

FINAL REPORT

**EVALUATION OF CENTRAL SECTOR SCHEME
DURING XI PLAN**

Research & Development/ToT/Training/IT initiatives



SPONSORED BY

**CENTRAL SILK BOARD
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CHAPTER I

ABOUT THE STUDY

1. 1. Introduction

Central Silk Board (CSB) under Ministry of Textiles, Government of India adopted a twin strategy of supporting the sericulture sector in the country; (1) Direct involvement in critical areas like research, training, basic seed production, Indian Silk brand promotion etc., through its own facilities for areas where a national outlook is needed, and (2) Financial support to States for the implementation of programs conceived by CSB in consultation with states and other all the stakeholders of the sector. These two programs are grouped under Central Sector Schemes (3 schemes), and Centrally Sponsored Scheme, namely Catalytic Development Programs (CDP), which consists of a basket of various components of developmental initiatives to support the sericulture farmers and processors directly through the State Department of Sericulture.

This report provides the evaluation of the implementation of the Central Sector Scheme “ R&D, Transfer of Technology, Training and IT initiatives” by Central Silk Board (CSB) through its nine R&D institutions and their nested units spread across the length and breadth of the country during XI Five Year Plan (2007-08 to 2011-12).

Research & Development activities of Central Silk Board (CSB) intensified during XI Five Year Plan in order to improve the productivity and quality of the sericulture sector and also to complement the expansion programme to reach the targeted production of raw silk. The Research Institutes established under the CSB functioning at Mysore (Karnataka), Berhampore (West Bengal) and Pampore (Jammu & Kashmir), are dealing with Mulberry sericulture. The Research Institute at Ranchi (Jharkhand) deals with Tasar, whereas the Institute at Lahdoigarh (Assam) is looking after research and development activities of Muga and Eri sericulture. Central Silk Technological Research Institute (CSTRI), Bangalore, carries out post cocoon R&D activities. The Silkworm & Mulberry Germplasm Station, Hosur (Tamil Nadu) has the responsibility of maintaining sericulture germplasm. The Seri Biotech Research Laboratory (SBRL), Bangalore, undertakes R&D in frontier areas like molecular characterization of silkworm races and mulberry varieties. The Silkworm Seed Technology Laboratory (SSTL),

Bangalore (Karnataka), is engaged in research on issues relating to Seed production, Seed Quality etc.

Each of these nine R & D institutions have their own nested Regional Sericulture Research Stations (RSRSs), Regional Muga Research Stations (RMRS), Regional Eri Research stations (RERSs), Demonstration Cum Technical Service Centers (DCTSC), Silk Conditioning and Testing Houses (SCTH), Regional Silk Technologies Research Station (RSTRS), Textile Testing Laboratories (TTL), Cocoon Testing Center (CTC), Raw Silk Testing Centers (RSTC) and Regional Tasar Research Stations (RTRSs). A large number of Research Extension Centers are also working under these Regional Research Stations.

1.2 Training

Trained human resource is one of the critical requirements for the production of quality silk at a reasonable cost. As any other rural based cottage industry, sericulture also needs trained technical personnel to provide training and transfer of technology to the rural masses. CSB has been playing a pivotal role in generating the required technical manpower for the dissemination work. It is organizing a number of training programmes for the benefit of various stakeholder categories of the silk industry. These training programmes are tailor-made to meet the specific needs of each sector of silk industry for updating the knowledge and skills of the extension personnel.

1.3. IT Initiatives

Under the IT Initiatives, CSB concentrates on networking various cocoon and silk markets with free flow of information regarding the availability of raw material, market trends etc., on its website. Information required for traders, buyers and other stakeholders have been hosted on the website.

1.4 Budgetary Allocation

CSB has been implementing the Central Sector Scheme namely Research & Development, Transfer of Technology, Training and IT Initiatives during the XI Five Year Plan (2007-08 to 2011-12) at an original outlay of Rs. 94.71 crores. However, the actual expenditure exceeded the original outlay by about 50% and the Total Expenditure towards the end of XI Five year Plan (2011-12) reported at Rs.144.60 crores (Table 1.1)

Table 1.1: Budgetary allocation for Research & Development, Transfer of Technology/ Training/IT initiatives during XI Plan (2007-08 to 2011-12)

(Rs Crores)

Particulars	XI Plan Original Out lay	2007-08 Actual	2008-09 Actual	2009-10 Actual	2010-11 Actual	2011-12 Actual	XI Plan Total Expenditure
Central Sector Scheme							
R&D and Training , IT	94.71	16.06	22.05	25.18	38.35	42.96	144.60

Present evaluation study has been entrusted to National Productivity Council (NPC) as a third party independent evaluation of the Central Sector Scheme namely R&D, Transfer of Technology, Training and IT initiatives implemented by CSB during the XI Five Year Plan. The evaluation study has been undertaken with the following objectives, Terms of Reference and methodology.

1.5. Objectives of the Evaluation Study

- i. The evaluation study of the R& D Programme of CSB is aimed at understanding the effectiveness of the scheme during XI plan period in improving the production & productivity and its impact in the field for the overall development of sericulture and silk industry in the country, results gained from the development of high yielding silkworm breeds and their food plants (Mulberry and Vanya Silk host plants), development of clonal propagation techniques, improving soil health, soil fertility and cultivation practices, water conservation techniques, development of disease management, disease forecast,

- forewarning system, economic farming models & practices, mechanization of sericulture farming and silkworm rearing under the pre-cocoon area etc.
- ii. Efforts taken in the development of improved reeling, weaving and processing devices for silk at low cost to produce quality silk.
 - iii. To study the quantity of region specific technologies developed by CSB Research Institutes and transferred from lab to land and its success among the stakeholders.
 - iv. To study the effectiveness of extension activities in disseminating the technologies from lab to land and creating awareness among the stakeholders through its training and other allied programmes.
 - v. To study the development of technologies and its commercialization thereof.

1.6. Terms of Reference of Evaluation

- i. Relevance & usefulness of R&D projects.
- ii. Appropriateness of time frame of R& D projects
- iii. Present status of technology transfers & efficacy of the R&D project to achieve the Intended end results
- iv. Performance of technologies/technology packages in field and its impact in the sericulture sector
- v. Acceptance of technologies/technology packages by end users
- vi. Fulfillment of objectives to the context proposed
- vii. Cost effectiveness of the projects-Initial cost (beginning of the project) & final cost (at the time of completion)
- viii. Training programmes-its relevance & usefulness
- ix. Product development and Diversification
- x. Evaluate the status of IT initiatives
- xi. Evaluate the impact of IT initiatives

1.7. Methodology

Evaluation study of the Central Sector Scheme – Research & Development, Transfer of Technology/Training/ IT initiatives has been undertaken in two phases.

First phase of the study focuses on an in depth analysis of secondary sources of data and information compiled from both published and unpublished sources of each R& D institute.

- Review of Research & Development Projects implemented by each of the nine R&D institutions during the XI Five Year Plan with a view to gauge their relevance, intended improvement, usefulness, appropriateness, acceptance of technologies etc.
- Research studies/articles/journals/CSB magazines on the technological development/ transfer of technology/training/ IT initiatives towards development of Sericulture Sector would also be reviewed and analyzed in order to find out technological development/ best practices and their effectiveness towards improving quality & productivity of the silk sector.

Second Phase of the study is based on detailed stakeholder interviews and discussions with various stakeholder categories such as Research and Development institutions, Training / Demonstrations Schools, Researchers/ Project Leaders, users or beneficiaries of new technologies, implementers, training schools/staffs and trainees, IT Providers, IT Initiatives of CSB (Cocoon Bank, raw silk, market network etc.) through structured interview schedules (**Annexures 1.1 to 1.4**).

1.7.1. Field survey methodology

The proposed field survey plan to conduct the field surveys across all the nine R&D Centres of CSB is given in (**Table 1.2**).

Table 1.2: Field Survey of R&D Institutes, Transfer of Technology /Training/IT initiatives

S.No.	R&D Institutes	Location	Project Leaders	Staff of Demonstration Schools	Users of New Technology (Farmers/Post cocoon)
1	CSR&TI	Mysore	5	5	10
2	CSR&TI	Berhampore	5	5	10
3	CSR&TI	Pampore	5	5	10
4	CMER&TI	Lahdoigarh	5	5	10
5	CTR&TI	Ranchi	5	5	10
6	CSTRI	Bangalore	5	5	10
7	CSGRC	Hosur	5	5	10
8	SBRL	Bangalore	5	5	10
9	SSTL	Bangalore	5	5	10
Total		9	45	45	90

Note: The coverage of actual number of Project Leaders and Staff of Demonstration Schools may vary based on ground realities.

Based on the field survey methodology, NPC field survey team conducted detailed interviews across all the nine R & D stations across India. Due to field related issues the actual number of sample surveys with respect to Questionnaire No.3 (Beneficiaries) and Questionnaire No.4 (Training / demonstration staff) varies from the initial plan. However, in the case of questionnaire 2 (Researchers), the actual field survey exceeded the initial field survey plan by almost double the target (**Table 1.3**).

