and Shri Alok Kumar, Development Commissioner (Handlooms) visited CSB Secretariat, CSTRI, SSPC, Bengaluru on 17th March, 2016 and also took a review meeting on CSB activities.

Introduction

Central Silk Board (CSB), constituted in April, 1949, by an Act of Parliament (Act No. LXI of 1948), is a statutory body under the Ministry of Textiles, Government of India, established for the development of sericulture and silk industry in the country.

The activities of CSB include research and development, front line demonstration, maintenance of four-tier silkworm seed production network, leadership role in commercial silkworm seed production, standardizing and instilling quality parameters in various production processes, promotion of Indian Silk in domestic and international markets and advising the Union Government on all matters concerning sericulture and silk industry. These activities are being carried out by a network of 324 units located in different states. The details of the units are at Annexure – I (a & b).

Functions

The CSB coordinates and assists in:

- Promotion of the development of silk Industry by such measures as it thinks fit.
- Undertaking, assisting and encouraging scientific, technological and economic research.
- Devising means for improved methods of mulberry cultivation, silkworm rearing, developing and distribution of healthy silkworm seed, improved methods of silk reeling and spinning of cocoons and silk-waste, improving the quality and production of raw silk, if necessary by making it compulsory for all raw silk to be marketed only after the same has been tested and graded in properly equipped raw silk testing and conditioning houses.
- Improvement of raw silk marketing.
- Advising the central government on all matters relating to the development of silk industry including import and export of raw silk.
- Collection of sericulture statistics.
- Preparation of reports related to silk industry for Ministry of Textiles, Government of India.

Constitution

Central Silk Board is constituted by 39 members appointed as per the powers and provisions conferred by Sub-Section 3 of Section 4 of the CSB Act 1948, for a period of 3 years. The new members nominated during the period under report are as follows:

Sl. No.	Name and Designation of nominated members	Period of nomination	Notification details
1	Shri Basawaraj Patil, Member of Parliament, New Delhi	22.05.2015 to 02.04.2018	25012/4/2014-Silk dtd.22.05.2015 Under Section 4(3)(c)
2	Shri Neeraj Shekhar, Member of Parliament, New Delhi	22.05.2015 to 07.05.2018	25012/4/2014-Silk dtd.22.05.2015 Under Section 4(3)(c)

Continued..

Sl. No.	Name and Designation of nominated members	Period of nomination	Notification details
3	Ms. Neelam S Kumar, Chief Controller of Accounts, MoT, New Delhi	10.07.2015 to 09.07.2018	25012/7/2014-Silk dtd.10.07.2015 Under Section 4(3)(b)
4	Dr. H. Nagesh Prabhu, IFS, Member Secretary, CSB, Bengaluru	20.07.2015 to 31.12.2017	25012/4/2014-Silk dtd.20.08.2015 Under Section 4(3)(b)
5	Joint Secretary (Silk), Ministry of Textiles, Govt. of India, New Delhi	26.02.2016 to 25.02.2019	25012/7/2014-Silk dtd.26.02.2016 Under Section 4(3)(b)

A list of members of the Board as on 31.03.2016 under different sections is at Annexure – II.

Staff Strength

The group-wise sanctioned strength and working strength of the CSB as on 31st March 2016 is indicated below:

Group	Sanctioned	Filled	GEN	SC	ST	OBC	PWD	TOTAL
A	811	676	424	130	53	66	3	676
B	1483	1353	873	255	129	77	19	1353
C	1554	1218	607	353	165	75	18	1218
D	9	9	1	3	4	1	-	9
Total	3857	3256	1905	741	351	219	40	3256
%			58.50%	22.76%	10.78%	6.73%	1.23%	100%

Implementation of Reservation Policy

Central Silk Board has been following the reservation policy as per the directions of Government of India for persons belonging to Scheduled Caste (SC), Scheduled Tribe (ST) and Other Backward Class (OBC) under direct recruitment and for promotion also. Apart from the above, the reservation policy is also extended to the Persons With Disabilities (PWD) for direct recruitment in all groups and for promotion under Group 'C' category under the Equal Opportunities, Protection of Rights and Full Participation Act, 1995 of Govt. of India.

Changes in Senior Level Officers

Central Silk Board has filled the vacancies at the level of Directors of research institutes, as a part of its administrative and financial responsibility for smooth running of the sericulture developmental activities. During the period under report, the following officers have taken over charge:

1. Dr. H. Nagesh Prabhu, IFS, has assumed the charge of the post of Member Secretary, Central Silk Board on 19.06.2015.
2. Dr. Satya Prakash Sharma has assumed the charge of the post of Director, Central

Sericultural Research & Training Institute, Central Silk Board, Pampore on 10.08.2015.

3. Dr. Pradeep Kumar Mishra has assumed charge of the post of Director, Central Sericultural Germplasm Resource Centre, Central Silk Board, Hosur, Tamil Nadu on 12.10.2015.
4. Dr. Kanika Trivedy has assumed the charge of the post of the Director, Central Sericultural Research and Training Institute, Central Silk Board, Berhampore, West Bengal on 02.11.2015.

Meetings of the Board and Standing Committee

During the period under report, two meetings of the Standing Committee were conducted on 07.10.2015 & 15.02.2016 and one Board Meeting was convened on 19.08.2015.

Vigilance

Measures taken to strengthen the Preventive Vigilance by Streamlining Procedures :

The units of CSB which are considered sensitive areas have been identified and measures for preventive vigilance, surveillance and detection have been taken. Besides the Chief Vigilance Officer, the Directors/Officers-in-Charge of CSB stationed at different zones have been entrusted with the task of carrying out surprise inspections of the units/sensitive areas, clearly demarcating their areas of jurisdiction. The surprise inspection reports are periodically received, scrutinized and actions are taken, wherever necessary. During 2015-16, no necessity aroused to initiate any disciplinary proceeding based on such reports.

An Internal Audit Wing, supported by Zonal Audit Teams of different zones, has been functioning to conduct the internal audit on the accounts of the units. The Directors of the research institutes/research stations and the officers of the rank of Scientist-D holding independent charge of various units have been delegated with powers to function as Disciplinary Authority in respect of certain categories of officials. The complaints and petitions received are examined and action is taken as and when a *prima facie* case is established. During the period under reference, 30 complaints were received, out of which, 28 were disposed off. Two complaints were pending for disposal as on 31.03.2016.

Expediting the Completion of Preliminary Investigations/oral Inquiries

Preliminary investigations, wherever ordered, are being carried out as early as possible and action is being taken on the findings of the preliminary investigation Officers. As on 31-03-2016, six disciplinary cases were pending for disposal. For the disciplinary cases initiated in the CSB under Rule 14 of Central Civil Services (Classification, Control & Appeal) Rules, 1965, viz., major penalty proceedings, serving as well as retired officers of the Board are being appointed as the Inquiry Officers, with instructions to complete the inquiry process within the specified time limit. Five Retired Judicial Officers (Retired District Sessions Judges) have been empanelled to be appointed as the Inquiry Officers (as and when disciplinary cases crop up).

Sexual Harassment Complaints

As regards the complaints relating to sexual harassment at work places received from

the women employees and women farm workers of the CSB, Complaints Committees are constituted at the Board's Secretariat and also at the institutes' level to act as the Inquiring Authority.

Observance of the Vigilance Awareness Week

In accordance with the guidelines issued by the Ministry/Central Vigilance Commission, New Delhi, Vigilance Awareness Week was observed at the Central Silk Board's headquarters and at all its subordinate units between 26.10.2015 and 31.10.2015 in a befitting manner.

PUBLIC INFORMATION CELL (PIC)

Implementation of Right to Information Act, 2005

Forty CPIOs and 215 APIOs have been designated from both Central Office and field units of CSB. The Public Information Cell has received 190 applications from the public during the year, of which 6 applications were pending for disposal as on 31st March, 2016. Eleven appeals were also received and were disposed by 31st March, 2016. The applications received and replies furnished to the citizen are uploaded in CSB website.

Collaboration with International Organizations

CSB continues to engage with the International Sericultural Commission (ISC), Bengaluru, India for the development of sericulture and silk industry in the country. The shifting and locating the office of ISC from Lyon (France) to Bengaluru, India, has significantly benefited CSB to engage with many other international organizations, governments and reputed institutions for the development of sericulture and silk industry. As an outcome of this, action has been initiated to forge bilateral collaborative programmes with institutions in

countries like Bulgaria, Brazil, Uzbekistan, Bangladesh, Italy, Australia, Myanmar and Romania. Special initiatives have also been taken to source assistance from international agencies like SAARC, ITC, UNIDO, ESCAP and FAO etc.

CSB extended local support for organization of a 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 Mysuru. All the eight SAARC nations participated in the event. The workshop came out with major recommendations for the development of sericulture and silk industry in SAARC region. As decided during the meeting, CSB is in the process of preparing the Indian part of a sericulture project to integrate into the SAARC plan of taking up a Joint Sericulture Developmental Project for SAARC countries.

International Collaborative Programmes of CSB

- 1) An MoU of collaboration between National Institute of Agro-biological Sciences, Japan and CSB to develop improved bivoltine breeds suitable to Indian condition has been finalized. Under this programme, Japan would share genetic materials for breed improvement and furthering research activities in Indian labs. The MoU is expected to be signed shortly.
- 2) A collaborative programme in silk sector between Uzbekistan and India has been developed for the benefit of both the countries. The MoU detailing the elements of collaboration is expected to be signed during the 3rd JWG Meeting on silk sector scheduled to be held during November, 2015 in Tashkent.

- 3) Central Silk Technological Research Institute, Bengaluru has commenced implementing 3 research projects in collaboration with Deakin University, Australia. These projects are expected to provide major fillip to the post-yarn sector of silk industry.
- 4) CSB and Sericulture Experimentation Station, Bulgaria have agreed to share genetic materials for the development of improved breed suitable to both the countries. The first batch of genetic materials is expected to be exchanged during the month of September, 2016.
- 5) On the initiative of CSB, the Guangxi Agriculture Department, Guangxi Province, China has agreed to collaborate with CSB on taking up collaborative research programme, training of Indian technical personnel's in China and sharing of technical know-how on silk industry. As part of this effort, a high level delegation from Guangxi Autonomous Government visited CSB on 14th December, 2015 to finalise the elements of collaboration. As an outcome of this visit, an MoU of collaboration has been prepared and is expected to be signed during 2016.
- 6) CSB has developed collaborative programme with University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania in the areas of plant and

breed development. An MoU of collaboration is expected to be signed shortly after receiving the clearance from Govt. of India.

Visit of CSB Delegation to Other Countries

A three-member delegation comprising Dr. V. Sivaprasad, Director, Central Sericultural Research and Training Institute, Mysuru, Dr. B.S. Angadi, Director (Tech), CSB, Bengaluru and Dr. G.V. Kalpana, Scientist-D, P4 Basic Seed Farm, Hassan visited National Institute of Agro-biological Sciences (NIAS), Japan from 15th to 17th July 2015 to discuss and finalize collaborative research programme on silkworm breeding between India and Japan.

Dr. A.R. Pradeep, Scientist-D, SBRL, Kodathi presented a research paper in the 4th International Congress on Analytical Proteomics held in Caparica, Lisbon, Portugal during 7th to 9th September 2015.

Parliament Related matters

A) Replies furnished to parliamentary questions

During 2015-16 (as on 31st March), CSB had furnished reply materials for 106 parliamentary questions (Lok Sabha - 84 and Rajya Sabha - 22) that were related to Ministry of Textiles, as per the break-up given in the following table.

House of the Parliament	Budget session April 2015	Monsoon Session Aug-Sept 2015	Winter Session Nov-Dec 2015	Budget Session March 2016-17	Total
Lok Sabha	24	27	20	13	84
Rajya Sabha	11	4	2	5	22
Total	35	31	22	18	106

B) CSB Review Meetings with Secretary (Textiles), MoT

During 2015-16, MOT has conducted 5 review meetings on 02.07.2015, 27.10.2015 and 06.01.2016 at New Delhi and on 19.11.2015 and 17.03.2016 at Bengaluru which have been attended by the Member Secretary, CSB and other officers/senior scientists.

C) Parliamentary Committee Meetings

Third Sub-Committee of the Parliament Standing Committee on Official Language visited Regional Office of CSB, New Delhi on 12th February, 2016 for an interaction review meeting with officers of the MoT and CSB and held discussions on the progress made towards implementation of Official Language by CSB.

Anti-dumping Duty on Chinese Raw Silk and Silk Fabrics

Raw Silk: With a view to protect the interest of domestic silk industry, Central Silk Board had filed a petition with the Director General of Anti-Dumping & Allied Duties (DGAD) on 8th May 2014 for considering imposition of anti-dumping duty on raw silk of 3A grade and below originating in or exported from China PR. The DGAD, after thorough investigation of the petition, has announced the final findings by recommending imposition of definitive

anti-dumping duty in the form of fixed duty of US\$ 1.85 per kg on Chinese raw silk vide their Notification No.14/17/2014/DGAD dated 04.12.2015. The duty so imposed is for a period of five years and is in force till December 2020.

Silk Fabric: Consequent upon completion of 5-year term regarding imposition of anti-dumping duty on Chinese silk fabrics, CSB along with the domestic silk weaving industry has filed a sunset review petition during 2010 for continuation of anti-dumping duty. Considering the merit of the case, the DGAD once again imposed an enhanced anti-dumping duty on Chinese silk fabrics with weight ranging from 20-100 g/mtr indicating a reference price of US\$ 2.08 - 7.59/mtr., with effect from December 2011 and the duty so imposed is in force till December 2016.

Customs Duty on Import of Raw Silk

When the financial bill for 2015-16 was passed, the customs duty on raw silk was reduced from 15 to 10%. The duty on raw silk was reduced with a view to make available the imported raw silk at an affordable price to the silk weavers. Immediately after the announcement of reduction in customs duty, there was a crash in the prices of cocoon and raw silk. However, the cocoon and raw silk prices recovered fairly after October, 2015.

CENTRAL SECTOR SCHEMES

The Central Silk Board is implementing a Central Sector Plan Scheme *viz.*, “Integrated Scheme for the development of Silk Industry” aimed to increase the quality and productivity of silk thereby enhance the income of state holders. The Scheme consists of following 4 components:

- Research & Development, training, transfer of technology and IT initiatives.
- Seed Organization
- Coordination and market development
- Quality Certification System

Component-wise details are given below :

Research & Development, Training, Transfer of Technology and IT initiatives

RESEARCH & DEVELOPMENT

The research and development institutes of CSB are striving continuously to provide scientific and technical support to the sericulture sector to meet the challenges posed by global warming, international competition, urbanization and outbreak of new pests and diseases. During the past couple of years, silk production in India has recorded a remarkable growth in both quality as well as quantity, which can be attributed to effective R&D and transfer of technology to field in sericulture.

The major research institutes engaged in research and development are Central Sericultural Research and Training Institutes (CSRTI) located at Mysuru (Karnataka), Berhampore (West Bengal) and Pampore (J&K) which deals with mulberry sericulture; Central Tasar Research & Training Institute (CTRТИ), Ranchi (Jharkhand) that deals with tasar culture and Central Muga Eri

Research & Training Institute (CMERTI), Lahdoigarh, Jorhat (Assam) that deals with muga and eri culture. Regional Sericultural Research Stations (RSRS/RTRS/RMRS) for mulberry and vanya sericulture have been functioning for the development and dissemination of region specific technology package.

Besides, the network of Research Extension Centres (RECs) & sub units for mulberry and vanya silk is providing extension support to the sericulturists. The required R&D support in post-cocoon sector is provided by Central Silk Technological Research Institute (CSTRI) at Bengaluru. Similarly, Silkworm Seed Technology Laboratory (SSTL), Bengaluru (Karnataka) delivers support to seed sector, Central Sericultural Germplasm Resource Centre (CSGRC) at Hosur (Tamil Nadu) helps in maintaining the genetic resources of both mulberry silkworm and its host plants while Seri-Biotech Research Laboratory (SBRL) at Bengaluru carries out seri-biotechnology research. The major research achievements of these institutes during 2015-16 are as follows:

MULBERRY SECTOR

Central Sericultural Research & Training Institute (CSRTI), Mysuru, Karnataka

Central Sericultural Research & Training Institute (CSRTI, Mysuru) conducts research in mulberry and silkworm breeding, production and protection to develop technologies catering to the needs of mulberry sericulture farmers in the states of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana, Maharashtra and Madhya Pradesh. Besides, it also conducts training programmes for the staff and farmers. The salient achievements of main institute and its nested units are as follows:

Mulberry Crop Improvement, Production and Protection

- MSG-2, a new mulberry variety with a yield potential of 22.7 MT/ha/year against 13 MT from the existing variety S13, was released for commercial exploitation in rainfed semi-arid conditions.
- Developed Distinctiveness, Uniformity and Stability (DUS) guidelines for mulberry by analyzing 48 identified and validated descriptors.
- Divergent mulberry germplasm for root rot resistance (20 resistant & 49 highly susceptible) were identified. Ninety-six genotypes were characterized for root rot resistance utilizing 20 polymorphic SSR markers.
- Field evaluation of “Nemahari”, a bio-nematicide resulted in the reduction of root knot disease upto 80% with an improved leaf yield (15-18%).
- A new formulation consisting of botanicals and alternative fungicides was developed against root rot disease with an efficacy of 88-94% disease suppression.

Silkworm Crop Improvement, Production and Protection

- A bivoltine single hybrid, CSR16 x CSR17 was released for commercial purpose after successful post-authorization trials.
- G11 x G19, bivoltine double hybrid recorded an average yield of 67.11 kg/100 dfls with 2A-

3A graded silk under Authorization trials with 4.03 lakh dfls in southern states.

- Three thermo-tolerant bivoltine hybrids (Double: TT21 x TT67 & TT23 x TT67; Single: TT2 x TT6) were developed by employing SSR marker assisted selection process with a cocoon yield of 60-70 kg/100 dfls, 22-23% shell, 88-90% reelability and 15-17% raw silk.
- Two improved cross breeds, L3 x S8 and HB4 x S8 tolerant to high temperature and BmNPV were developed with a pupation rate of >90%, 20-21% shell and 14-15% raw silk.
- Field evaluation of S8 x CSR16, a productive bivoltine single hybrid recorded an average yield of 74.64 kg/100 dfls in Andhra Pradesh, Karnataka and Tamil Nadu. The hybrid is characterized by higher cocoon weight (2.12g), shell (0.502g @ 23.75%), filament length (1175m), reelability (>90%) and neatness (95%), with a better raw silk recovery (19.5%) and renditta (5.0-5.5).
- Field evaluation of SSBS5 x SSBS6, a productive bivoltine double hybrid suitable for favourable conditions (6500 dfls/23 farmers) recorded an average yield of 70-75kg/100 dfls in Tamil Nadu.
- Field evaluation of a newly developed improved crossbreed, Cauvery Gold (MV1 x S8) for cocoon productivity and silk quality covering 35,300 dfls with 153 farmers recorded an average cocoon yield of 60-65 kg/100 dfls.
- Bivoltine hybrids, FC3 x FC4 and CSR50 x CSR51 were subjected to popularization

trials, which recorded an average yield of 68.18 and 67.11 kg/100 dfls, respectively.

- On-Station Trials of BmNPV tolerant hybrids (single: 21x35; double: 21.118 x 62.87 and 21.27 x 62.26) developed through BmNOX marker assisted selection showed encouraging results with an average yield of 65-75kg/100 dfls.
- Multi-location field trials of transgenic BmNPV resistant silkworms were initiated and two crop data showed relatively better cocoon yield by 6.7% (61.64kg/100 dfls) in transgenic hybrid (CSR2-T x CSR4) over control (57.75kg).
- Biological control agents, *Nesolynx thymus* (~703 lakh number) and *Cryptoleamus montrozeuri* (~1.6 lakh number) were supplied for uzifly and Mealy bug control respectively resulting in the management of pest incidence below Economic Threshold Level (ETL).
- SERIFIT, a new general disinfectant @ 0.2% was found effective for the disinfection of contaminated silkworm eggs, rearing trays and rearing house. The product was jointly developed with M/s. Sree Rayalaseema Hi-Strength Hypo Limited, Kurnool, Andhra Pradesh on consultancy project programme.
- LAMP (Loop-Mediated Isothermal Amplification) method was developed for the detection of *Nosema bombycis* in silkworms using specific primers without involving Polymerase Chain Reaction (PCR) and Electrophoresis.

Transfer of Technology

- A record quantity of 2772 MT bivoltine raw silk was produced through Bivoltine Cluster Promotion Programme covering 106 clusters in Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana and Maharashtra and by rearing 256.73 lakh dfls with an average cocoon yield of 70.18 kg/100 dfls.
- 8.47 lakh dfls of bivoltine hybrids were reared with an improvement of cocoon yield by 13.55% under Institute Village Linkage Programme (Seri Model Village) in Karnataka, Tamil Nadu, Andhra Pradesh, Telangana and Maharashtra.
- 36,562 sericulturists were sensitized with new technologies through 1083 extension communication programmes in bivoltine rearing, mulberry and silkworm disease management and quality cocoon production.
- Model CRC located at CSRTI, Mysuru was used for entrepreneurs in chawki rearing. 87,550 dfls were chawki reared in 32 batches and supplied to 195 farmers covering 68 villages resulted in an improvement of 9.4% cocoon yield (average cocoon yield: 71.15 kg/100 dfls).
- PVC stands for late age silkworm rearing were jointly developed with M/s. Concept Components, Mysuru.
- Regional Consultative Meet on "Sericulture Scenario in SAARC Region – A Re-Emerging Industry for Poverty Alleviation in SAARC

Region” (24-28th August, 2015) sponsored by SAARC Agriculture Centre (SAC) and International Sericulture Commission (ISC) was organized for a comprehensive review on potentials and challenges in sericultural industries in the SAARC region.

- Silkworm Breeders Meet was organized on 29th September, 2015 to finalize the action plan for breeding programmes/activities in mulberry, eri, tasar and muga silkworms to be undertaken in the next two years.
- A National workshop on “Innovative Technologies and Best Practices in Sericulture” sponsored by Ministry of Textiles was organized on 17th & 18th November, 2015 to felicitate 54 Best Seri-Achievers from 27 states and for facilitating exchange of best sericulture practices.
- Sericulture farmers workshops were organized in Haveri (Karnataka), Hindupur (Andhra Pradesh), Hosur (Tamil Nadu) and Baramati (Maharashtra) and 3275 farmers were enlightened on improved mulberry sericulture technologies.
- Technical books on Commercial Chawki Rearing, Integrated Drought Management for Mulberry Sericulture and Bio-Control of Insect Pests in Mulberry Sericulture were published for the benefit of farmers and officials.

Patents and Commercialization

- Patent application on “Utilization of sericultural waste biomass - a potential resource for generation of electricity and production of bio-manure” – A joint technology initiative in collaboration with M/s. S.V. Renewable Energy,

Bengaluru was filed through NRDC (Patent application No.20162001688 dated 18.01.2016).

- Patents were granted for ‘Hand operated mature worm separator and collector’ (Patent No.266685), ‘Pedal operated composite cocoon harvester’ (Patent No. 267244) and ‘Mountage used for production of cocoons’ (Patent No. 267245), which were filed during 2007.
- SERI FIT - a new disinfectant was released for commercial production jointly with M/s. Sree Rayalaseema Hi-Strength Hypo Ltd., Kurnool, Andhra Pradesh.
- NEMAHARI - a bionematicide formulation was commercialized to M/s. Rainbow Agri Life India Private Limited, Kadapa, Andhra Pradesh through NRDC for production and supply to sericulture farmers.

Capacity Building & Training

- 1622 sericulturists and officials were trained under Capacity Building & Training (CBT) and Technology Orientation Programme (TOP) at CSR&TI, Mysuru and its nested units.
- 371 farmers, entrepreneurs and officials were trained under need-based programmes including Intensive bivoltine technology, chawki rearing, bio-control agent production, integrated pest & disease management.
- 14 CSB/DoS officials were trained in Silkworm Race Maintenance programme (60 days).
- Foundation training (6 days) in mulberry sericulture for the 59 newly recruited young scientists of CSB and orientation courses for three JOCV (JICA) volunteers (30 days) and 21 PGDS students (5 days) were conducted.

- An International Training Programme in Silk and Sericulture Industry (45 days) sponsored by Indian Technical and Economic Co-operation (ITEC), (Ministry of External Affairs), Govt. of India, New Delhi was organized for 14 trainees from Thailand, Bangladesh, Egypt, Philippines and Uganda.
- Two Egyptian researchers sponsored through ISC scholarships were trained in advanced technology in silkworm physiology and silkworm pathology for one month.

Achievements of Regional Sericultural Research Stations (RSRSs)

RSRS, Ananthapur (Andhra Pradesh)

- 1874.50 acres with 1286 farmers have been covered under mulberry plantation with new varieties.
- Evaluation trials of 1.30 lakh dfls of new bivoltine hybrids (G11 x G19, FC1 x FC2, FC2 x FC3 and CSR16 x CSR17) with 436 farmers recorded an average cocoon yield of 68.34 kg/100dfls.
- The fortnightly survey of major pests showed an incidence of 10.0-23.6% leaf roller, 5.0-13.5% tukra and 0.5-6.5% thrips.
- Uzi infestation was reduced to less than 5% from 13.5-16% through adoption of bio-control agent, *Nesolynx thymus* (675 sachets to 350 farmers covering 35 villages).
- Rearing of 63.66 lakh dfls of bivoltine hybrids with 21,821 farmers under CPP recorded an average cocoon yield of 69.54 kg/100 dfls. Under IVLP, 85,500 dfls of bivoltine hybrids were reared with 200 farmers and an average yield of 69.64 kg/100 dfls was recorded.