Table 1.3: Actual Field survey for R& D, Transfer of Technology/Training/ ITInitiatives

S.No	R&D Institutes	States	Questionnaire No.1 (R & D Institutes)	Questionnaire No.2 (Researchers)	Questionnaire No.3 (R & D Beneficiaries)	Questionnaire No.4 (demonstration staff)	Total
1	CSR&TI	Karnataka	1	28	2	1	32
2	CSR&TI	West Bengal	1	13	-	-	14
3	CSR&TI	Jammu & Kashmir	1	-	-	-	1
4	CMER&TI	Assam	1	5	1	5	12
5	CTR&TI	Jharkhand	1	5	1	8	16
6	CSTRI	Karnataka	1	14	1		16
7	CSGRC	Tamil Nadu	1	9	-	-	10
8	SBRL	Karnataka	1	-	-	-	1
9	SSTL	Karnataka	1	-	-	-	1
Total			9	74	5	14	103

1.8 Evaluation of IT initiatives

- To understand the effectiveness of different of IT initiatives particularly the networking of various cocoon and silk markets through website and its utility in terms of free flow of information on the availability of raw material, market trends etc, an intensive review of CSB website shall be undertaken based on the utilization of the website by traders, buyers and other stakeholders during the XI Five Year Plan.
- IT system administrator shall be interviewed in order to understand the issues regarding real time data requirements for effective market network, availability of real time data on line etc.
- Major Cocoon markets and raw silk exchanges in Karnataka, Andhra Pradesh and Tamilnadu have already been linked through Information Technology Network. These markets shall be visited and their staff shall be interviewed in order to capture the issues regarding market networking, support required from IT team etc.

1.9. Structure of the Evaluation Report

The evaluation study report on the implementation of R&D, Transfer of Technology/Training/IT Initiatives scheme has been presented in **Eleven Chapters**. **Chapter 1** presents the background, objectives, terms of reference and the methodology adopted for the evaluation study. **Chapter II to Chapter X** presents the performance of each of the nine R&D institutions of CSB with respect to both financial and physical performance of the implementation of the scheme during XI Plan. **Chapter XI** provides summary of the findings of the evaluation of the R&D Scheme during XI Five Year Plan along with recommendations to make it more effective and also for the continuation of the scheme during XII Five Year Plan.

CHAPTER II

EVALUATION OF R&D ACTIVITIES OF CENTRAL SERICULTURE RESEARCH & TRAINING INSTITUTE (CSR&TI), MYSORE DURING XI PLAN

2.1. Introduction

Central Sericulture Research & Training Institute (CSR&TI), Mysore, has its hinterland in all the four Southern States besides Maharashtra, Madhya Pradesh, Gujarat and Rajasthan. Nested under it are 4 Regional Sericulture Research Stations (RSRSs) at Ananthpur, Chamarajnagar, Kodathi and Salem. 18 Research and Extension Centres (RECs) at Bidaraguppe, Chitradurga, Krishnagiri, Madivala, Rayachoti, Amrawati, Baramati, Samayanallur, Vikrabad, Palakkad, Venkatagiri, Kota, Udumalpet, Madakasira, Gobichettypalayam, Hosur, Agali, Nagpur and Hosangabad with 12 Sub-units at Bidar, Kinakanahalli, Shimoga, Koppal, Mugur, Eluru, Kanakapura, Maddur, Punkonda, Attappadi, Neyeli and Aurangabad and one Satellite Silkworm Breeding Station at Coonoor.

Major research areas of CSR&TI, Mysore are (a) Mulberry Crop Improvement, Production and Protection and (b) Silkworm Crop Improvement, Production and Protection.

2.2. Major Research Activities

Central Sericulture Research & Training Institute (CSR&TI), Mysore is the major R&D Centre of CSB. CSR&TI has undertaken a large number of R&D Projects during XI Five Year Plan (**Table 2.1**). Many research projects are of a continuous nature and the work is in progress. About 44 new technologies have been successfully transferred to the field during XI Plan.

Table 2.1. Number of R&D Projects undertaken by CSR & TI during XI Five year Plan

Year	Number of Projects	Status of R&D projects		
		Completed	Work in Progress	Technology Transferred (Lab to Land initiative)
2007-08	51	14	37	5
2008-09	63	10	53	5
2009-10	61	18	43	9
2010-11	65	8	57	11
2011-12	52	17	35	14

Source: NPC Field Survey –August-Sept 2012

Research projects have been undertaken in the areas of Development of high yielding silkworm breeds and their food plants (Mulberry & Vanya silk host plants, development of clonal propagation techniques, improvement in soil health and fertility, Mulberry Cultivation / Silkworm rearing practices, water conservation techniques, development of disease management, economic farming models and practices, mechanization of sericulture farming, mechanization of silkworm rearing, product development and diversification, any other region specific technologies, improved rearing, weaving and processing devises, IT initiatives, transfer of technology, sericulture economics, Eri culture, Transfer of technology, Studies on Forecasting and Forewarning for mulberry / silkworm pests and diseases and silkworm pests., Establishment of Farmers' Field Schools and Establishment of Soil testing facility.

Table 2.2 Research & Development projects undertaken by the institute and its nested units during XI five Year Plan

Area of Research	Name of the Projects taken up	Amount sanctioned in the area of research (Rs Lakhs)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers benefitted from the project
Development of high yielding silkworm breeds and their food	Advanced generation breeding (second generation) for the development of mulberry varieties suitable to sub-optimal irrigated conditions -PIB-3172	17.16	Concluded	Three genotypes out yielding V1 by 14-16% under optimum irrigation and 2 genotypes outyielding RC1 by 25-26% under sub-optimal irrigation were isolated	The genotypes would be subjected to OFT and multilocal trials

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plants (Mulberry & Vanya silk host plants)	Development of superior triploids through polyploid breeding for high yield and adaptability - PIB-3302	6.36	Concluded	Three triploids out yielding V1 by 10-14% under irrigated conditions and 3 triploids out yielding S13 by 15-28% under rainfed conditions were isolated	The triploids would be subjected to final yield evaluation in different agro-climatic situations
	Mulberry genome characterization: DNA profiling for ascertaining genetic diversity and construction of framework linkage map	35.38	Concluded	Estimated genetic diversity in mulberry germplasm. Constructed linkage maps and identified major QTLs for yield and yield contributing characters.	
	Identification of QTLs for water use efficiency and root traits to improve moisture stress tolerance in mulberry (<i>Morus alba</i> L.) through marker assisted selection	15.25	Concluded	Constructed parent specific linkage maps for water use efficiency and root trait and identified major QTLs for the two traits.	
	Screening of parental breeds of silkworm <i>Bombyx mori</i> L. for suitability in quality seed preparation based on alkaline phosphatase activity in the mid gut	0.50	Concluded	Variation in alkaline phosphatase activity was recorded in 10 test breeds	
	Application of parthenogenetic engineering in the development of superior breeds / hybrids of the mulberry silkworm, <i>Bombyx mori</i> L. (AIB-3410)	12.08	Concluded	Three parthenogenetic lines, two multivoltine androgenic lines were developed. One superior bivoltine hybrid and two multi x bi hybrids were developed	
	Evaluation of new multi x bi and multi x multi hybrids and studies on reproductive behaviour in new multivoltine breeds (AIB 3275)	94.12	Concluded	Three multi x bi hybrids Cavery, Jayalakshmi and D1 x CSR2 were evolved	

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	DNA fingerprinting of indigenous and evolved silkworm (<i>Bombyx mori</i>) races.	21.31	Concluded	Molecular IDs established for 16 breeds using RAPD markers	Useful for molecular characterisation of breeds
	Evolution and evaluation of productive silkworm breeds with high survival using polyvoltine donors employing amylase marker assisted selection AIG-3316	101.3	Concluded	Robust hybrid GEN1 X 4C and double hybrid G3 x G8 evolved based on amylase marker based selection	
	Shuttle breeding approach for development of bivoltine silkworms with better plasticity.		Concluded	Evolved one hybrid D2 x D13 superior to CSR2 x CSR4 in productivity and plasticity. One double hybrid superior to (CSR6 x 28) x (CSR2 x 27) evolved.	
	Evaluation of elite mulberry genetic resources for abiotic and biotic stress hot spot locations.	5.08	Concluded	No incidence of leaf spot disease was recorded.	
	Fast track breeding: Development of an efficient model for screening and preliminary selection of potential genotypes at the shortest possible time through stability analysis	17.55	Concluded	Only 7-8 harvest data are sufficient to know the true potential of a genotype at PYE level as against 15 harvest data over 3 years.	Findings useful in saving time and resources in mulberry breeding
	Identification of RAPD-SCAR marker linked to amylase gene using the near isogenic lines of mulberry silkworm (AIT – 3419)	15.5	Concluded	Six RAPD markers linked to amylase genes identified. RAPD-SCAR marker of 2.6 Kb specific to both 4 and 5 band amylase genes developed.	
	Identification of EST cDNA markers linked to genes controlling cocoon and post cocoon traits in mulberry silkworm, <i>Bombyx mori</i> (DBT 9537)	28.4	Concluded	SNP marker of linkage group 4, 9 and 12 linked to genes controlling cocoon weight, filament length and denier identified.	

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	Development and field evaluation of transgenic mulberry for abiotic stress tolerance (PIB 3411) DBT funded	18.04	Concluded	Hardened and multiplied transgenic plant developed at Delhi University. Various physiological and bio-chemical characters were studied. Validation for drought tolerance was done by pot studies.	
	Development of mulberry transgenics over expressing transcription factors associated with drought and epicuticular wax biosynthesis to increase stress tolerance and leaf quality (PIB 3444) DBT funded	18.95	Concluded	Protocol for production of transgenics with SHN1 and DREB 2A genes was standardized	
	Identification of DNA markers linked to infectious flacherie virus (BmIFV) in silkworm, <i>Bombyx mori</i> L. (AIG 3439)	12.10	Concluded	One SSR marker linked to IFV resistance was identified	
	Identification of cDNA markers linked genes controlling non-susceptibility to BmNPV in the mulberry silkworm <i>Bombyx mor.</i> AIG-3440	7.31	Concluded	Possibility of a dominant gene controlling non-susceptibility to BmNPV was indicated. SNP primers of three linkage groups indicated association with NPV tolerance. Screening with RAPD primers showed linkage with NPV tolerance in Tx crosses.	
	<i>In vitro</i> screening of promising mulberry genotypes for tolerance to alkalinity and drought stress	15.92	Concluded	On the basis of sprouting response, two genotypes tolerant to moisture stress and four tolerant to alkalinity stress were isolated.	Useful in breeding programmes
	Development of protocol for <i>Agrobacterium</i> - mediated transformation for the production of drought tolerant mulberry (<i>Morus spp.</i>) Genotypes.	3.48	Concluded	Standardized protocol for transformation	

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	Identification of physiological and biochemical markers associated with root-rot resistance in mulberry (PRP-3402)	15.26	Concluded	Leaf temperature, phenol content and total carbohydrate were listed as indicators for screening mulberry genotypes for resistance to root rot. Five tolerant and five susceptible genotypes were identified for resistance breeding.	Useful in breeding programmes
	Development of superior mulberry varieties suitable for moisture stress environments- PIB-3268	56.03	Ongoing	Five mulberry genotypes short listed from a PYE in three locations are being evaluated under rainfed and irrigated conditions at three locations	
	Development of superior mulberry varieties by exploitation of hybrid vigor based on molecular marker diversity of parental lines - PIB 3370	50.14	Ongoing	Progeny of crosses among parents selected based on molecular marker diversity were screened under moisture stress and non-stress environments. 16 short listed hybrids are being evaluated in PYE.	
	Maintenance of bivoltine silkworm races (AIB-3294)	5.67	Ongoing	Maintenance of bivoltine silkworm breeds Viz., CSR2, CSR3, CSR4, CSR5, CSR6, CSR12, CSR16, CSR17, CSR18, CSR19, CSR26, CSR27, CSR46, CSR47, CSR48, CSR50, CSR51, CSR52, CSR53, CSR2 (SL), CSR4 (SL), CSR202 (SL), CSR8 (SL), JPN7, NB1, D20, S8 etc., conforming to their breed characteristics	
	Test verification of newly developed silkworm breeds and their hybrids	5.85	Ongoing	To study the performance of hybrid CSR50 x CSR52, the parental breeds viz., CSR50, CSR51 were evaluated. Further, the egg production aspects of the parental breeds and foundation crosses were studied.	

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	Development of high sericin content breeds in silkworm, <i>Bombyx mori</i> L.		Concluded	One hybrid N x CSR26 was selected with high sericin content	
	cDNA cloning and expression of anti-viral gene in <i>Bombyx mori</i>	27.8	Concluded	Anti-viral protein against BmNPV, viz., BmNOX has been cloned & sequenced.	
	Identification of DNA markers to develop as SCAR marker using RAPD and ISSR markers for high survival and BmNPV resistance in silkworm (AIG 3407)	5.00	Concluded	One SCAR marker developed for NPV resistance. On the basis of genetic diversity, parents for hybrids are identified for better heterosis.	The information is being used by the breeders to develop the hybrids for field exploitation & benefit to farmers.
	Qualitative screening of mulberry varieties suitable for improvement of cocoon characters in productive bivoltines under hill conditions		On going		
	Shuttle breeding approach for development of bivoltine silkworms with better plasticity.		On going		
	Studies on identification new FCs and new double hybrids SIM 0017		On going		
	Maintenance of bivoltine silkworm germplasm and breeders' stock races SIM 0016		On going		
	Maintenance of bivoltine and multivoltine semi-synthetic diet silkworm strains for original breed characters	33.87	On going	21 bivoltine and 13 multivoltine diet breeds are being maintained for original breed characters	
	Identification of DNA markers associated with disease and pest resistance in mulberry (<i>Morus</i> sp.)	18.03	On going		

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	DNA marker aided analysis of mulberry gene bank towards a core assembly for sustainable conservation and enhanced utilization in crop improvement. DBT Funded	24.69	On going		
	Evaluation of three way cross hybrids for commercial exploitation SIM-0008	4.3	On going	Based on cocoon uniformity and evaluation index for nine economic traits, three hybrids were selected in four consequent cycles. The hybrids are under on station trials.	
	Studies on hybrid evaluation and identification of new polyvoltine x bivoltine hybrids of the silkworm <i>Bombyx mor.</i> AIB-3437	36.21	On going		
	Maintenance of breeds developed through amylase marker assisted selection, NPV tolerance and morphological mutant stocks. SIM-0011	61.00	On going		
	Studies on the reproductive efficiency of new polyvoltine and bivoltine breeds of silkworm <i>Bombyx mori</i> and egg production for field trials SIM-0043	43.65	On going		
	Large scale multiplication of new multivoltine and bivoltine breeds. SPR-0041.	9.65	On going		
	Large scale in-house evaluation and validation of new silkworm hybrids of silkworm <i>Bombyx mori</i> developed at CSRTI and its nested units. SPR-0019	0.40 per year	Continuous		

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	Development of disease resistant and productive mulberry genotypes with special reference to root rot and rook knot diseases suitable to the seri-zones of South India (PIB 3457)	18.5	On going		
	Development of doubled haploids through <i>in vitro</i> technique for mulberry improvment	0.71	Concluded		
	Development of robust bivoltine hybrids of silkworm, <i>Bombyx mori</i> L., tolerant to high temperature environment of the tropics through DNA marker assisted selection. AIT-3445.	17.56	On going	Two multivoltine (Nistari, Cambodge) , two bivoltine breeds (SK4C, BHR3) are identified as tolerant and CSR2 was identified as susceptible Isolated DNS from the six parents 15 SSR primers were screened in the tolerant and susceptible breeds and three polymorphic markers viz., 0329,0658, 0407 were identified .	
	Development of productive polyvoltine breeds of the silkworm <i>Bombyx mori</i> L. tolerant to high temperature and BmNPV. AIB-3456	5.0	On going		
	Evaluation and on farm trials of single and double hybrids with high amylase activity and temperature tolerance. AIG 3438	3.5	On going		
	Development of NPV tolerance bivoltine breeds using BmNOX as a marker AIB 3476	10.1	On going		
	Sericulture women and technology transfer – a group approach	1.6	On going		
	Evaluation of Elite mulberry varities under semi-arid agro-climatic condition.	0.91	On going		

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	Maintenance of polyvoltine silkworm breeds SIM009	1.25	On going		
	Post-authorization trials and popularization of authorized silkworm hybrids at field level.	31.72	On going		
	Evaluation of post cocoon parameters of cocoons generated from CSRTI, Mysore and its nested units. SIM-0037	1.25	On going		
	Studies to determine the process parameters for the new multi x bivoltine hybrids	1.00	On going		
Development of clonal propagation techniques					
Improvement of soil health and fertility	Sustenance of soil fertility and yield of mulberry under long term fertilization.	58.30	Concluded	Recommended NPK (350:140:100 kg / ha / year) and 25 MT FYM for high leaf yield or 150:50:90 kg / ha / year + 20 MT FYM + biofertiliser + VAM.	
	Fortification of sericultural compost and its effect on mulberry production.		Concluded	Method of preparation of fortified sericompost qualitatively superior to FYM was standardized.	
	Studies on the utilization of sericultural wastes for large scale production of compost and vermicompost.	7.46	Concluded	Crushing machine developed by the institute proved 40% more efficient. Quality of compost and relative efficacy of composting studied.	
	Evaluation and promotion of vermicompost technology for the efficient nutrient supplement for the quality leaf and cocoon productivity at farmers' field.	10.00	Concluded	Vermicompost significantly increased OC, EC, NPK, Cu, Mn, Fe, Zn and microbial load substantially. Economic feasibility was studied. CB – 1:1.75.	