- 5214 farmers were sensitized with new sericulture technologies through state level sericulture farmers workshop and 123 extension communication programmes.

RSRS, Chamarajanagar (Karnataka)

- AR12 and V1 mulberry varieties were popularized among 11 farmers covering 19.75 acres.
- Seri-lac agro system for income augmentation with sericulture farmers was successfully demonstrated realizing upto Rs.2.0 lakh/acre/year.
- Twenty-four farmers planted S13 saplings under 8' x 8' spacing for tree mulberry cultivation. 35 farmers adopted Affordable Micro-Irrigation Technology (AMIT) for tree mulberry plantation under IVLP.
- Uzi fly infestation was limited to 3.95% from 8.69% through the supply of *N. thymus*. Further, mealy bug infestation was contained to 7.6% from 13.15% with *S. coccivora* beetles.
- Under CPP, 1.89 lakh dfls of bivoltine hybrids were reared with 835 farmers and the average cocoon yield realized was 64.5 kg/100 dfls.

RSRS, Kodathi (Karnataka)

- 100 soil samples were analyzed and soil correction measures were recommended to the farmers.
- Rearing of 90.01 lakh dfls of bivoltine hybrids with 3016 farmers under CPP recorded an average cocoon yield of 66.77 kg/100 dfls.
- Under IVLP, 47,600 dfls of bivoltine hybrids were reared with 100 farmers and recorded an average cocoon yield of 63.15 kg/100 dfls.

- Popularization of new silkworm hybrids (Bivoltine: S8 x CSR16, G11 x G19, FC3 x FC4, CSR50 x CSR51 and Crossbreed: MV1 x S8 & L14 x CSR2) were undertaken (93850 dfls/586 farmers).

RSRS, Salem (Tamil Nadu)

- Soil testing of 393 samples was conducted covering 327 sericulture farmers and suitable soil amelioration measures were suggested.
- Natural enemy (*Chrysoperla zastrowi sillemi*) of thrips (71,400 eggs) was released in the mulberry garden of farmers for effective control.
- Biological control measures for papaya mealy bug were continued through the release (63,266 individuals) of parasitoids covering 240 sericulture farmers and 97% pest reduction was observed.
- Bio-control agents viz., *Trichogramma chilonis* (114 cc) and *Bracon* (1,635 pockets), *Tetrastichus howardi* (92 pockets), *Cryptolaemus montrozieri* (3000 numbers), *Scymnus coccivora* (8500 numbers) and *Nesolynx thymus* (226 pouches) were mass multiplied and supplied to the farmers.
- 1.31 lakh dfls of new bivoltine silkworm hybrids (S8 x CSR16, G11 x G19, FC3 x FC4, CSR50 x CSR51 and SSBS5 x SSBS6) were reared with an average cocoon yield of 68.23 kg/100 dfls.
- 72.38 lakh dfls of bivoltine hybrids were reared in 30 clusters under CPP against the target of 68.46 lakh (105.73% achievement) and recorded the highest average cocoon yield @ 76.76 kg/100 dfls in the country.

- 2.76 lakh dfls of bivoltine hybrids were reared under IVLP with 200 farmers and obtained an average yield of 74.89 kg/100 dfls with a productivity improvement of 11-15%.

Central Sericultural Research and Training Institute, Berhampore, West Bengal

CSRTI, Berhampore along with its four Regional Sericultural Research Stations and 15 Research Extension Centers (REC) & Sub-units have made significant contributions for the development of sericulture industry in the eastern and North-eastern regions. The Research & Development focus was mainly on prioritized need on regional requirements, extension and human resource development for benefiting the sericulture farmers and stakeholders in close coordination with Directorates of Sericulture/Industries in 13 states in eastern and North-eastern India. During the period, 51 research projects/programmes/pilot studies were carried out for addressing problems in various aspects of sericulture industry. Major achievements made during the year are as follows:

Mulberry Crop Improvement, Production & Productivity

- Seven new mulberry genotypes with higher leaf yield and quality (1.75 kg to 2.51 kg/plant/annum) against S-1635 (1.71 kg/plant) were developed.
- Four new mulberry varieties were tested under All India Coordinated Experimental trial on Mulberry (AICEM-III) along with local control varieties in 7 test centres and C-2038 was found yielding better in all test centres except at RSRS, Kalimpong (hills of West Bengal), where Tr-23 recorded the highest leaf yield.

- Seven new triploid mulberry genotypes with higher leaf yield of 353g to 465.3g/ plant/crop (S-1635: 288.6g/plant/crop) were identified for irrigated condition.
 - A new mulberry genotype C-13 was developed for low input soils. It recorded a leaf yield of 1.27 kg/plant/yr, compared to 1.066 kg in S1635, under 50% chemical fertilizer reduction.
 - Moderate tillage with grass cover was found as the highest leaf producer (38.7 MT/ha/yr) having the maximum "Carbon Sequestration Potential" of 6.9 MT/ha/annum with 40.1 mg / ha/annum soil organic carbon stock.
 - Application of geo-spatial technology on mulberry area digitalization was conducted in West Bengal in collaboration with the North-Eastern Space Application Centre (NESAC), Shillong, Meghalaya.
 - The fungi *Laciodiplodia theobromae*, *Botryodiplodia theobromae* has been identified as the causal agent of root rot disease of mulberry in Murshidabad, Malda and Birbhum districts of West Bengal.
 - Forewarning system for mulberry diseases along with ready reckoner for application of fungicides was developed for Eastern and North-eastern India.
 - For effective management of mulberry pests, a mulberry pest incidence calendar for different agro-climatic zones of eastern and North-eastern regions was developed.
- Silkworm Crop Improvement, Production & Productivity**
- A new bivoltine silkworm hybrid Gen 3 x SK6 having cocoon yield potential of 50-55 kg yield/100 dfls was developed for tropical region.
 - A promising Multivoltine x Bivoltine silkworm hybrid, M6DPC x (SK6 x SK7) was developed with 45-50 kg yield/100 dfls.
 - Ten silkworm breeds (5 each of oval and dumb bell) having higher pupation rate were shortlisted as breeding resource materials for high temperature ($35\pm 1^{\circ}\text{C}$) and high humidity ($85\pm 5\%$) condition.
 - Six silkworm breeding lines viz., M.Con.1 x MH1 (white), M.Con.4 x MH1 (yellow), M6DPC x MH1 (yellow), MH1 x BHB (white), Gen 3 x M.Con.4 (yellow) and (SK6 x SK7) x M.Con.4 (yellow) of multivoltine breeds with high shell percentage (>17) and high neatness (>85) were raised for further breeding process.
 - Multi x Bi [Nistari x (SK6 x SK7)] and bivoltine hybrid (SK6 x SK7) tested at farmers' level during autumn and spring seasons in eastern and North-eastern regions gave significantly higher yield, under the Silkworm Race Authorization Trial. A Multi x Bi hybrid M6DPC x (SK6 x SK7) for favourable seasons of West Bengal and Jharkhand states and bivoltine hybrid B.Con.1 x B.Con.4 for West Bengal, Jharkhand and North-eastern states were recommended.
 - Five *Id* character carrier silkworm breeds were raised.
 - A new silkworm bed disinfectant 'Ghar Sodhon' has been formulated and tested in West Bengal, Jharkhand, Assam, Ranchi and Odisha. It is found effective in suppressing disease incidence and increasing the cocoon yield by 3-4 kg/100 dfls over the control.

- For symbiotic therapy to control silkworm disease, out of seven probiotics, tested *Lactobacillus sporogenes* (Lactic acid bacillus) and *Sacchromyces boulardii* (yeast) performed well based on *in vitro* and *in vivo*/ bioassay studies.

Cost Reduction

- An efficient, economic and eco-friendly weed mower-cum-shoot harvest/pruning machine (E3 WM © SH/PM) has been developed and supplied to RSRSs and popularization of the machine is under process.
- A new easy to maintain, disinfect, clean, durable and cost-effective rearing rack for mulberry twigs/shoot feeding to silkworm has been developed using PVC pipes.

Transfer of Technology

- Cluster promotion programme has been implemented in fifteen bivoltine clusters in West Bengal (4), Odisha (2), Bihar (1), Assam (3), Manipur (2), Mizoram (1), Nagaland (1) and Tripura (1). Against a total target of 29.45 lakh (Bivoltine 22.5 lakh; Improved Cross Breed 6.95 lakh) dfls, 29.604 lakh (Bivoltine 13.29 lakh; Improved Cross Breed 16.314 lakh) dfls were reared with 64.35% achievement. Total cocoon production was 826.9 MT (Bivoltine 499.552 MT; Improved Cross Breed 327.364 MT). Raw silk production was 148.082 MT (Bivoltine 80.788 MT; Improved Cross Breed 67.294 MT) which was 135.3% gain against a target of 109.39 MT.
- Two separate improved package of practices were disseminated among 880 farmers under irrigated (470) and rainfed (410) conditions.

Under irrigated condition, mulberry leaf yield gain was 22% (42.5 MT/ha/yr against 34.8 MT) and cocoon yield gain was 29% (44.5 kg against 34.3 kg/100 dfls). Under rainfed conditions, mulberry leaf yield gain was 16.2% (11.5 MT/ha/yr against 9.9 MT) and cocoon yield was 42.4 kg/100 dfls against 33.9 kg with 28.8% gain.

- Seven technologies viz., Botanical pesticide (1% Neem oil) for management of major mulberry pests, application of Thiamethoxam (0.075%) for whitefly management, yellow sticky traps for the management of whitefly, foliar application of 1% Potassium Chloride (KCl) in mulberry field under rainfed condition for moisture retention, application of soil test based Sulphur fertilizer in mulberry field for productivity and quality improvement, Tr-23 mulberry variety in Kalimpong and Sikkim hills and inter-cropping in mulberry with cash crops for additional income during establishment of mulberry, were popularized among 1,125 farmers.
- A total of 14,290 stakeholders were sensitized through extension communication programmes viz., field days, group discussions, technical demonstrations, exhibitions, awareness programmes, Resham Krishi Melas, workshops etc.

Capacity Building & Training

- A total of 340 persons/stakeholders were trained under skill development programme such as, skill updation programme, farmer's skilled training and technology orientation programmes.
- A total of 707 persons were trained under structured programme and need-based programmes. Besides, regular trainings were

imparted to the farmers/stakeholders on different aspects/technologies of sericulture, developed by the institute.

- 39 farmers training programmes and 2 trainers training programmes were organized for the benefit of 1372 persons.
- During the year, surveillance audit has been conducted for accreditation of ISO 9001:2015 certification.

Publications

- Twenty research papers, 9 books/book chapters and 40 technical bulletins/compendium/brochures/pamphlets/extension manuals/leaflets were published.
- Two research abstracts in national and one in international seminar/symposium/conference were presented and published.
- "News & Views", Institute's R&D half yearly news bulletin was published.
- "Resham Krishi Barta", a quarterly sericulture bulletin in Bengali was published.

Achievements of Regional Sericultural Research Stations

RSRS, Kalimpong (West Bengal)

- Accredited with ISO 9001: 2008 certification.
- 81 bivoltine silkworm germplasm accessions are maintained.
- Better performance of mulberry varieties Tr-23 (5.1 MT/ha/crop) at RSRS, Kalimpong and C-2038 (8.7 MT/ha/crop) at Ambari-Falakata Sericultural Project Farm, DoT (Seri), West Bengal has been recorded under the AICEM trial.

- Disease forecasting and forewarning systems were followed for management of mulberry foliar diseases and pests.
- Testing of carbon capturing efficiency of mulberry registered 7.4% leaf yield gain over the control.
- Various HRD programmes were organized for transfer of technology and 13 persons were trained under Farmers' training programme. Regular trainings were imparted to the farmers/participants on different activities of sericulture.
- Under technology dissemination, 602 farmers/seri-stakeholders were sensitized on improved sericulture technologies through resham krishi melas, field days, awareness programmes, group discussions and exhibitions.

RSRS, Koraput (Odisha)

- Accredited with ISO 9001: 2008 certification.
- Survey and surveillance of mulberry foliar diseases and pests and silkworm disease incidences at farmer's level was conducted for management.
- Better performance of mulberry variety C-2038 (7.6 MT/ha/crop) has been recorded under the AICEM trial.
- Under IVLP, mulberry leaf yield gain of 6.8 - 13.1% over control was registered.
- Testing of Carbon Capturing Efficiency of mulberry registered around 2% leaf yield gain over the control.

- Under technology dissemination, 147 farmers/seri-stakeholders were sensitized on improved sericulture technologies through reshama krishi mela.

RSRS, Jorhat (Assam)

- Accredited with ISO 9001: 2008 certification.
- Efficacy of *coccinellid predator, Scymnus posticalis* Sicard for management of whitefly on mulberry and mass culture of mealy bug on potato sprouts and pumpkin are being done.
- Under AICEM trial, mulberry variety C-2038 registered the highest leaf yield both at RSRS, Jorhat and REC, Imphal.
- Water-logged tolerant mulberry variety C-2028 has been popularized at Majuli Island in Assam. In addition, 17.5 acres were brought under S-1635 mulberry variety covering 35 farmers.
- Various extension programmes such as, awareness programme, audio-visual programme, exhibition, field day, group discussion, technology demonstration and krishi mela were organized by RSRS and RECs and 4846 stakeholders were sensitized. In addition, 5 mini workshops were organized to sensitize 509 farmers in five RECs.
- Under IVLP, a mulberry leaf yield gain of 23.7% and cocoon yield gain of 9.2% was registered over the control.
- Under BV-CPP (8 Clusters) in 5 different states of North-eastern region 3226 acres

were covered with high yielding mulberry. A total of 8.46 lakh dfls were reared in three seasons by 5658 farmers and produced 46.3 MT of raw silk.

- Under popularization of silkworm hybrids, 1.165 lakh dfls of SK6 x SK7 & N x (SK6 x SK7) silkworm hybrids were reared in North-eastern states covering 1702 farmers during summer, autumn and spring seasons. SK6 x SK7 showed better performance than FC1 x FC2.

RSRS, Ranchi (Jharkhand)

- Survey and surveillance of mulberry foliar diseases and pests and silkworm disease incidences at farmers level was conducted for management.
- Better performance of mulberry variety C-2038 (63 MT/ha/crop) has been recorded under the AICEM trial.
- Under screening of bivoltine hybrids, SK6 x SK7 and NB18 x P5, yielded cocoons @ 50 kg/100 dfls & 44 kg/100 dfls, respectively, during August and October crops.
- Testing of carbon capturing efficiency of mulberry registered 2.8% leaf yield gain over the control during October-November crop.
- Under technology dissemination, 135 farmers/seri-stakeholders were sensitized on improved sericulture technologies through Reshama Krishi Melas.

Central Sericultural Research and Training Institute (CSRTI), Pampore (Jammu & Kashmir)

Mulberry Crop Improvement, Production and Productivity

- A new mulberry variety PPR-1 with the advantages of early sprouting, greater rooting efficiency and enhanced leaf yield than other temperate varieties in vogue was evolved and released for commercial exploitation.
- One acre demonstration plot-cum-nucleus seed cutting garden was established and 3000 saplings were supplied to Department of Sericulture, J&K for establishment of chawki-cum-nucleus seed cutting garden in Kashmir region.
- The AICEM-III studies were concluded at 4 test sites in North-West India. All three new varieties showed early sprouting nature in temperate zone, but found susceptible to frost. In sub-tropical zone of Jammu, C2038 gave 17-20% more leaf than checks. In Uttarakhand sub-tropical zone, Tr-23 was found better with 6-14% more leaf than checks.
- Evaluation of mulberry germplasm bank under temperate conditions has exhibited large variability in reproductive parameters amongst the 80 germplasm mulberry accessions (36 exotic and 44 indigenous). S-1301 emerged as the most fertile genotype in the germplasm bank, followed by C-776.
- Under the study of isolation of native AM fungi and bacterial endophytes, the results indicated that the genus *Glomus* was ubiquitous in various regions across the valley.

G. macrocarpum, *G. arboretum* and *G. clarum* were most predominant AM fungal spores in rhizospheric soil samples of mulberry.

- Three promising bacterial endophytes viz., *Bacillus safensis*, *Bacillus pseudomycooides* and *Bacillus amyloliquefaciens subsp. Plantarum* were characterized based on plant growth promoting activities.
- INM package helped in curtailing application of chemical fertilizers by 25% without affecting the growth and productivity of mulberry.
- Kokusu-13 showed higher protein content (spring: 61.28 mg/g/dwt, autumn: 56.30 mg/g/dwt.) and S-799 showed higher carbohydrate content (spring: 325.92 mg/g/dwt, autumn: 330.75 mg/g/dwt) among the ten GPB accessions analyzed.
- IPDM module has reduced the mulberry crop loss due to key pests and diseases to the tune of 38.63% in case of leaf webber, 78.08% in case of semilooper, 49.33% in case of leaf spot and 26.71% in case of powdery mildew.

Silkworm Crop Improvement, Production and Productivity

- Nine BmNPV tolerant bivoltine silkworm lines viz., Line-1, Line-4, Line-7, DR-9 (Oval), Line-6, Line-12, Line-16, Line-18 and DR-8 (Dumbbell) have been evolved. The selected lines exhibited mortality range between 8.0 and 10.7% under inoculation and cocoon weight ranges between 1.701g and 1.724g and shell ratio from 20.26 to 20.89%.
- 80 mulberry genotypes were maintained at Pampore and 82 at P4 Basic Seed Farm,

Manasbal as temperate germplasm. 82 accessions were maintained at Sahaspur as sub-tropical germplasm and 18 varieties are under evaluation at RSRS, Jammu.

- 165 silkworm accessions at Pampore as temperate germplasm and 54 at Sahaspur as sub-tropical germplasm were maintained.

Transfer of Technology

- 96,050 dfls were reared by 633 farmers across North-western India under the technical guidance of RECs and produced 12,077 kg cocoon with an average yield of 46.81 kg/100 dfls.
- 14 technologies were disseminated covering 954 farmers through seven farmer field schools.
- A total of 498 extension communication programmes viz., group discussions, vichar goshtis, technology awareness programmes, film shows and field days were organized.
- Four Resham Krishi Melas, one each at Anantnag (Kashmir), Jammu, Sahaspur (UK) and Ghumarwin (HP) were organized and about 3000 farmers were sensitized on various sericulture technologies.

Capacity Building and Training

- Two months job skill training programme was conducted at RSRS, Jammu for 19 M.Sc. (Sericulture) students of Jammu University.
- 1211 sericulture farmers, students and in-service CSB/DOS officials were trained in routine training programmes. Similarly, 897 farmers and officials of CSB/DOS were also

trained on various aspects of sericulture viz., farmers skill training and orientation programmes.

- A total of 24 students were enrolled under IGNOU Study Centre, RSRS, Jammu for Certificate Course in Sericulture (CIS).

RSRS, Miransahib (Jammu & Kashmir)

- Use of Paclobutrazol (10 to 25 mg/l) is recommended to mitigate stressful environment under water stress and rainfed conditions and to improve mulberry leaf biomass.
- Among the five top ranking mulberry genotypes (TR-10, AR-12, V1, S-13 and S-41) identified based on leaf yield under sub-tropical conditions of Jammu, TR-10 has shown the highest leaf yield in autumn 2015 i.e., 1.23 kg/plant.

RSRS, Sahaspur, Dehradun (Uttarakhand)

- Three single hybrids viz., APS9 x CSR51, APS5 x CSR51 and CSR51 x BBE 198 were developed and three double hybrids (D x O1, D x O2 and D x O3) suitable for autumn rearing for sub-tropical zones of North and North-West India.
- Azotobacter based Nitrofert bio fertilizer outperformed the Nitrofert of local strain *Stenotrophomonas maltophilia* in improving the leaf yield and soil health.

RSRS, Ghumarwin (Himachal Pradesh)

- The samples were collected and tested from four CRCs of Ghumarwin, Hatwar, Ladda and Harlog and were found to be free from diseases.

- During Spring 2015, 5000 dfls were chawki reared and distributed to 100 selected IVLP farmers and 2030 kg cocoons were harvested with an average yield of 40.61 kg/100 dfls, while in Autumn 500 kg cocoons were harvested from 1800 dfls with an average yield of 27.77 kg/100 dfls.
- Under Capacity Building, 85 farmers were trained in Skill Training Programme, organized exposure visit for 17 lead farmers to Dehradun. Besides, 53 sericulture staff of Himachal Pradesh were trained under Technology Orientation Programme.
- Silkworm disease monitoring surveys were conducted in association with KSSRDI, Thalaghattapura, APSSRDI, Hindupur and respective state DOSs in bivoltine and multivoltine seed areas of Karnataka, Andhra Pradesh and Tamil Nadu and 2242 samples were tested.
- The samples of egg shells, larvae, moths received from BSFs/SSPCs of NSSO, BV Clusters and RSPs were tested and the test results provided.
- Under quarantine services, two lots of bivoltine eggs of M/s. VSSPC, Bengaluru were tested and certificate issued.
- Technology demonstration programmes were conducted at Anekal bivoltine seed area (Karnataka) to enhance the technical knowledge among the stakeholders.
- A total of 230 sericulture personnel from DoS/CSB, LSPs and farmers were trained on various aspects of seed technology under different training programmes.

Silkworm Seed Technology Laboratory, Kodathi, Bengaluru, Karnataka

Silkworm Seed Technology Laboratory (SSTL) exclusively tackles various seed related issues and develops suitable packages/technologies for improving the quality of silkworm seed produced in the country. The major achievements made during the year are as follows:

- Studies conducted on long term egg preservation of multivoltine pure breeds indicated that Pure Mysuru, Nistari, M12W, L14, Sarupat and MH1 eggs can be preserved upto 35-40 days by adopting double step refrigeration method.
- Twelve multivoltine pure breeds (Nistari Chalsa, Debra, Balapur, M12W, Sarupat, L14, APDR15, Pure Mysuru, MCON1, MCON4 and M6DPC), 4 Bivoltine breeds (SK6, SK7, BCON1 and BCON2) and one Univoltine breed (Barpat) were maintained as per their racial characters.

Central Sericultural Germplasm Resources Centre, Hosur, Tamil Nadu

Central Sericultural Germplasm Resources Centre (CSGRC), Hosur, Tamil Nadu was established in 1990 to act as the national nodal centre for conservation of sericultural germplasm in the country. Over the years, it has gained prominence and emerged as the premier germplasm institute in India committed to overall conservation of seri-biodiversity for posterity and duly recognized by National Bureau of Plant Genetic Resources (NBPGR), New Delhi and National Bureau of Agriculturally Important Insects

(NBAII), Bengaluru. The highlights of the work done and the achievements made during 2015-16 are described below:

- 1269 mulberry germplasm accessions (270 exotic and 999 indigenous) are under conservation in the *ex situ* field gene bank. 42 new mulberry germplasm were collected from KSSRDI, Thalagattapura, Bengaluru for enrichment of mulberry field gene bank. Drip irrigation system was installed for 9 acres of *ex situ* field gene bank.
- Towards establishment of safety backup of the mulberry germplasm, 220 mulberry accessions core collections have been established at CSRTI, Mysuru. 60 exotic accessions were sent to CSRTI, Pampore, 50 accessions (Uttaranchal Collections) to RSRS, Sahaspur and 20 to CSRTI, Berhampore. Besides, 532 indigenous mulberry accessions are also maintained as safety backup at CSGRC, Hosur.
- 466 silkworm germplasm stocks (81 multivoltine, 365 bivoltine and 20 mutants) are maintained through scheduled rearing. Four authorized bivoltine breeds CSR 50, CSR 51, CSR 52 and CSR 53 were collected from CSRTI, Mysuru and quarantine rearings were completed. National accession numbers were obtained from NBAIR, Bengaluru.
- 22 new accessions in the mulberry field gene bank were characterized for morphological, reproductive and anatomical characters. There was preponderance of femaleness (64%) in the accessions followed by 27% males and 9% Bisexuals. Accessions *viz.*, MI 0933, MI 0934, MI 0936, MI 0937, MI 0940, MI 0943, MI 0945, MI 0946 and MI 0953 were found promising with erect plant types, with straight branches and smooth unlobed leaves.
- 22 mulberry accessions were evaluated for propagation, growth and yield, bio-chemical parameters and natural incidence of diseases in the field gene bank. Accessions *viz.*, ME 0240 and ME 0692 performed better for propagation traits and MI 0913 and MI 0917 for growth and yield parameters. Leaf yield (2.20 kg/plant) was found the highest in the accession MI 0911. Preliminary evaluation was made with 40 mulberry accessions for photosynthesis efficiency, gas exchange parameters and high variability among the accessions were observed.
- Towards the development of drought tolerant variety for rainfed sericulture, a project was initiated by CSRTI, Berhampore in collaboration with CSGRC, Hosur. A total of 35000 F1 seeds were produced from strategic trait-based crossing programme involving 8 female and 7 male parents. The progenies of different crosses were raised at CSRTI, Berhampore and CSGRC, Hosur. Number of early sprouters was maximum in MI 0763 x MI 0012 progeny and were least in MI 0477 x ME 0065 cross.
- Confirmatory characterization of 81 MV accessions, 365 BV accessions and 20 mutant accessions was completed and all the accessions were maintained true to type as per passport data. Top performing bivoltine and multivoltine accessions were identified for utilization.
- The differential expression profiling of the 4 MV accessions using 10 antifungal genes was

studied and a negative correlation was found between the gene expressions with that of fungal proliferation.