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	Screening and identification of efficient lignolytic/ cellulolytic microbes for effective decomposition of seri-residue (PRP-3274)	17.32	Concluded	Technology for preparing compost out of mulberry shoots using <i>Pleurotus florida</i> along with SSP, lime and sugercane molasses developed to convert mulberry shoots to compost within 150 days. CB -1:1.22	
	Effect of shoot harvesting techniques and biomass yield of mulberry on soil organic carbon depletion in mulberry fields	2.07	On going		
	Monitoring of soil fertility status in sericultural areas of Karnataka to improve soil health and nutrient management for enhancing quality mulberry leaf and cocoon production	0.60 per year	Continuous		
	Long-term ecological research in mulberry cropping system on soil biology and productivity.	117.04	On going		
Mulberry Cultivation / Silkworm rearing practices	Studies on the different organic sources of nutrients in mulberry cultivation PPA-3327	16.25	Concluded	A package for substituting chemical fertilizer through supplementation of different sources of organic and biological inputs was developed.	
	Studies on chlorotic disorders in mulberry under field conditions.	2.01	Concluded	A colour chart for identifying degree of deficiency was prepared. Two nutrient formulations were developed.	
	Effect of graded levels of phosphorus application on phosphorus uptake, mulberry leaf yield, quality and silkworm rearing	13.44	Concluded	300:150:120 NPK + 20 MT FYM recorded highest yield and quality cocoon wherever available phosphorus was medium or low. Recommendations given for 150 kg P in place of 120 kg /ha / year.	
	Development of rearing package for high temperature and low humidity condition		Concluded	Package for reducing temperature by 7-8°C and increasing humidity up to 30% was developed	

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	Effect of integrated plant nutrient management systems (IPNMS) combined with nutrient rich organic washes on mulberry crop production and protection under irrigated conditions] RSRS Kodathi	28.76	Concluded	An eco-friendly technology with seri-azo and seri-phos was developed for sustained mulberry production. Efficacy of vermicompost and vermiwash established and popularized.	
	Investigations into mulberry root rot disease, identification of QTLs conferring resistance and trait introgression.	0.30	Concluded	Causal organisms and associated fungi were isolated.	
	Development of package of practices for mulberry suitable under low input condition. (PPA 3326)		Concluded	The study suggested that under sub-optimal conditions RC2 responds significantly better than RC1 and K2	
	Development of diagnostic kit for identification of nutrient deficiencies in mulberry and to assess the leaf quality.	0.25	Concluded	Standardized a rapid tissue test for identifying nitrogen, phosphorus, calcium, iron and magnesium deficiencies in mulberry.	
	Development of package of practices for mulberry varieties suitable under low input condition		Concluded		
	Effect of plant extracts and growth promoters on shortening larval duration in Pure Mysore.	0.25	Concluded	Extract P5 with 0.5 g/lit concentration applied at 0 days in fifth instar resulted in one day reduction in 5 th instar larval duration in PM.	
	Studies on rhizosphere microflora of mulberry varieties as influenced by different cultivation practices under alkaline soil conditions	1.82	Concluded		
	Studies on the comparative yield potentiality of promising mulberry varieties under different sources of organic / inorganic nutrients. (PPA 3420)	29.58	On going		

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	Validation of foliar application of macro and micro nutrient formulation to mitigate the nutritional deficiencies in mulberry.	3.25	Concluded		
	Refinement and standardization of commercial viability of young silkworm (chawki) rearing center for easy operation and quality cocoon production. SPR 0032.	9.36	Concluded		
	Development of silkworm rearing package for newly developed hybrids / breeds SPR 0044	1.7	On going		
	Studies of mulberry leaf nutrition on intermediary metabolism of silkworm <i>Bombyx mori</i> L. AIB-3748	7.00	Ongoing		
Water conse techniques	Physiological studies on the effects of anti transpirants for higher productivity and leaf quality in mulberry under soil moisture stress conditions (Pilot project)	0.25	Concluded	Humic acid at 0.1% most effective among the three anti-transpirants tried. Bio-assay showed no toxicity. Water savings of up to 25% with an yield increase of 13.2% per plant was recorded.	
Developmen disease management disease fored forewarning	Impact of microbially enriched compost on suppression of soil borne diseases of mulberry (January 2005 to June 07)	11.2	Concluded	A package involving enriched seri-residue + rock phosphate + beneficial fungi and bacteria was recommended to control rook knot and root rot diseases. CB- 1:1.6	
	Investigations on the green muscardine disease of the silkworm, <i>Bombyx mori</i> L.	3.3	Concluded	Prevalence of green muscardine in Karnataka was surveyed in three seasons. Fungal pathogen was isolated and pathogenecity established. Susceptibility of silkworm breeds and effect of temperature were studied.	

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	Infectivity of fungal pathogens to silkworm eggs and its relation to egg and larval mortality	3.56	Concluded	100% mortality resulted in 5 day old eggs on inoculation with <i>B. bassiana</i> . The mortality gradually reduced to 1.68% on the day of hatching. SEM studies revealed penetration process through the eggs.	
	New approaches for the management of fungal diseases in silkworm, <i>Bombyx mori</i> L.	2.15	Concluded	Nine botanicals shortlisted out of 85 for efficacy against <i>B. bassiana</i> and <i>S. prassina</i> . Four formulations were found effective in preventing spread of muscardine.	
	Isolation and characterization of low virulent and non-transovarially transmitted microsporidia infecting silkworm, <i>Bombyx mori</i> L.	5.17	Concluded	Isolated six microsporidia with different morphology. The microsporidia were less virulent compared to <i>N. bombycis</i>	
	Identification and standardization of parameter (s) to determine the health status of early instar silkworm, <i>Bombyx mori</i> L. (ARP-3304)	11.26	Concluded	Diagnostic symptoms for detection of different silkworm diseases in early instar were defined and procedures standardized. Parameters for chawki quality defined.	
	Evaluation of performance and establishment of natural enemy complex of uzi fly <i>Exorista bombycis</i> in different agro-climatic sericultural zones ARE-3353	15.06	Concluded	Efficacy of <i>N. thymus</i> in various sericultural belts for management of uzi fly and feasibility of its mass multiplication on housefly pupae established.	
	Survey on the occurrence, distribution and severity of root rot and root knot diseases of mulberry in Chamarajanagar district. RSRS Chamarajanagar	0.79	Concluded	The survey indicated no threat to mulberry due to root diseases in Chamarajanagara District, since the incidence was very low. Root knot disease was not found in the area	

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	Studies on improvement of tolerance of promising silkworm breeds to BmIFV	8.53	Concluded	Two multivoltine and two bivoltine breeds highly tolerant to BmIFV were identified.	The breeds can be used in different hybrid combinations to produce tolerant hybrids
	Studies on biointensive pest management strategies of papaya mealy bug <i>Paracoccus marginatus</i> in mulberry ecosystem (PRE 3425)	16.83	Concluded	Protocol for mass production of <i>A. papayae</i> standardized. Pest incidence totally controlled in Tamil Nadu and Karnataka.	
	Identification of resistant multivoltine and bivoltine donor parents and their characterisation to white muscardine disease in the mulberry silkworm	3.35	Concluded		
	A practical technology for diagnosis and management of diseases in silkworm rearing (PEBS project under JICA)		Concluded	Demonstrated silkworm disease management technology to the sericulturists in South India	
	Maintenance of mother culture for production of recommended biocontrol agents and mass release of recommended biocontrol agents of sericultural pests in CSRTI campus.	2.93	On going	Nucleus culture of 5 species of uzi fly parasitoids and 2 species of ladybird beetles was maintained throughout the year and mass produced the bio-control agents for field release.	Produced 3169 pouches <i>N.thymus</i> and 785 boxes of ladybird beetles during the year.
	Development of integrated package for management of soil borne pathogens (ERP 3436)	1.0	Concluded		

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	Studies on forecasting and forewarning for mulberry pests, diseases and silkworm pests (CSS 2107)	25.77	Concluded	As per target, fortnightly survey was completed. It was observed that the pests i.e., mealybug, thrips, whitefly, leaf roller are found to attack mulberry in all the 3 states during the year.	A total of 200 farmers were covered for monitoring of the pest during the year. And remedial measures were suggested to farmers through media, magazines and video conferencing, awareness programmes and other extension programmes.
	Biological control of fungal root rot disease of mulberry by endophytic bacteria <i>Burkholderia cepacia</i> and <i>Bacillus subtilis</i> strains (DBT funded)	12.59	On going		
	Maintenance of silkworm pathogens and testing their virulence at periodical intervals. SPT-0024.	1.5	On going		
	Impact of new microsporidian infection on silkworm rearing. SPT-0025.	0.5	On going		
	Habitat studies – impact of crop diversity on conservation and performance of natural enemies in mulberry ecosystem. PPE-3455	2.5	On going		