- Out of 10 top bivoltine silkworm germplasm evaluated at selected centres across the country, accessions *viz.*, BBI 0348 performed better in 7 centres (spring season) while accessions BBE 0266 performed better in 6 centres (Autumn season).
- 323 mulberry accessions were supplied to 7 institutes (Maharani's Science College for Women, Bengaluru, Paul Hebert Centre, Aurangabad for DNA bar coding and biodiversity studies, CSR&TI, Mysuru, Pampore, RSRS, Sahaspur, CSRTI, Berhampore and IIHR, Bengaluru for establishment of safety backup centre).
- 69 silkworm accessions (23 BV and 46 MV) were supplied to 3 institutes (CSRTI, Pampore, NEHU, Shillong and SBRL, Kodathi) in 15 spells.
- New technology of making handmade non-wovens from silk waste has been developed and a catalogue was prepared containing 16 non-wovens. Two molded articles have been made using the similar technique. Using the non-wovens, few novel products *viz.*, panels for cubicles and ceilings, bulletin board, yoga mat, meditation mat, mouse pad and hand-made products have been developed. A workshop for women on value addition to silk waste was organized in association with Urvee, Bengaluru involving 22 women beneficiaries.
- A new web domain (www.csgrc.res.in) was registered highlighting the institute's activities on mulberry and silkworm database.

Seribiotech Research Laboratory, Kodathi, Bengaluru

Seribiotech Research Laboratory (SBRL), Kodathi, Bengaluru is involved in modern biotechnological research on silkworms and their host plants. During 2015-16, SBRL worked in the areas of silkworm improvement and pathogen detection by development of transgenic silkworm, marker assisted breeding and other biotechnological tools. The highlights of work done and the findings are as follows:

- Cell-mediated immune responses against infection by uzi fly and microsporidians were studied and found that cytotoxicity and detoxification reactions were induced in hemocytes by increasing the Reactive Oxygen Species (ROS) level which in turn induced lipid peroxidation in the plasma membrane that caused membrane porosity, cell rupture and degranulation. Three phases of detoxification mechanism represented by detoxification enzymes like total oxidases, catalase, Glutathione-S - transferase were activated. Genes encoding detoxification enzymes and immune – associated proteins showed differential expression in hemocytes.
- Microsporidian infection of silkworm induced cellular changes, enhanced expression of parasitic recognition proteins, humoral lectin, apolipoprotein and five uncharacterized proteins in hemocytes. The expression of genes that encode Toll pathway components and cytokines *viz.*, spatzle and paralytic peptide were activated. However, the melanization pathway components such as phenol oxidase 1 and 2 and PPAE showed reduction in expression level.

- Serine Protease Inhibitor (SERPIN) family proteins showed comparatively higher expression indicating its role in inactivating Prophenol oxidase Activating Enzyme (PPAE) suggesting suppression of melanization by the microsporidians. The information will be used for developing an early detection mechanism and to screen germplasm accession to assess their disease tolerance.
- Comparative expression analysis of 12 antifungal genes viz., Lysozyme, LIM protein, Transferrin, Bm8 interacting protein, Chemosensory protein, Peptidoglycan precursor, Glucose transporter, Vacuolar ATP synthase, Troponin C, Ecdysone induced protein, Arylphorin and Amidase in *Beauveria bassiana* infected and control samples of four silkworm breeds viz., MH1, APM2, APM3 and APDR15 revealed higher expression of maximum genes in APM2 and the least in APM3. The multiplication of *B. bassiana* was the highest in APM3 and the lowest in APM2 indicating a correlation of higher gene expression with lower fungal multiplication.
- BC4 - F10 generation of CSR4 and CSR27 was developed by transferring NPV resistance through conventional breeding from a transgenic silkworm developed through RNAi technique and at 40% showed NPV tolerance while maintaining the commercial parameters of the cocoons *at par* with that of CSR4 and CSR27, respectively.
- The full length viral DNA viz., VD1 and VD2 were cloned and sequenced to characterize the *Bombyx mori* Densovirus causing flacherie disease in silkworm. The viral DNA polymerase enzyme sequence has been submitted to the NCBI (Acc No. KP886818). Pathogenicity analysis of BmDV-2 showed that nsd-2 gene, present in some of the silkworms was responsible for blocking BmDV-2 viral replication.
- In order to develop flacherie resistant silkworm lines, 20 bivoltine and 18 multivoltine parental silkworm races were screened for the nsd-2 gene. The nsd-2 gene was detected in the silkworm races viz., APS-5, APS-HTP5 and BBE198. The races APS-5 and BBE 198 showed minimum expression of the gene, thereby confirming their viral resistance character. These parental breeds were used for developing autumn specific breeds suitable for North and North-West India.
- The yolk protein receptors (Lipophorin and Vitellogenin) from eri silkworm, *Samia ricini* have been cloned and characterized.
- Work on development of multiple disease resistant silkworm *Bombyx mori* through transgenic technology is being carried out in collaboration with Indian Institute of Science (IISc), Bengaluru. Silk fusion protein for biomedical applications has been started using recombinant technology in collaboration with IISc, Bengaluru.
- Sericin was biochemically characterized from cocoons and silk glands for cosmetic applications.
- Whole genome sequencing of muga silkworm *Antheraea assamensis* has been initiated and muga silkworm collected from Assam is being tested for homozygosity.

VANYA SECTOR

Central Tasar Research and Training Institute, Ranchi, Jharkhand

Central Tasar Research and Training Institute (CTRTI) is a flagship institution catering to the needs of Research & Development and generation of skilled manpower in tropical tasar and oak tasar. It is engaged in generating useful technologies and their effective transfer to the field with an ultimate aim to improve the socio-economic status of the stakeholders associated with tasar culture. It provides support to all tasar growing states through its extension network of 8 Regional Tasar Research Stations, 13 Research Extension Centres and 3 P4 Tasar Silkworm Breeding Stations. The achievements of the institute and its nested units during the year are as follows:

Host Plant Improvement, Production and Productivity

- Twenty-nine F1 hybrids of *Terminalia spp.* isolated from 1st batch of crosses were evaluated for their growth behaviour. From the 2nd batch of crosses, 33 F1 seedlings were isolated and are under multiplication through cuttings for further evaluation.
- Early sprouter/dwarf strain of *T. arjuna* is identified and are under multiplication through leaf node cuttings for further evaluation.
- Package for tasar silkworm rearing on *Lagerstroemia speciosa* is under standardization.

Silkworm Improvement, Production and Productivity

- Package of practices is recommended for the efficient utilization of Sal flora in Jharkhand and also to improve the Laria productivity on Sal.

- Field trial of CTR14, a high fecundity line of tropical tasar silkworm, was conducted at seven centres under different agro-climatic conditions.
- Two tasar silkworm lines were isolated based on higher shell weight and high pupal weight, for further evaluation.
- Survey conducted for exploration of wild Saturniid species in Manipur revealed the presence of 16 species of wild sericigenous insects under nine genera viz., *Antheraea*, *Actias*, *Attacus*, *Bombyx*, *Samia*, *Cricula*, *Dendrolimus*, *Lebeda* and *Rhodinia*. The maximum species composition was noticed with genus *Antheraea*, whereas *Samia canningi* occurred throughout the year.
- Based on characterization, evaluation and categorization of wild sericigenous insects, *Antheraea frithi* has been selected as the future prospective species of the North-eastern region.
- Native cocoonase secretion process, secretion volume, chronological secretion profile and quantification, sequential changes in cocoonase concentration, purification, characterization, proper storage conditions and enzymatic action have been worked and cocoonase molecular sculpt is prepared.
- Preliminary results on cold temperature (20-22°C) treatment of seed cocoons during April-May for 15 day's duration delayed the moth emergence by 10-15 days.
- Multi-location trial of semi-synthetic diet, Tasar Amrit was conducted.

Post-cocoon Technologies

- A new tasar cocoon cooking recipe i.e., a combination of Borax and Sodium Bicarbonate developed for Daba, Raily and Modal cocoons were found to be techno-economically feasible with 67% silk recovery and 33% reelability.
- Vertical Reeling Machine developed by the institute has been fine-tuned and is made as 3-ends machine for higher productivity.

Human Resources Development, Extension Communication and Transfer of Technology

- A total of 908 persons were provided training under different programmes (Structured course: 13; Farmers skill training: 602; Farmers exposure visit: 78; Ad-hoc programmes: 215).
- 687 persons were trained under different programmes in 25 batches.
- 6381 stakeholders participated under various motivation programmes.
- The multi-locational trial of CTR14 conducted at 4 locations has obtained encouraging results.
- The multi-locational trial of semi-synthetic diet is conducted at 3 locations.
- The multi-locational trial of disease tolerant breed is conducted at 4 locations.
- An integrated package of rearing, incorporating 4 low cost technologies was popularized among stakeholders.
- RECs provided technical support to the DOSs & NGOs.

- P4 TBS Kargi-Kota has maintained two trivoltine lines namely DTS and DT12.
- IVLP and CSB's cluster programmes were initiated by RTRS, Baripada, Jagdalpur, Bhandara, Warangal, Bhimtal, Imphal and Hatgamaria.

Achievements of Regional Tasar Research Stations

RTRS, Jagdalpur (Chhattisgarh)

Conservation, multiplication and popularization of local eco-race Raily was carried out, technical support to DOS, Chhattisgarh was extended and tasar farmers were motivated for adoption of improved technologies through extension activities and 50 farmers were trained. IVLP and Vanya Cluster programme were conducted covering 164 farmers who harvested 13,49,480 cocoons @ 47.35 cocoons/dfl.

RTRS, Baripada (Odisha)

Conservation, multiplication and popularization of local eco-race Sukinda was continued; 225 dfls were reared and 10,874 cocoons @ 48 cocoons/dfl were harvested. The Centre extended technical support to DOS, Odisha and motivated tasar farmers for adoption of improved technologies. Extension activities such as field days, farmers days and kisan mela were organized to enhance the knowledge/skill levels of stakeholders and trained 25 farmers in new technologies.

RTRS, Warangal (Telangana)

Conservation, multiplication and popularization of local eco-race Andhra Local was carried out. 215 dfls of Andhra Local were released

in the identified core zone under the project AIB-4706 and 100 dfls were supplied to farmers. 279 dfls were used for own departmental rearing which yielded 4,840 cocoons @ 17.34 cocoons/dfls. Extended technical support to DOS, Telangana and Andhra Pradesh and conducted extension activities viz., field days, farmers' days and kisan mela. Under farmers training programme, 50 farmers were trained. Under CSB Vanya Cluster programme, 99 adopted farmers reared 19,800 dfls and harvested 4,83,550 cocoons.

RTRS, Dumka (Jharkhand)

Work on conservation, multiplication and popularization of local eco-race Sarihan was carried out, under which 27,247 seed cocoons were preserved and 4100 dfls were produced. 3,100 dfls of eco-race Sarihan were supplied to farmers. Departmental rearing of 1000 dfls was done and 23,190 cocoons were harvested. Extension activities, such as, field days, farmers' days and kisan mela were conducted to motivate farmers for adoption of technologies and 50 farmers were trained.

RTRS, Bhandara (Maharashtra)

Conservation, multiplication and popularization of eco-race Bhandara Local were continued. 150 dfls were reared in 3 crops and 7,475 cocoons were harvested @ 49.83 cocoons/dfl. RTRS extended technical support to DOS, Maharashtra and motivated tasar farmers for adoption of improved technologies. Regular extension activities were carried out to improve the skill levels of local sericulturists. Under CSB's Vanya Cluster programme, 100 farmers reared 10,000 dfls and harvested 4,97,478 cocoons @ 49.75 cocoons/dfl.

RTRS, Imphal (Manipur)

Germplasm maintenance of *Antheraea proylei*, *A. pernyi*, *A. frithii* and 12 different breeds were continued. The Centre extended technical support to DoS, Manipur and motivated oak tasar farmers for adoption of improved technologies. To enhance farmers knowledge and skill level, extension activities such as, group discussions, field days, farmers days and kisan melas were organized, in which 973 farmers participated. Two farmer training programmes were organized covering 50 farmers. 1,86,265 oak tasar seed cocoons were preserved and 23,470 dfls were produced. A total of 19,795 dfls were supplied to farmers. Departmental rearing was carried out with 3,675 dfls and 1,72,395 cocoons were harvested @ 55.57 cocoons/dfl.

RTRS, Bhimtal (Uttarakhand)

Technical support to DoS, Uttarakhand was continued. Extension activities such as field days, farmers days and kisan mela were organized to motivate oak tasar farmers for adoption of improved technologies. Under IVLP, 23 farmers reared 2,300 dfls and harvested 89,028 cocoons @ 38 cocoons/dfl. A total of 53,200 oak tasar seed cocoons were preserved, of which, 6,397 dfls were produced with a cocoon-dfl ratio of 4.25:1. Besides, 1,600 dfls were reared and 85,050 oak tasar cocoons were harvested @ 53.16 cocoons/dfl.

RTRS, Batote (J&K)

The centre processed 5,962 cocoons and 649 dfls were produced with a cocoon-dfl ratio of 9.19:1. Out of 649 dfls, 449 dfls were supplied to sister units and DOSs. Departmental rearing was carried out with 200 dfls and 10,754 cocoons were harvested @ 53.77 cocoons/dfl.

Central Muga and Eri Research & Training Institute, Lahdoigarh, Jorhat (Assam)

The Central Muga and Eri Research & Training Institute (CMER&TI), Lahdoigarh, Jorhat along with its network of nested research stations viz., RMRS, Boko; RERS, Shadnagar; RERS, Mendipathar and RECs located at Lakhimpur, Coochbehar, Tura, Diphu, Kokrajhar and Fatehpur provides research and development support in muga and eri sectors for the development of the industry. During 2015-16, 4 CSB, 4 DBT and 5 DST funded research projects were undertaken under different areas viz., environmental challenges and global warming, drudgery reduction and women friendly technologies and eco-friendly and organic farming. Out of which, 8 projects were concluded and 5 projects are being continued. The highlights of the research work done during the year are as follows:

Host Plant Improvement, Production and Productivity

- INM formulation/package for castor cultivation was developed which can reduce 50% of the recommended inorganic fertilized dose.
- *Ailanthus grandis* (Borpat) has been identified as the best perennial host plant based on biomass production, bioassay, biochemical and nutritional analysis of leaves for eri silkworm rearing. Field trials were conducted in Borpathar (Golaghat), Nagajangka & Morangial (Jorhat) and Barekuri (Tinsukia) covering 250 farmers for popularization of *Ailanthus grandis* in eri silkworm rearing.
- Two kisan nurseries were developed at Barekuri and one at Mariani for mass multiplication of *Ailanthus grandis*.

- S3 and S6 morphotypes of Som were multiplied in large scale at RMRS and 6000 saplings were supplied.

Silkworm Improvement, Production and Productivity

- A muga egg preservation schedule was developed by which 48 hours old embryos could be preserved at low temperature (7°C) for 20 days. Eggs of different ages (24-72 hr) can also be preserved at 7°C and 75-85% RH upto 15 days.
- Two high yielding breeds of muga silkworm, CMR1 and CMR2 have also been developed.
- Muga silkworm gut-microflora was morphologically and biochemically characterized. The most efficient cellulase, lipase and antagonistic gut-bacteria were identified as *Bacillus cereus* strain MGB011, *Bacillus stratosphericus* strain MGB05 and *Bacillus atrophaeus* strain MGB14, respectively.
- The selected localities of North-eastern states of India were surveyed for insect fauna associated with muga ecosystem from two primary host plants (Som - *Persea bombycina*, Soalu - *Litsea monopetala*). Four groups of insect viz., Coleoptera, Lepidoptera, Hemiptera and Hymenoptera were collected and a database with 970 specimens of insect fauna associated with muga ecosystem was developed. Two hundred and three species were identified upto species and genus level while other

specimens were identified upto family and genus level.

- Field trial with improved C2 breed of eri silkworm was conducted and 78000 dfls were distributed to farmers under SMVs.
- Three bacterial pathogens namely *Lysinibacillus shaericus*, *Serratia marcescens* and *Enterococcus casseliflavus* were identified as causal diseases of muga silkworm through sequencing of the 16srDNA.
- Forecasting and forewarning system for pests and diseases of muga host plants and silkworm have been developed and uploaded in the institute's website. SMSs were sent to 44,160 farmers for forewarning of pests and disease incidence.
- A new wooden collapsible strip type mountage for mounting ripened eri silkworm was developed.
- For conservation of genetic resources of muga silkworm, eight wild genetic resources are being maintained under *ex-situ* condition at GCC, Damalgre, West Garo Hills, Meghalaya.
- Field trial of eri eco-race SR025 at semi-arid conditions of Andhra Pradesh has been initiated.

Human Resource Development, Extension Communication and Transfer of Technology

- For dissemination of technologies in muga and eri sectors, 4 muga & 4 eri Sericulture Model Village (SMV), with 100 beneficiaries in each and one PCT SMV covering 62 beneficiaries were implemented. Improvement was noticed in respect of cocoon and raw silk production and income generation among the farmers. Cumulative impact assessment from the rearing performance during 2015-16 revealed that the level of cocoon production was enhanced by 28.0% in muga SMVs and 40.8% in eri SMVs.
- Under Transfer of Technology (ToT) programme on Integrated Technology Package of muga culture, 508 farmers were covered. Demonstration programmes on integrated technology package of muga culture and on job practical training at the field of lead farmers in 4 different muga Farmers' Field School (FFS) were conducted. The impact assessment result showed that adopting the latest technologies by the farmers, the cocoon yield increased from 50-61 cocoon/df.
- 300 farmers were covered under the demonstration programmes on Integrated Technology Package of eri culture and on-job practical training at the field of lead farmers in 3 different eri FFSs. Impact assessment result showed that adopting the latest technologies by the farmers, the average eri cocoon (shell) yield increased from 7.5-9.50 kg/100 dfls.
- 4 Krishi Melas, 35 technology awareness programmes, 70 group discussions and 35 field days were organized to popularize the technologies and motivate farmers.
- 3571 beneficiaries were trained on different seri-technologies under different training programmes. Farmers Skill Training was organized for 6 days covering 1325 farmers. and for 3 days covering 150 farmers. National Institute of Agricultural Management (NIAM)

sponsored training programme covering 90 farmers, technology orientation programme for 24 farmers and orientation training to 16 Seed Officers/Seed Analysts (SOs/SAs) were conducted. Further, training for the beneficiaries under SMVs & FFS, farmers training programme sponsored by DOS, UP, Refresher training programme to RSPs and foundation training to CSB young scientists were conducted.

- One national seminar on problems & prospects of muga and eri silk sectors were organized at Indian Institute of Entrepreneurship (IIE), Lalmati, Guwahati during 25-26 February, 2016.
- One national level workshop-cum-training programme was organized on “Advanced diagnostic techniques of infectious diseases in insects” at the institute during 21st - 23rd March, 2016 wherein 31 scientists, scholars and students from different organizations participated.
- Under Institutional Biotech Hub project, one workshop on “Diversity, Exploration, Taxonomy and Management: Advanced Tools and Techniques for Lepidopteran Insects”, two demonstrations and one awareness programme conducted. A total of 225 students from nearby schools and colleges participated.

Land Utilization Programmes

- 60000 som/soalu seedlings /saplings (50,000 at RMRS, Boko, 5000 at REC, Lakhimpur and 5000 at REC, Coochbehar) were raised and 34,863 som seedlings (6,000 from CMER&TI, 25,600 from RMRS, 263 from REC,

Lakhimpur and 3000 from REC, Coochbehar) were supplied.

- 22,500 Kesseru seedlings (15,000 at CMER&TI and 7,500 at RERS, Mendipathar) were raised and 61 kg castor seeds (43 kg from RERS, Mendipathar and 18 kg from REC, Diphu) and 13,500 Kesseru seedlings (6400 from CMER&TI and 7,100 from RERS, Mendipathar) were supplied.
- 3,307 muga dfls as commercial (1,497 at CMER&TI, 760 at RMRS and 1,050 at RECs) and 6,857 dfls (2,384 at CMER&TI, 2,576 at RMRS, and 1,897 at RECs) were raised as seed crops and thereby, 79,273 commercial cocoons and 1,06,410 seed cocoons produced.
- Reared 1,291 eri dfls (441 at CMER&TI, 200 at RERS, Mendipathar, 500 at RERS, Shadnagar, 150 at REC, Diphu) and harvested 110.2 kg eri cocoons.
- Produced 35,255 Muga dfls, out of which 32,256 dfls were supplied to rearers.
- 15,960 Eri dfls were produced, out of which 14,858 dfls were supplied to rearers.
- Rs.28.22 lakh revenue during 2015-16 (Rs.20.41 lakh from CMERTI, Rs.7.142 lakh from RMRS, Boko and Rs.0.668 lakh from RERS, Shadnagar.

Infrastructure Development & Others

- A insect repository is being maintained.
- A video conference room has been established.
- High speed National Knowledge Network (NKN) internet connection has been provided in the institute.

- 1,000 farmers' database for m-Kisan portal is created.
- ISO 9001: 2008 certificate for the institute was renewed during October, 2015.
- ISO 9001: 2008 certificate for RMRS, Boko was received during November, 2015.

Publications

- The institute published 2 issues of CMERTI Sericulture News (English) and 2 issues of Hindi newsletter, 2 extension manuals, 11 leaflets/technical bulletins and 3 books/manuals. Besides, the scientists of the institute published seven research articles in reputed journals and 32 research articles in the proceedings of various seminar/conference/workshop.

Achievements of Regional Muga/Eri Research Stations

Regional Muga Research Station, Boko, Assam

- S3 and S6 morphotypes of Som are being multiplied in large scale for supply to the field and 25600 saplings have been supplied during the year.
- One Krishi Mela, 3 technology awareness programmes, 3 field days and 10 group discussions were conducted.
- A Farmers Skill Training of 6 days was organized covering 314 farmers.
- 3336 muga dfls were reared for seed crop and 760 dfls for commercial crop and 37512 cocoons were harvested.
- 11240 muga dfls were produced and 8974 dfls were supplied.

Regional Eri Research Station, Mendipathar, Meghalaya

- One Krishi Mela, 4 technology awareness programmes, 4 field day and 7 group discussions were conducted for the sericulturists.
- Farmers Skill Training was organized for 6 days covering 240 farmers.
- 7100 nos. of kesseru seedlings were raised and supplied.
- 43 kg castor seeds were supplied.
- 500 eri dfls were reared and 33.7 kg eri cocoons were harvested.
- 9345 Eri dfls were produced and supplied.
- 100 farmers were sensitized with the technologies developed by the institute on eri culture through technology adoption programme.

Regional Eri Research Station, Shadnagar, Andhra Pradesh

- One research project has been carried out and genotypes CSH-103, CSH-105 and CSP-003 have been found to be high leaf yielding that can tolerate higher temperature during summers which can be used for rearing throughout the year under semi-arid conditions of Andhra Pradesh.
- Farmers skill training was organized for 3 days covering 50 farmers.
- Two technology awareness programmes, 3 field days and 6 group discussions were conducted for the sericulturists.
- 200 eri dfls were reared and 35 kg eri cocoons harvested.
- 200 eri dfls were produced and supplied.

POST-COCOON TECHNOLOGY

Central Silk Technological Research Institute, Bengaluru

Central Silk Technological Research Institute (CSTRI) with its 22 units *viz.*, Regional Silk Technological Research Station (1), Zonal Office (1), Silk Testing & Conditioning Houses (4), Demonstration-cum-Technical Service Centres (8), Textile Testing Laboratory/Demonstration-cum-Technical Service Centres (2), Silk Testing & Conditioning House/Textile Testing Laboratory (1), Silk Testing & Conditioning House/Demonstration-cum-Technical Service Centre (1), Cocoon Testing Centres (2) and Raw Silk Testing Centres (2) spread across the country caters to the research and developmental activities related to silk technology. The institute was awarded ISO 9001:2008 certification of the Quality Management System during 2015. Significant contributions made by the Institute and its nested units during 2015-16 are as follows:

Research

- Improvement in abrasion properties of silk upholstery fabrics has been achieved through modification of fabric structure and by applying chemical finish.
- Muga cocoon stifling and reeling studies have been completed and muga cocoon stifling technology is being popularized in the field.
- Composite specimen characterization and biodegradability tests based on enzymatic degradation method have been successfully conducted. Silk based bio-composite materials have been optimized for time based degradation of relevant wound dressing applications.
- Indigenous automatic silk reeling machine with mechanical brushing unit has been developed for the production of superior grade raw silk from multi-bivoltine and bivoltine hybrid cocoons.
- Machine for the production of novel yarn using cocoon entanglement system has been designed, fabricated and tested. Novel yarn has been produced and characterized. Using these yarns as weft, fabrics have been developed.
- Thirteen projects are being carried out. Of these, 6 are collaborative research projects, including 3 projects with Daekin University, Australia.

The exploratory work is being carried out on the following:
- Computerization of chemical zari testing for better credibility.
- Complete computerization of limited test of raw silk for better transparency.
- Studies on mechanical finish of printed fabrics (special reference to Kundi finish practices in Serampore cluster).
- Development of actuator Handloom.
- Development of Multi twist-for-one Twisting Machine (MFO).
- Study on evaluation of fabrics produced on handloom, power loom and rapier loom by using indigenous multivoltine, bivoltine and imported silk.
- Development of eco-friendly sericin fixation technology for loom finished mulberry raw silk fabrics produced in India.