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	Development of database for mulberry diseases	5.0	On going		
	Application of nano particles to control bacterial disease and to understand <i>modus operandi</i> of natural color pigments in silkworm, <i>Bombyx mori</i> L. SPR-0034A		On going	Comparative physiological studies with 8 colours were carried out. Colour larvae were dissected to check colour penetration into silkgand, alimentary canal, fat bodies and malpighian tubules. Haemolymph. Collected and analyzed through spectrophotometer. Colour diffusion experiment was carried out both <i>In-vitro</i> and <i>In-vivo</i> .	
	Investigations on the elimination of New microsporidian infection from initially infected population of silkworm, <i>Bombyx mori</i> L. through successive generations.	0.5	Ongoing		
	Evaluation of available management strategies of gaint African Snail. (<i>Achatina sulica</i>) in mulberry eco-system PRE 3467	2.4	On going		
	Development of bionematicide for management of mulberry root knot disease MPT-0040	0.20	On going		
	Identification of factors responsible for silkworm crop loss due to diseases at field level and its impact on cocoon productivity	6.30	On going		
	Investigations on the new microsporidian (NIK-7Bm) isolated from silkworm <i>Bombyx mori</i> L.	0.5	On going		

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Economic farm models & practices	Mulberry based integrated farming system – an evaluation	11.48	Concluded	The study clearly indicated that mulberry based integrated farming system can effectively bring about enterprise diversification for sustainability and better management of resources.	
	Intercropping in mulberry with cereals, pulses and oil seeds under rainfed conditions of Chamarajanagar district RSRS Chamarajanagar	10.32	Concluded	Identified ground nut as one of the most promising intercrop in rainfed mulberry in Chamarajanagara Area.	
	Setting up of model organic farm (NCOF, MOA, GOI)	4.0	Concluded	It was demonstrated that it is possible to avoid application of chemical fertilizers by applying different combinations of organic manure	
Mechanization of sericulture farming					
Mechanization of Silkworm rearing					
Product development & diversification	Formulation of viable semi-synthetic diets for young instar Vanya silkworms viz., <i>Antheraea assamensis</i> Helfer (muga) and <i>Samia ricini</i> Donovan (eri) and standardization of commercial young instar diet rearing technology	19.61	Concluded	Semisynthetic diets for Muga, Eri and Tasar with 90% feed response were formulated and technology for rearing young instar larvae standardized.	

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	Induction of colour to the larvae and cocoons of silkworm , <i>Bombyx mori</i>		Concluded	Procedure for producing natural colour cocoons and silk was standardized. Color flat silk and fabric were produced.	
	Preparation and screening of silkworm byproducts for human health beneficial effects	28.95	Concluded	Standardization of process for production of silk powder (Fibroin powder). 5 silkworm powder samples tested at NIN Hyderabad for anti diabetic property.	
	Development of new plastic rotary mountages for quality cocoon production	9.40	Concluded	Plastic rotary mountages to replace the card board mountages were prepared. The plastic mountages are more durable as efficient as the card board ones.	
	Studies on the development of indigenous method for culturing <i>Cordyceps</i> and other useful species. AIB-3449	17.27	On going		
	Regenerated silk fibroin and its application in producing film and electrospun silk mats. SPR-0035	1.0	On going		
Any other (Please specify)					
Transfer of Technology	Promotion and popularization of artificial diet chawki rearing through chawki rearing centers (DST funded)		Concluded	Five CRCs selected for demonstration and training. Average cocoon yield increased to 66.80 kg / 100 DFLs.	
	Impact analysis of commercial chawki rearing centers (CRCs) established under IVLP popularization of bivoltine cocoon production in the field	10.60	Concluded	19% increase in bivoltine and 14% increase in multi x bi was recorded in CRC service area. Net income of CRCs for rearing 100 DFLs ranged from Rs. 163 – 170. CB ranged from 1:1.69 to 1:1.74	
	Technology assessments and refinement for cocoon production through institute village linkage programme [IVLP]		Concluded	Studies involving 482 farmers across 11 clusters revealed an increase of 15.54 kg / 100 DFLs over the bench mark value for cocoon yield.	

Area of Research	Name of the Projects taken up	Amount sanctioned in the area of research (Rs Lakhs)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers benefitted from the project
	Transfer of technology through farmers' field school - a case study.		Concluded	Six FFSs in three southern states studied. Strong linkage established among scientists – extension worker – lead farmers – farmers.	
	Socio-economic empowerment of tribals through state-of-art technologies in sericulture at Karamadai and P.N. Palayam ranges of Coimbatore district, Tamil Nadu RSRS Salem	14.23	Concluded	17% increase in cocoon production achieved in the target groups. Returns per 100 DFLs increased from Rs. 4500 to Rs. 7000 due to adoption of new technologies after demonstration and training.	
	Empowerment of SC sericulturists through state-of-art sericulture technologies in Thalinchy at Udumalpet taluk of Coimbatore district (DST) of tamil nadu RSRS Salem	5.75	Concluded	309 persons trained in INM, IPM, Chawki rearing, value addition to byproducts etc.	
	Empowerment of SC/ST sericulturists through state-of-art of sericulture technology (In collaboration with DST, New Delhi) RSRS Chamarajnagar and Ananthapur		Concluded		
	Popularisation of chawki rearing center model developed by CSRTI, Mysore in identified clusters of Karnataka, Andhra Pradesh and Tamil Nadu – A support mechanism of bivoltine sericulture (DBT funded)	17.59	Concluded	7894 small and marginal farmers benefited. 72315 mandays of employment generated with a CB ratio of 1:1.43-1:1.61. Cocoon yield increased by 14.37 kg / 100 DFLs with an increase in the net income of Rs. 73268 per acre per year.	
	Studies on adoption of silkworm disease control measures and its impact on cocoon production in farmers' field under Tamil Nadu conditions.	0.48	Concluded		

Area of Research	Name of the Projects taken up	Amount sanctioned in the area of research (Rs Lakhs)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers benefitted from the project
	Studies on adoption of mulberry and silkworm pest management technologies (IPM) by the sericulturists in Tamil Nadu.	0.32	Concluded		
	Popularisation of productive bivoltine double hybrid "Krishnaraja" with farmers of Karnataka MOE-3463	10.33	On going	A total of 3500 dfls of double hybrids were distributed to 10 farmers of Srirangapatna and average cocoon yield recorded was 62.4 kg as against 55.2 kg /100 dfls in CSR2xCSR4.	
	Characterisation of status and assessment of potential for adoption of farm machinery and equipment in sericulture SEM 0029	0.82	Concluded	The adoption rates, reasons for high adoption <i>vis-à-vis</i> non adoption were assessed. Need for financial assistance and conduct of awareness programmes indicated.	
	Assessment of women participation and time spent on different sericultural activities in three southern sericultural states MOE-3461	1.5	On going		
Sericulture Economics	A study on economics of sericulture and other competitive agricultural crops in non-traditional areas of Southern India and Maharashtra	7.83	Concluded	CB ratio in Karnataka, AP, TN and Kerala were calculated which ranged from 1:1.41 to 1:1.63. Knowledge level, adoption level and constraints faced by the farmer were listed.	
	An Economic investigation on costs and returns in mulberry cocoon production in south India	11.15 per year	Continuous		
	Impact of urbanization in sericulture belts on sericulture development in Karnataka	2.53	Concluded	The need for a well focused approach to shift sericulture to central and north Karnataka is realized. Small sized seri farms in peri urban regions are more efficient.	

Area of Research	Name of the Projects taken up	Amount sanctioned in the area of research (Rs Lakhs)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers benefitted from the project	
Ericulture	Studies on prospects of ericulture in Karnataka	21.41		Effect of defoliation on castor seed yield, suitable variety, incubation and rearing practices were studied.		
CSS 2110	Transfer of Technology					
CSS 2107	Studies on Forecasting and Forewarning for mulberry / silkworm pests and diseases and silkworm pests.				Details submitted during Visit to CSRTI, Mysore	
CSS 2105	Establishment of Soil testing facility					
CSS 2106	Establishment of Farmers' Field Schools					

2.3. Sources of Funds and Expenditure on R&D Projects

It may be noted from **Table 2.3** that the funding and expenditure on various R&D projects by CSR&TI Mysore, have doubled during XI Plan as it increased from Rs.1937 lakhs in 2007-08 to Rs.4109 lakhs by 2011-12.

Table 2.3. Source of Funds and Expenditure of R&D Projects of CSR & TI, Mysore

Sl No.	Source of Grants/Funds/Sponsors	Approximate Annual Funding (In Rs.Lakhs)				
		2007-08	2008-09	2009-10	2010-11	2011-12
a)	State Government					
b)	CSB (under the R&D scheme)	1937.35	2865.05	3610.10	4314.78	4109.54
c)	Industries					
d)	International Bodies					
e)	Others (Specify)	78.55	48.57	92.21	128.67	101.71
	Total Funding	2015.90	2913.62	3702.31	4443.45	4211.25
	Total Expenditure	1937.35	2865.05	3610.10	4314.78	4109.54

2.4. Number of Patents awarded & Research Papers published

CSR & TI, Mysore scientists have applied for 10 patents during XI Plan of which 4 patents have been awarded (**Table 2.4**).

Table 2.4. Number of Patents applied and awarded during XI Five Year Plan

Year	No. of Patents Applied (Nos)	No. of Patents Awarded (Nos)
2007-08	3	-
2008-09	-	3
2009-10	3	-
2010-11	3	1
2011-12	1	-

A large number of research papers have also been published by CSR & TI, Mysore researchers and scientists in national and international journals during XI plan. Altogether 1370 research papers have been reported to be published during XI plan (**Table 2.5**).

Table 2.5. Number of Research papers published during XI Five Year Plan

Year	Research Papers published (Nos)
2007-08	235
2008-09	210
2009-10	218
2010-11	329
2011-12	378
Total	1370

2.5. Commercialization of Technologies

- Technologies Commercialised are :
- High sprayer pump – for rearing house disinfections,
- Bio fertilizer – for mulberry plants
- Navinya – a bio-formulation for control of root rot disease
- Poshan – a multi-nutrient formulation for mulberry

2.6. Training & Human Resource Development

In collaboration with JICA, two International training programmes were organised for the participants from Third World countries. The participants from Kenya, Nigeria, Uganda, Ghana, Madagascar, Nepal and Kyrgyzstan attended the training programme. Based on the requests received from Universities, Department of Sericulture, NGOs etc., need based training programmes were also organised. In addition to this, students from various universities/colleges were provided support for the M.Sc project/dissertation work.

- Persons trained under various training programmes: 4069 persons

- Enterprise promotion (MDP&TUP) : 331 persons
- Training under XI Plan of CSS including nested units: 3403 persons
- Certificate course: 45 Nos.
- Third country training programme: 28 persons
- Need based training programme : 247 persons
- Integrated Skill Development Scheme (ISDS) : 15 persons

2.7. Sericulture Extension, Economics and Management (SEEM)

The average cost of production of cocoon per kg was estimated through sample survey at Rs.150.45, Rs.147.54 and Rs.134.58, respectively for Karnataka, Andhra Pradesh and Tamil Nadu. A total of 84,750 dfls of bivoltine hybrids were chawki reared and supplied to adopted farmers and an average cocoon yield of 68.97 kg/100 dfls was obtained. Under Cluster Promotion Programme (CPP), a total of 22,58,024 dfls of bivoltine hybrids were distributed in 22 clusters spread across Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra and an average cocoon yield of 67.79 kg/100 dfls was reported. A total of 12 improved technologies are currently under testing/demonstration in different RSRSs, RECs and REC Sub-units. Besides, 7 demonstrations of compost making, 3 demonstrations of foliar spray with Poshan and 12 demonstrations of disinfection with Asthra were conducted by scientists of CSRTI, Mysore.

2.7.1: Extension Activities of CSR&TI, Mysore

The details of the extension activities are given in **table 2.6**. It may be seen from **table 2.6** that 847 events have been organized under 13 different programmes during XI plan period.

Table 2.6. Extension activities of CSR&TI, Mysore

Sl.No	Programme	No. of events conducted at RSRS & its nested units				
		Ananthapur	Kodathi	Salem	Chamraj Nagar	Total
1	Group Discussion	93	34	65	11	203
2	Film Show	87	34	41	12	174
3	Exhibition	41	9	32	3	85
4	Awareness Programme	51	38	48	0	137

5	Field Day	55	10	38	9	112
6	Study Tour	9	8	12	2	31
7	Enlightenment programme	10	7	12	0	29
8	Farmers meet	0	2	0	0	2
9	Technology Demonstration	0	19	46	0	65
10	Work shop	5	0	1	1	7
11	Resham Krishi Mela	0	1	1	0	2
	Total	351	162	296	38	847

It may also be noted from **Table 2.7** that CSR & TI, Mysore organized 160 training programs wherein 21939 participants got the benefit of various training programmes.

Table 2.7. Number of training Programs conducted during XI Five Year Plan

Year	No. of Training Programme	Total no. of Participants
2007-08	27	4003
2008-09	32	2869
2009-10	35	3241
2010-11	30	6455
2011-12	36	5371
Total	160	21939

A large number of IT initiatives have also been taken up by CSR&TI during XI plan. Details of these IT initiatives undertaken by Bio-informatics centre and Computer facility centre are given in **Table 2.8**. A number of workshops have been conducted and databases have been developed for the benefit of scientists and research students.

Table 2.8. IT Initiatives undertaken to propagate new technologies developed by the R & D institute during XI Five Year Plan

Sl. No	New Technology Developed	IT Initiative details	Whether successful (1=yes 2=No)	Impact of the Initiative
I.	Bio-informatics center			
1	Development of sero-bioinformatics databases	Databases on silk proteins, silkworm transcription factors, mulberry genome, soil information, important plant genes in mulberry, mulberry & silkworm pests and diseases have been developed using bioinformatics tools.	1	These databases are useful for R & D in the area of sericulture biotechnology and bioinformatics.

2	Development of HRD in bioinformatics	Guidance to students for M.Sc. dissertations in bioinformatics	1	9 M.Sc. bioinformatics students have completed their project works
3	Workshops on basics and applications of bioinformatics	Two workshops were organized	1	64 scientists of the institute & nested units were sensitized on the applications of bioinformatics
4	Workshops on basics of network & internet usage	Three workshops were organized.	1	80 officials of the institute were benefited on applications & usage of networking & internet.
II.	Computer facility center			
1	CPP Database	Development of database for farmers details	1	Provide access to ready reports for effective decision making.
2	MIS Database	Development of database for complete sericulture farmers	1	Providing summarized information for management to effectively make policy decisions.

2.8. Problems faced by the Institute during XI Plan

2.8.1. Manpower

- Shortage of subject expertise adversely affected a thrust in frontier areas of research including basic sciences.
- Due to ban on recruitment for the last two decades a vacuum has been created, only two new scientists have been recruited and appointed during XI plan for the institute of which one has already resigned.
- No attractive incentives or career progression plans to attract young scientists.

2.8.2. Finance

Due to restricted delegated powers vested with the institute's head, most of the purchase proposals' including the external funded projects need to be routed to head quarters for financial and administrative approvals, leading to delays in implementation of programmes on time.

2.8.3. Infrastructure

- Most of the lab buildings are more than three decades old and are in a dilapidated condition, except for the JICA and NSP buildings, which were constructed after 1992.
- The infrastructure created during NSP and JICA period are not fully utilised due to lack of maintenance staff, spare parts etc.

2.9. Overall acceptability of new technology among end users.

- Many of the technologies developed by the Institute are aimed at improvement in quality and quantity of cocoon.
- Most of the product development was towards prevention and control of silkworm diseases, which resulted in providing substantial benefit to the farmers' in harvesting 5-8 kg more cocoons as against the non use of technology products.
- Currently bed disinfectants for silkworms are accepted and used in field.
- The proliferation of Commercial Chawki Rearing Centres has improved the survival rate of young age silkworms.
- Due to high labor cost, alternate approaches like farm mechanization, shoot rearing technology, leaf chopping machine, silkworm separator etc., has given a thrust in silkworm rearing and has reduced the labor inputs and drudgery of work.
- Transfer of Technology through Cluster Promotion Programme has brought farmers together in understanding the use and advantages of new technologies.
- Training cum demonstration of new technologies and trainers training programme has created awareness among the field functionaries.
- Production and supply of bio-control agents and development of entrepreneurs has given a role to non sericulture ones to contribute indirectly in silk production.

2.10. Initiatives Planned during XII Five year Plan

A number of R&D initiatives have been planned by CSR&TI, Mysore during XII Five Year Plan (table 2.9).

Table 2.9. R&D activities planned for XII Five Year Plan

SI. No.	Name of the Initiative	Objectives/ Targeted stake holders
1	R&D	Conduct scientific, technical and economic research to enhance production, productivity and quality of Indian silk. Stake holders: Main beneficiaries are the sericulture farmers' who look towards higher production and productivity.
2	R&D	Development of package of practices for mulberry cultivation and silkworms rearing and their dissemination Stake holders: package of practices are to be developed and given to sericulture farmers along with new variety / hybrids to harvest optimum yield.

3	R&D	Commercialization of products and Technologies Stake holders: the technologies, processes, product has to be patented to give IPR for the developer. To make the innovation useful the technologies are offered to entrepreneurs for production and marketing.
4	TOT	Transfer of Technology Stake holders: All new technologies developed needs to be validated and tested in field before recommended to the farmers.
5	R&D	Disease & Pest Forecasting and Forewarning Stake holders: To help the sericulture farmers' in prevention and control of various mulberry and silkworm diseases, disease forecasting and forewarning is an important tool to give farmer prior notice about the entry of disease or damage which may happen.
6	Training	Training Stake holders: Both government officials and non governmental organizations / general public who are interested in starting sericulture or state extension staff who give technical guidance to farmers need to update the knowledge of the existing technology and other new ones.
7	R&D	Strengthening institutional framework to support ongoing research and related programmes Stake holders: To hasten the R & D work, and help the scientists to carry out the work, necessary support in infrastructure and other facilities has to be facilitated.
8	R&D	Maintenance of Breeders Stock (P4 laying)/ Stake holders: To utilize the breeds / races in development of new hybrids etc., maintenance is mandatory to help the breeders.
9	R&D	Collaborative Research Programmes with other R&D organizations in India and abroad Stake holders: To have effective interaction among the institutes, also to utilize the expertise in specific field of research collaborative research programmes have been drawn to reach the goal.
10	TOT	Publication of R&D innovations and package of practices for knowledge dissemination. Stake holders: To help all the stake holders of silk industry, regular publication and dissemination of knowledge is needed.