- Studies on fluorescence characteristics of multibivoltine and bivoltine cocoons and its effect on reeling performance and quality of raw silk.
- Study on the techno-economics of silk reeling units in North Karnataka.
- Development of suitable handloom for production of Ilkal sarees.
- Studies for evaluation of tasar cocoon cooking method with different chemicals towards improvement of yarn quality and productivity.

Product Development

Thirteen products were developed during the period *viz.*, Chanderi Silk x Silk Sarees - 3 varieties, mulberry silk fabric reinforced with fibroin matrix, muga silk fabric reinforced with fibroin matrix, tasar silk fabric reinforced with fibroin matrix, eri silk fabric reinforced with fibroin matrix, mulberry silk fabric reinforced with fibroin matrix along with honey as active ingredient for wound healing, mulberry silk fabric reinforced with fibroin matrix along with honey and aloe-vera as active ingredients for wound healing, stole prepared from eri-wool blended fabric, wrinkle wool-eri high neck top, men winter shirt made from eri-wool blended fabric and silk non-woven passport bag.

Testing

During the year, 1,10,210 lots were tested by Textile Testing Laboratory (TTL), Bengaluru, which included 93,433 cocoon and raw silk lots, 3,463 samples of yarn and fabric, 13,314 samples of water, dyes and other textile auxiliaries.

Extension activities

The main institute and its nested units conducted 529 technology demonstrations and

field programmes and adopted 46 reeling/twisting/weaving/vanya units covering 460 beneficiaries. 1,850 field visits were undertaken by scientists and staff for solving field related problems and for addressing various field issues.

Institute Village Linked Programme (IVLP)

Three Institute Village Linked Programme IVLPs have been established at Kollegal (Karnataka); Ilkal (Karnataka) and Kumarapalayam (Tamil Nadu).

MSME Cluster Project

Under the Scheme "Micro & Small Enterprises - Cluster Development Programme" (MSE-CDP) of the Ministry of Micro, Small & Medium Enterprises (MSME), GoI, CSB has been implementing MSE-CDP in 5 existing silk processing clusters *viz.*, Y.N. Hosakote (Karnataka), Salem (Tamil Nadu), Dharmavaram (Andhra Pradesh), Sualkuchi (Assam) and Srinagar (J&K) with the support of state departments. The Diagnostic Study Reports of all the 5 clusters were approved by MSME. The Soft Interventions (SI) application of Y.N. Hosakote, Salem, Dharmavaram and Srinagar were also approved. In case of Sualkuchi cluster, the DC-MSME has informed to revise the SI application as per modified guidelines issued by them. The required land for implementing MSE-CDP in Y.N. Hosakote, Dharmavaram, Srinagar and Sualkuchi has been allotted by the respective state governments. The land for MSE-CDP in Salem is allotted by CSB in its RSRS.

CDP implementation

During the period, 16 automatic reeling machines, 2 automatic dupion reeling machines, 50 multi-end reeling machines, 25 cottage basin

reeling machines, 525 vanya reeling and spinning machines and 12 hot air driers were established in the field.

CAPACITY BUILDING AND TRAINING

The Central Silk Board, Bengaluru along with its R&D institutions continued to build capacities and spread sericulture technologies during 2015-16 across all the four sub-sectors and activities falling on the silk value chain. On the conclusion of Catalytic Development Programme (CDP) in April 2015, the Central Sector Scheme (CSS) was restructured during the period under report to include following capacity building & training components:

1. Skill Training & Enterprise Development Programme (STEP).
2. Establishment of Sericulture Resource Center (SRC).
3. Capacity Building & Training under R & D.
4. Capacity Building & Training in seed sector.
5. Information, Education and Communication (IEC).

During the year under report, 13,986 persons (farmers, industry stakeholders and departmental candidates) were trained under various training programmes through skill seeding and skill development approaches, as detailed below:

Sl. No.	Training Category	Programme	No. of persons Trained
1	Skill Training & Enterprise Development Programmes	Resource Development Programme	94
		Foundation Training programme for newly recruited scientists	62
		Technology Up-gradation Programme	391
		Management Development Programme	362
2	Sericulture Resource Center (SRC)	Under the process of establishment	-
3	Training under R&D	Post-Graduate Diploma in Sericulture	37
		Intensive Training in Sericulture	48
		Farmers Skill Training	7120
		Exposure visit for technology awareness	951
		Technology Orientation Programme	1792
		Training program funded by other agencies	1194
4	Training under Seed Sector	Training for Adopted Seed Rearers	957
		Training for Private Grainages	55
		Other need-based training programme in seed sector	923
Total			13986

Highlights of Capacity Building and Training during 2015-16

1. The CBT division in association with R&D institutes and seed organizations have trained a total of 13,986 persons against a target of 10,880 persons (achievement - 129%).
2. A total of 62 newly recruited Scientist-B were trained in two batches of 16 day each and at three locations namely CSB, Bengaluru; CSRTI, Mysuru and CMERTI, Lahdoigarh.
3. During the year, 33 candidates successfully completed the Post-Graduate Diploma in Sericulture (Mulberry and Vanya).
4. For the first time, Drivers and Attenders (Multi-tasking staff) of CSB, NSSO and CSTRI, Bengaluru were exposed to general sericulture information, office etiquette and general motivation etc., in three batches.
5. A total of 951 farmers covering all the sub-sectors of silk were taken for exposure visit to developed sericulture clusters and R&D centres for inspiring them, strengthening their belief in sericulture, broadening their vision and knowledge levels.
6. Under the restructured Central Sector Scheme (CSS), a new component entitled - Information Education and Communication (IEC) has been initiated for supporting capacity building and training initiative by way of printing information brochures, technical course materials, instructional videos, sericulture films and documentaries.
7. The construction of Centre of Excellence for post-cocoon technology started during 2014-15 is nearing completion for running industry aligned PCT courses during 2016-17.

TRANSFER OF TECHNOLOGY

- A total of 47 technologies have been successfully disseminated in the field through various technology demonstration programmes.
- More than 60,000 sericulturists were sensitized with new technologies through 1893 extension communication programmes in host plant cultivation, silkworm rearing, disease and pest management and quality cocoon production.
- The authorized silkworm hybrids such as CSR16xCSR17, MH1 x CSR2 in south, FC1 x FC2, M.con1 x B.con4, M.con4 x B.con4, M.con1 x M.con4 in East and North-East, CSR46 x CSR47, FC1 x FC2 and APS5 x APS4 in North and North-western Zone were popularized for commercial exploitation.
- A new tasar breed 'BDR10' and eri breed 'C2' was promoted in their culturing areas.
- Improved package of practices were disseminated among the farmers under irrigated and rainfed condition in East and North-eastern region and a yield gain of upto 22% in mulberry leaf production and 29% in cocoon yield were achieved.
- The integrated package of tasar rearing including 4 low-cost technologies were popularized among the stakeholders.
- 46 reeling/twisting/weaving/vanya units were adopted besides, conducting 529 technology demonstrations and field programmes.
- 1850 field visits were undertaken for solving field related problems and addressing various field issues in post-cocoon sector.

- Technical bulletins/brochures/pamphlets/extension manuals, leaflets in different regional languages were published for the benefit of sericulture farmers and extension workers.

Institute Village Linkage Programme

For effective transfer of technology from lab to land and to establish model sericulture villages, CSB has decided to implement Institute Village Linkage Programme (IVLP) through its main R&D institutes during 2015-16. The major activities of IVLP are as follows:

- Identify domains for new technology requirement at macro and micro levels.
- Introduce technological interventions with emphasis on stability and sustainability along with productivity of small farm production system.
- Introduce and integrate appropriate technologies to sustain technological interventions and their integration to maintain productivity and profitability, taking environmental issues into consideration.
- Facilitate adoption of appropriate on-farm value addition of agricultural products, by products and wastes for greater economic dividend.
- Facilitate adoption of appropriate technologies for removal of drudgery, increase efficiency and higher income to farm women.
- Monitor socio-economic impact of the technology intervention.

CSB has adopted 48 clusters under IVLP covering about 5,000 farmers, of which 27 clusters with 3,573 farmers are covered under bivoltine programme. Against the above target, CSB has organized 27 bivoltine clusters covering 3,778 farmers and 19 vanya clusters covering 1,462

farmers. Besides, 3 clusters have also been organized under post-cocoon sector. About 100 MT of raw silk was produced through the IVLP clusters. The progress is directly monitored by CSB's R&D institutes and will contribute immensely to the bivoltine silk production of the country and also socio-economic development of farmers.

Bivoltine Cluster Promotion Programme

Bivoltine Sericulture in India

The foremost thrust of the XII Plan is to augment the import substitute silk in the country and increase the production of bivoltine silk to 5000 MT. To achieve the target, CSB in association with state sericulture departments has organized 172 bivoltine clusters to produce about 3340 MT of bivoltine silk during XII Plan through clusters besides concentrating in non-captive areas to produce remaining 1660 MT. The year-wise bivoltine raw silk production during XII Plan period from 2012-13 to 2016, deciphering the progressive increase in the bivoltine raw silk production as an impact of Cluster Promotion Programme is given below:

Year	Raw Silk target (MT)	Achievement (MT)	% of Achievement
2012-13	2100	1984	94.0
2013-14	2480	2559	103.0
2014-15	3500	3870	111.0
2015-16	4500	4613	103.0
2016-17 (projected)	5260		

With the joint concerted efforts, the production of bivoltine raw silk in the country has reached to 4613 MT during the year registering a growth rate

of 103%. About 2930.50 MT of raw silk has been produced through 174 bivoltine clusters under CPP registering 64% of the total production (4613 MT). A database of farmers covered under the Cluster Promotion Programme is maintained in CSB web

portal "seri5k.csb.gov.in" and the cluster performance is monitored and reviewed at Central Office. The details of state-wise progress of bivoltine silk production for the year 2015-16 is as follows :

Production of Bivoltine Raw Silk through Captive and Non-Captive Areas during 2015-16

Sl. No.	State	Cluster	Raw Silk output (MT) during 2015-16		
			Captive area	Non-captive area	Total
Southern Zone					
1	Karnataka	46	1068	276	1344
2	Tamil Nadu	28	856	676	1532
3	Andhra Pradesh	13	616	92	708
4	Telangana	4	66	23	89
5	Maharashtra	9	129	120	249
6	Kerala	2	9	2	11
	TOTAL	102	2744	1189	3933
North-West Zone					
1	Jammu and Kashmir	25	37	90	127
2	Uttarakhand	7	8	22	30
3	Himachal Pradesh	8	12	20	32
4	Punjab	1	0.75	0	0.75
5	Haryana	0	0	0.6	0.60
	TOTAL	41	58	132	190
Central-Western Zone					
1	Madhya Pradesh	5	23	84	107
2	Uttar Pradesh	10	35	56	91
3	Chhattisgarh	0	0	0.40	0.4
	TOTAL	15	58	140	198
Eastern Zone					
1	West Bengal	4	29	1	30
2	Odisha	3	0.50	2.50	3
3	Bihar	1	neg	neg	neg
	TOTAL	8	29.50	3.5	33
North-East Zone					
1	Assam & BTC	3	12	20	32
2	Mizoram	1	6	40	46
3	Nagaland	1	4	0	4
4	Manipur	2	15	118	133
5	Tripura	1	4	18	22
6	Sikkim	-	0	4	4
7	Arunachal Pradesh	-	0	3	3
8	Meghalaya	-	0	15	15
	TOTAL	8	41	218	259
	GRAND TOTAL	174	2930	1683	4613

Implementation of Field Level Critical Interventions under Restructured Central Sector Scheme (CSS) during 2015-16

During XII Plan (upto 2014-15), the “Catalytic Development Programme” was implemented as a Centrally Sponsored Scheme in collaboration with States. Based on the recommendations of the 14th Finance Commission, the Govt. of India has increased the State’s share in net proceeds of Union Tax Revenue from 32-42%. As such, majority of the Centrally Sponsored Schemes including the Catalytic Development Programme (CDP) were discontinued during 2015 - 16. On account of the higher flow of funds to state governments, the states will have more autonomy to utilize the funds for various production activities across silk value chain.

In view of the above, the ongoing Plan Schemes of CSB have been restructured for implementation during the remaining Plan Period 2015-16 and 2016-17. The critical components of

CDP scheme have been merged with the two Central Sector Schemes viz., a) Research & Development, Training, Transfer of Technology & IT Initiatives and (b) Seed Organization. As a rationalization effort, all the existing four Central Sector schemes “(a) Research & Development, Training, Transfer of Technology & IT Initiatives (b) Seed Organization (c) Coordination and Market Development (d) Quality Certification Systems & Export/Brand Promotion and Technology Upgradation” have been brought under one umbrella Scheme viz., “Integrated Scheme for Development of Silk Industry” focusing on interventions in critical areas such as Seed, Breed, Post-cocoon Technology and Capacity Building, for visible impact on quality and productivity improvement.