2.11. Suggestions for improving the R&D scheme during XII Five Year Plan

A multi-disciplinary approach is required on the lines of ICAR's All India Coordinated Crop Improvement Programme (AICRP). All extension activities need to be undertaken on Mission Mode Approach. Cluster Development Approach to be considered in sericulture growing areas only. Detailed survey and analysis of complete farming approach needs to be taken up by an outside agency.

Being the lone developer and promoter of R&D activities in sericulture for about half a century in India, maintaining sufficient scientific manpower is critical to the success of sericulture in the country. Average age of scientist-B (entry level) is 51 years in 2012 due to the prolonged govt. ban on recruitment in the recent decades. There is an urgent need to induct Research Fellows / Research Associates on contract basis with consolidated pay to carry out specific research programmes on the lines of other national institutes and organizations like ISRO, IISc etc.

There is a need to upgrade the labs and infrastructure for the priority areas of research, other activities may be kept low. Keeping in view the global warming and Co2 concentration in the environment, non conventional energy and solid waste material generated from sericulture has to be converted to useful product for farming purposes. Various technologies need to be developed and standardized.

Mass communication programmes have helped the farmer to understand the sericulture practices, therefore short programmes are to be developed and broadcasted on day to day basis. Besides on farm demonstrations are essential for incorporating the required skills and mobilizing the farmers to take up sericulture.

All projects must work with zero budgeting, so that most of the problems and difficulties faced can be sorted out. Research Extension Centres need to be kept at optimum level to offer technical assistance to farmer's field problems.

2.12. Field Survey Findings from RECs

2.12.1. Research Extension Centre Sub Unit, Kinakahalli, Mysore

Table 2.10. Important new technologies or R&D initiatives disseminated in the field by REC Kinakahalli, Mysore during XI Five Year Plan (2007- 2011)

Name of Technology/Process/ R&D Project	Method of Technology Transfer (i.e. On field Demonstration , Training etc.	Approx No. of farmers benefitted till date	Comment on overall acceptability of these technologies by the beneficiaries	Impact of the technology on Productivity & Quality
Disinfection for Disease management	Oral presentation	100	All farmers accepted	More Cocoon Yield is 10-15 kg
Mulberry Cultivation&	Field Demonstration	4 nos beneficiaries	Increases the quality output and hygienic method of dyeing	After demonstration beneficiaries adopted the technology
Chawki Rearing	Group Discussion	150		Adopted REC system

Table 2.11. Training programs undertaken by REC Kinakahalli, Mysore during XI Five Year Plan

Year	Total Trainings/Demonstration Conducted (Nos.)	Total Participants (Nos.)	SC participants (Nos.)	ST participants (Nos.)	Female Participants (Nos.)
2010-11	2110 Training	100	20	5	40
2011-12	CSS 2101 Training	120	30	10	45

2.12.2. Research Extension Centre, Hosur

Table 2.12. New technologies or R&D initiatives disseminated in the field by REC, Hosur during XI Five Year Plan (2007- 2011)

Name of Technology/Process/ R&D Project	Method of Technology Transfer (I.e. On field Demonstration, Training etc.	Approx No. of farmers benefitted till date	Comment on overall acceptability of these technologies by the beneficiaries	Impact of the technology on Productivity & Quality
Importance of Soil testing and soil sampling methods for soil analysis	On field demonstration by soil sampling	582	Level of acceptability is about 60%	After soil testing recommended dose of fertilizer and organic inputs applied in mulberry field increased the productivity of mulberry leaf and cocoon production and also maintain the soil fertility status.
High yielding Mulberry variety-VI	By training and on extension communication programme	1250	Level of acceptability is about 100%	Mulberry variety-VI yield more leaves and better quality for silkworm feeding which leads to increase of cocoon yield and its quality.
INM packages in Mulberry-Bio fertilizer application/Bio composting/Vermi composting	On field demonstration and Training	475	Level of acceptability is 50%	Availability of FYM difficult now a days. To overcome this situation, application of Bio fertilizers/ Bio composting/ Vermin composting are adopted by the farmers to maintain the quality of mulberry leaf and reduce drudgery and soil health status.
Root rot control in mulberry by Chetak/Navinya	On field demonstration and Training	210	Level of acceptability is about 100%	Root rot disease incidence was reduced from 50 to 75 % in mulberry over control.
IPM packages in mulberry	On field demonstration and Training	702	Level of acceptability is about 70%	Tukra, leaf webber and thrips incidence were reduced from 15%, 12% and 7% to 6%, 4% and 2% respectively and increased leaf yield of 5.3%.
Application of mulberry tonic Poshan to control micronutrient deficiency	On field demonstration and Training	205	Level of acceptability is about 100%	No yellowing of leaf and leaf yield improvement was about 6.5 to 7.3% in mulberry.
Silkworm rearing technology: Disinfection of rearing houses/Shoot	On field demonstration and Training	890	Level of acceptability is about 70%	Crop success and cocoon yield (kg) was improved over bench mark. Defective cocoon % was reduced to <5% and Cocoon quality was

rearing practices/Use of bed disinfectants				improved which leads to better market price to the farmers.
Control of Uzi fly by biological methods/Uzi traps	On field demonstration and Training	1122	Level of acceptability is about 60%	Uzi fly incidence was reduced from 11.8 to 4.5 and cocoon yield 9.3% was increased over control.

Table 2.13. Training programs undertaken during XI Five Year Plan

Year	Total Trainings/Demonstration Conducted (Nos.)	Total Participants (Nos.)	SC participants (Nos.)	ST participants (Nos.)	Female Participants (Nos.)
2007-08	30	840	30	28	26
2008-09	25	1612	32	27	20
2009-10	39	928	26	29	10
2010-11	94	2943	30	19	122
2011-12	89	3292	26	24	131

2.12.3. Research Extension Centre, Krishnagiri**Table 2.14. Important new technologies or R&D initiatives disseminated in the field by REC Krishnagiri during XI Five Year Plan (2007- 2011)**

Name of Technology/Process/ R&D Project	Method of Technology Transfer (I.e. On field Demonstration, Training etc.	Approx No. of farmers benefitted till date	Comment on overall acceptability of these technologies by the beneficiaries	Impact of the technology on Productivity & Quality
Integrated Nutrient Management (INM in mulberry)	Training	125	Training improved the skill of the beneficiaries	Improved the cocoon yield from 55kg/100 Dfls to 69.3 kg/100 Dfls
Integrated pest Management (IPM)	-do-	30	-do-	-do-
Chawki Rearing	-do-	10	-do-	-do-
Disinfection & Disease Management	-do-	75	-do-	-do-
Mulberry cultivation & Disease Management	-do-	60	-do-	-do-

Table 2.15. Training programs undertaken by REC Krishnagiri during XI Five Year Plan

Year	Total Trainings/Demonstration Conducted (Nos.)	Total Participants (Nos.)	SC participants (Nos.)	ST participants (Nos.)	Female Participants (Nos.)
2007-08	Nil	Nil	Nil	Nil	Nil
2008-09	Nil	Nil	Nil	Nil	Nil
2009-10	Nil	Nil	Nil	Nil	Nil
2010-11	12	165	NA	NA	57
2011-12	9	135	NA	NA	33

2.13. Feed Back Received from Users or beneficiaries of CSR & TI, Mysore**2.13.1. Anantpur, Mysore****Table 2.16. New sericulture R&D technologies adopted during XI Plan**

Year	Name of Technology/Process/Product/Best Sericulture Practice adopted	Implemented by CSB/DOS/NGO/Others	Whether Beneficial (1=Yes 2=No)	Impact on sericulture yield/productivity/Quality or other benefits
2010-11	CSS:2109 Plant diseases & control measures	CSB	1	Quality of leaf yield has improved. Plant diseases like Tukra have reduced
	Plant Diseases & management	CSB	1	Papaya Milieu bug is controlled
2011-12	CSS 2110: Group Discussion	CSB	1	Knowledge sharing mostly Disinfection

CHAPTER III

EVALUATION OF R&D ACTIVITIES OF CENTRAL SERICULTURE RESEARCH & TRAINING INSTITUTE (CSR&TI), BERHAMPORE DURING XI PLAN

3.1. Introduction

CSR&TI, Berhampore, has been rendering outstanding research, development, technical, technological, extension and service support through its four Regional Sericultural Research Stations (RSRSs) at Kalimpong (WB), Koraput (Odisha), Ranchi (Jharkhand) and Jorhat (Assam) and 14 nested units of which 12 Research Extension Centres (RECs) at Nabagram (Murshidabad) & Mothabari (Malda), West Bengal, Rangpo (Sikkim), Deogarh (Odisha), Singhanpur (Chhattisgarh), Gumla and M.P.Raj (Jharkhand), Agartala (Tripura), Dimapur (Nagaland), Shillong (Meghalaya), Imphal (Manipur) and Aizawl (Mizoram) and two Research Extension Centres sub-units (REC-SUs) at Bhandra and Rajmahal (Jharkhand), besides, generating expertise in mulberry sericulture through its various Human Resource Development programmes. The highlight of research activities are in the areas of (a) Mulberry Crop Improvement and Production, (b) Mulberry protection, (c) Silkworm improvement, (d) Transfer of Technology and (e) Cluster promotion programmes.