Major achievements made under the Field Level Critical Interventions of restructured Central Sector Scheme (CSS) during 2015-16 is as follows:

Sl. No.	Name of the Scheme / Component	Achievement
I	Scheme-I: Core research for Productivity and Quality Enhancement of Silk	
1.	Training Initiatives of 9 Main Research & Training Institutes	
a)	Beneficiary Empowerment Programme (BEP)	4110
b)	Skill Training & Enterprise Development Programmes (STEP)	22
c)	Training for Adopted Seed Rearers (ASRs), Training for Private Graineurs and Need-based Focused Training under NSSO, BTSSO, MSSO & ESSO	100
2.	Transfer of Technology in Pre-cocoon Sector through Clusters/Blocks, CRCs, FFs, Biological control units, Krishimela, Group Discussions etc.)	
a)	Prophylactic Measures (Includes Quality Disinfectant, Inputs Supply for Productivity Improvement), Support to CBOs	24953
b)	Production Units for Biological Inputs/Door to Door Service Agents for Disinfection and Inputs Supply & Assistance for Sericulture Poly-clinics	73
c)	Support for Motorized Charka to Dissuade Child Labour	159
d)	Support for Establishment of Improved Cottage Basin Reeling Units: 48 ends Unit (6 basins of 8 ends each)	3

Continued...

Sl. No.	Name of the Scheme / Component	Achievement
e)	Support for Establishment of Multiend Reeling Units : 6 basins Unit (10 ends per basin)	7
f)	Support for Establishment of Multiend Reeling Units 10 basins Unit (10 ends per basin)	23
g)	Support for Establishment of Automatic Reeling Units: 200 ends unit	3
h)	Support for Establishment of Automatic Reeling Units: 400 ends unit	7
i)	Support for Establishment of Automatic Dupion Reeling Units (142 ends)	2
j)	Assistance for Twisting Units (480 ends)	14
k)	Support for Vanya Reeling/Spinning Sector Reeling cum Twisting Machines	77
l)	Wet Reeling Machine (2 basins of 6 ends each)	25
m)	Motorized/Pedal operated Spinning Machine	139
n)	Solar Operated Spinning Machine	72
o)	Improved Vanya Reeling Machines (Unnathi-Jharcraft, Charkha, Two Step, Improved (Nos.))	135
p)	Providing Services of Master Reelers/Technicians(Nos) Master Reelers/Technicians	7
q)	Arm Dyeing: 100 kg. Capacity Units (Multifuel)	9
r)	2000 kg. Capacity Conveyor Hot Air Dryer	5
II	Scheme - II: Seed Organizations and Coordination	
a)	Revolving Capital Fund Support for State Grainages and RSPs	2
b)	Assistance for Purchasing Seed Testing Equipments for State Grainages and Private RSPs	4
c)	Support to Upgrade State and Private Commercial Seed Production Units	1
d)	Strengthening Mulberry Silkworm Seed Crop Rearers (ASRs) for Quality Seed Cocoon Generation	1290
e)	Assistance to Private Tasar Graineurs	250

Post-cocoon Technology under Research & Development Component of Central Sector Scheme:

In order to improve the quality and productivity of silk yarn, certain post-cocoon technology

components were implemented during 2015-16 under Research & Development component of Central Sector Scheme. The achievement under such components is as follows:

Sl. No.	Component	Achievement
1	Support for Motorized Charkha to Dissuade Child Labour (Twin Charka)	108 units
2	Support for Establishment of Improved Cottage Basin Reeling Units (6-basins of 8-ends each)	3 units
3	Support for Establishment of Multi-end Reeling Units	
a	6-basin unit (10 ends per basin)	7 units
b	10-basin unit (10 ends per basin)	21 units
4	Support for Establishment of Automatic Reeling Unit	
a	200-ends unit	3 units

Sl. No.	Component	Achievement
b	400-ends unit	7 units
5	Support for Establishment of Automatic Dupion Reeling Unit	2 units
6	Assistance for Twisting Unit (480 spindles)	15 units
7	Support for Establishment of Pupae Processing and Drying Units	1 unit
8	Support for Vanya Reeling/Spinning Sector	
a	Reeling-cum-Twisting Machine	181 units
b	Wet Reeling Machine	21 units
c	Motorized/Pedal Operated Spinning Machine	216 units
d	Solar Operated Spinning Machine	62 units
e	Kamadhenu Reeling Machine	2 units
f	Unnati Reeling Machine	50 units
9	Providing Services of Master Reelers/Technicians	22 persons
10	Support for Setting up of Hot Air Drier	
a	Electrical Hot Air Drier - 50 kg. capacity	14 units
b	Electrical Hot Air Drier - 100 kg. capacity	5 units
c	Conveyor Hot Air Drier (Imported) -2 MT capacity	1 unit

Japan Overseas Cooperation Volunteers (JOCV)

Central Silk Board has implemented JOCV programme in cooperation with JICA since 07.01.2015 for a period of two years in the field of extension methodology, in organizing Self-Help Groups/CBOs, by involving sericulturists for effective technology transfer in bivoltine clusters. Five JOCVs have been posted at cluster locations, 1 each in Karnataka, Tamil Nadu, Andhra Pradesh and 2 in Uttarakhand.

IT INITIATIVES

The Central Silk Board has been using the information technology to improve the functioning of the Board as well as assisting scientists in their research activities for the past 26 years. Central Silk Board has taken many initiatives to make stakeholders reap the advantages of information technology in getting timely and accurate

information, providing access to various data and reports through sets of databases maintained at Central Office, CSB.

Present set up of information technology infrastructure in the Central Silk Board consists of:

- a. Hosting of the website www.csb.gov.in and intranet service for CSB units and employees deployed at Central Office with two state-of-the-art servers with a high speed internet (10 Mbps IBW).
- b. Linux and Windows Server 2003 operating systems are used in servers. Windows-7, Vista, Windows-XP and Linux are used on desktop computers.
- c. MS-Office 2000/2007/2010 and Open Office are used for general office correspondence, research, technical and statistical data maintenance. Power Builder, VB.net, ASP.net,

- PHP and Java are used for developing front end and web interfaces on LAN. Oracle, My SQL, MS-Access and Foxpro are used for managing data, handled through applications. SPSS, SYSSTAT and Windostat are used for analysis of research and statistical data.
- d. There are about 950 computers in CSB, including servers, Core i7, Core i5, Core i3 & Dual core computers and notebooks, which are extensively used for research data compilation, analysis of data, sericulture statistics, office productivity and routine correspondence in CSB and its nested units.
 - e. Video Conferencing (VC) facility established at Central Office, CSB is being used extensively to conduct meetings, reviews etc., covering the entire nation. More research institutes are in the process of establishing VC studios for effective communication.
 - f. Biometric finger print capturing system for recording attendance is successfully implemented in CSB complex. The same is being upgraded to Aadhaar Enabled Biometric Attendance System (AEBAS) and is being implemented in all other CSB units also to ensure punctuality and discipline. This will ensure proper time management and better output by officials.
 - g. Major applications status developed during the year:
 - i. *SMS services*: Introduced on day-to-day market rates of raw silk and cocoons for farmers and other stakeholders.
 - ii. *SERI5K Database*: 3700 bivoltine cluster farmer profiles have been updated into SERI5K database during the year.
 - iii. *mkisan.gov.in*: Using mkisan portal timely and relevant advisory SMS messages are sent to farmers in local language. During the year, 5,83,398 SMSs were sent to farmers. These SMSs contain 196 advisories.
 - iv. Video Conferencing facility has been established at CSRTI, Mysuru, Berhampore, CTRTI, Ranchi, CMERTI, Lahdoigarh and RO, New Delhi.
 - v. National Knowledge Network (NKN): Major research institutes (CSTRI, Bengaluru, CSRTI, Mysuru, CTRTI, Ranchi and CMERTI, Lahdoigarh) under CSB has obtained NKN connection for sharing and facilitating research materials among scientists.
- CSB has hosted bi-lingual website www.csb.gov.in for dissemination of up-to-date information. The other research units of CSB have also created websites to give research and scientific information:
- | | |
|--------------------|--|
| CSR&TI, Mysuru | - www.csrtimys.res.in |
| CSR&TI, Berhampore | - www.csrtiber.res.in |
| CSR&TI, Pampore | - www.csrtipam.res.in |
| CTR&TI, Ranchi | - www.ctrtiranchi.co.in |
| CSGRC, Hosur | - www.silkgermplasm.com |
| CMERTI, Lahdoigarh | - www.cmerti.res.in |
| BTSSO, Bilaspur | - www.btssso.gov.in |
| CSTRI, Bengaluru | - www.cstri.res.in |
| SMOI, Bengaluru | - www.silkmarkindia.com |
| SBRL, Bengaluru | - www.sbri.res.in |

Applications of Remote Sensing (RS) and Geographical Information System (GIS) in Sericulture Development

Sericulture is one of the important sectors of Indian economy and plays an important role in poverty alleviation programmes. Sericulture production is still limited to a few pockets in our country. The current production is not adequate to meet the demand for silk in the country. There is tremendous scope for enhancing the production and quality of silk through expansion area under host plants and improved method of information collection, processing and dissemination. In this context, space technology may provide vital inputs in the form of using satellite remote sensing data processing and integration of large volume of information in GIS domain.

Under the project *viz.*, “Applications of Remote Sensing (RS) and Geographical Information System (GIS) in Sericulture Development”, Central Silk Board in collaboration with North-Eastern Space Applications Centre (NESAC), Umiam, Shillong, Meghalaya has developed a SILKS (Sericulture Information Linkages and Knowledge System) web portal and put in the public domain (<http://silks.csb.gov.in>), which covers a total of 108 selected districts in 24 states. An effort has been made in identifying vanya food plant potential areas by RS & GIS techniques for the first time in the country. SILKS portal is a single window, ICT-based information and advisory services system for the farmers, sericulture extension workers, administrators and planners working in the field of sericulture development. The portal is now made available in 12 languages. It has 13 major non-spatial modules and 4 spatial modules. Within a short span of one year, the portal has made significant impact, particularly in the

North-eastern region and a number of sericulture expansion activities have been initiated based on the outcome of the project.

The findings and final recommendations were recognized through a Silver award under category “Innovative use of GIS Technology in e-Governance” for the year 2014-15 during 18th National Conference on e-governance held at Gandhinagar, Gujarat on 30th January 2015. Later, the outcome of the project was compiled in the form of an atlas which, contains maps and statistics generated as project output along with the description of methodology adopted, results and recommendations. It was released during the National workshop held at CSR&TI, Mysuru on 17th & 18th November, 2015. These state-wise & district-wise maps and statistics are helpful to the state departments of sericulture, their extension functionaries and all other agencies interested in development of sericulture.

Outcome of the first phase of the project

- > Mapping of potential areas for development of silkworm food plants for mulberry and non-mulberry sericulture in the non-traditional states on 1:50000 scale was done for 108 selected districts covering 24 states.
- > Appraisal surveys were carried out in 8 selected taluks to evaluate the progress of sericulture development as per the requirement of CSB.
- > Sericulture Information Linkages & Knowledge System (SILKS) web portal was hosted in public domain under the name <http://silks.csb.gov.in>

- SILKS portal was made available for use of user departments in North East since 14th June, 2013.
- SILKS portal was officially inaugurated by the Hon'ble Minister of Textiles, Govt. of India on 9th October, 2013 at New Delhi.
- The portal is presently available in 12 languages namely, English, Hindi, Telugu, Kannada, Assamese, Bengali, Mizo, Manipuri, Khasi, Garo, Ao Naga and Sumi Naga.
- One module specifically for the Farmers Services has been added.
- With the support of Indian Metrological Department (IMD), the weather bulletin of IMD-DAAS has been linked with the portal and the efforts are on for preparing sericulture advisories for SILKS portal. SMS based sericulture advisory services have been started in selected NE states.
- State sericulture departments have appreciated the project outcome and have started using the findings for sericulture planning and development. SILKS portal contents are helping the user departments for educating the farmers. Requests are made from state sericulture departments for covering more areas/districts.

Second Phase of RS & GIS Project

Central Silk Board has approved the implementation of second phase of the project in collaboration with North-Eastern Space Applications Centre (NESAC), Shillong at an estimated cost of Rs.60 lakh commencing from 2015-16. NESAC will execute the second phase of the project for 20 districts in North-eastern region and the remaining 30 districts in rest of the India in collaboration with State Remote Sensing Centres (SRSCs). NESAC will also facilitate in executing the project by providing necessary technical guidance and training to concerned SRSCs and other partner institutes. The progress made in the second phase of the project is as follows:

- Satellite data have been procured covering all the selected 20 districts for mapping of potential areas for sericulture development.
- Satellite data analysis is in progress for mapping of potential areas for sericulture development.
- A new database has been created for the twenty districts and is being integrated into SILKS portal.
- A two day hands-on training for the scientists and officials from SRSCs and state sericulture departments of North-eastern region was conducted.