3.2. R&D Projects and Transfer of Technology by CSR & TI Berhampore

Table 3.1 provides details regarding the status of R&D projects undertaken by CSR & TI Berhampore during XI Plan. It may be noted from **table 3.1** that a large number of R&D Projects have been undertaken by the CSR & TI Berhampore during XI Plan. Many projects are still in progress. It may also be noted that 19 new technologies developed by CSR & TI Berhampore have already been transferred to field during XI Plan.

Table 3.1. Number of Projects undertaken by the CSR & TI Berhampore during XI Five Year Plan

Year	Number of Projects	Status of project		
		Completed	Work in Progress	Technology Transferred (Lab to Land initiative)
2007-08	50(Proj.36, Prog.14)	13(Proj.12 Prog.1)	37(Proj.24,Prog.13)	9
2008-09	38(Proj.23, Prog.15)	10(Proj.6, Prog.4)	28(Proj.17, Prog.11)	3
2009-10	31(Proj.20, Prog.11)	12(Proj.8, Prog.4)	19 (Proj.12, Prog.7)	5
2010-11	37(Proj.15, Prog.22)	10(Proj.6, Prog.4)	27(Proj.9, Prog.18)	2
2011-12	49(Proj.14, Prog.35)	10(Proj.2, Prog.8)	39(Proj.12, Prog.27)	3 Will be disseminated in XII plan

Source: Field Survey of CSR & TI Berhampore

3.3. Source of Funds and R&D Expenditure during XI Plan

Major sources of funds for the R&D projects are the plan funds received from CSB. The CSR&TI Berhampore also received nominal funding from State Government and other sources as well (**Table 3.2**). Total expenditure of all the R&D projects during the first year XI plan was reported at Rs. 1197 lakhs which increased to Rs. 2591 lakhs by 2011-12. It may be noted that the R&D expenditure more than doubled during the XI Plan period.

Table 3.2. Sources of Funds and Expenditure on R&D Projects by CSR & TI Berhampore

Sl. No	Source of Grants/Funds/Sponsors	Approximate Annual Funding (In Lakhs)				
		2007-08	2008-09	2009-10	2010-11	2011-12
a)	State Government (DST, West Bengal)					5.29
b)	CSB					
c)	Industries					
d)	International Bodies					
e)	Others (Specify) DBT			6.68	3.99	13.42
	Total Funding					
	Total Expenditure	1196.99	1853.77	2122.35	2307.76	2591.27

3.4. Patents and Research papers published

Table 3.3 provides details regarding the patents applied and awarded during XI Plan. It may be noted that five patents were applied by the scientists whereas three patents were awarded during XI Plan.

Table 3.3. Number of Patents applied and awarded during XI Plan

Year	No. of Patents Applied (Nos)	No. of Patents Awarded (Nos)
2007-08	1. Silkworm egg box	Silkworm egg box Labex Light weight rearing tray
2008-09	2. Labex	
2009-10	3. Sericillin	
2010-11	4. Light weight rearing tray	
2011-12	5. Uzi trap	

It may be seen from **table 3.4** that the total number of research papers published are 250 in national and international journals during XI Plan period.

Table 3.4. Number of Research papers published during XI Plan

Year	No. of Research Papers published (Nos)
2007-08	44
2008-09	40
2009-10	42
2010-11	51
2011-12	73
Total	250

3.5. Achievements during XI Plan

- i. High Yielding Mulberry Variety, C-2038 has been found to be highly suitable for the alluvial gangetic plains (under irrigated conditions) with a productivity of 54-56 mt/ha/yr, which is 27% higher than the existing ruling variety (S1635).
- ii. For the Acidic soils of the hills and foot hills of West Bengal and similar regions, Tr-23 has been identified as a highly promising variety with a leaf yield of 14-15 mt/ha/yr over the ruling variety BC₂ 59 (9-10 mt/ha/yr), reflecting an yield gain of 50%. In the foot hills, Tr 23 is yielding 24-25 mt/ha/yr over the ruling BC₂ 59 (18-20 mt/ha/yr) (with a gain of 25%).
- iii. A highly promising flood tolerant variety (C2028) has been developed and is under extensive popularization.
- iv. To maintain the soil health and fertility status, a ready reckoner for Sulphur application is developed by Soil Test based targeted yield approach for a balanced use of fertilizer to optimize the quality mulberry leaf production per unit area.
- v. Package for increasing mulberry leaf yield through Integrated Nutrient Management for the farmers of rainfed area has been developed.
- vi. For increasing mulberry leaf yield under rainfed condition an anti-transparent KCl (1%) has been validated at farmers' level and found to be highly effective.

- vii. The season and region specific silkworm breeds/hybrids and appropriate rearing packages are being widely popularized for enhancing cocoon productivity
- viii. The Pest Management Technologies that were developed for the control of major mulberry pests are being widely popularized at farmers' fields, so as to avert pest outbreaks and huge crop losses.
- ix. The Disease Management Technologies that were developed for the control of major silkworm diseases are being widely popularized at farmers' fields, so as to avert disease outbreaks and huge crop losses.
- x. During XI plan, Extension Communication Programmes viz., Resham Krishi Mela (RKM), Field Days, Exhibitions, Awareness Programmes (AW), Audio-Visual (AV), Farmers Field School and Trainers' Training Programme were taken up for transfer of technology and a total of 55,449 farmers were trained / sensitized.
- xi. Under HRD programme, 1814 personnel have been trained under various structured and non-structured courses about the modern sericulture technologies developed by the institute.

3.6. Training Programmes Organized

Table 3.5. Training Programmes conducted during XI Five Year Plan (Under CSS 2101)

Year	No. of Training Programme	Total no. of Participants
2007-08	14 (PGDS-1, Capsule-5, Short term-3, Special-3, Adhoc-1, Farmers exposure-1)	297 (PGDS-42, Capsule -79, Short term – 16, Special-41, Adhoc-42, Farmers – 77)
2008-09	14 (PGDS-1, Capsule-7, Short term-2, Special-1, SUP-1, Adhoc-1, Farmers exposure-1)	239 (PGDS-48, Capsule -60, Short term – 05, Special-45, SUP-20, Adhoc-12, Farmers – 49)
2009-10	08 (PGDS-1, Capsule-1, Short term-2, CSS-1, SUP-1, Adhoc-1, Farmers exposure-1)	175 (PGDS-31, Capsule -05, Short term – 09, CSS-9, SUP-15, Adhoc-23, Farmers – 83)
2010-11	16 (PGDS-1, MDP-5, SUP-6, Special-3, Farmers exposure-1)	582 (PGDS-39, MDP-110, SUP-205, Special-90, Farmers –138)
2011-12	14 (PGDS-1, MDP-5, SUP-6, Farmers exposure-1, ISDS -1)	521 (PGDS-46, MDP-179, SUP-270, Farmers –11 & ISDS - 15)

3.7. IT Initiatives

Table 3.6: Details of IT Initiative undertaken to propagate new technologies developed by R &D institute during XI Five Year Plan (Under the CSS – 2112)

Sl. No	New Technology Developed	IT Initiative details	Whether successful (1=yes 2=No)	Please explain the Impact
1.	Computerization	Old and outdated computer systems were replaced with the new one	1	Computers became faster & more reliable and trouble free. Able to use latest software.
2.	Networking	Local Area Network is extended.	1	Computers became free from virus and resources were shared effectively
3.	KIOSK Hardware and Software	KIOSK machine with contents in Bengali Language is installed.	1	Information available in the KIOSK Machine is useful to the stake holders.
4.	Website	Forewarning and forecasting of mulberry disease and pest of mulberry in the institutes website for general information and taking up possible control measures by the field functionaries.	1	Forewarning calendar information helped the farmers to the great extent to take precautions.

3.8. Extension Communication Programme

To disseminate technologies, educate and train the farmers on different aspects of improved mulberry cultivation and silkworm rearing practices/technologies developed by the Institute, different extension programmes were taken up and more than 14694 farmers/seri-stakeholders participated in the Krishimelas, Field Days, Awareness & A-V Prog., visited exhibition and gained knowledge on different improved sericulture technologies:

Table 3.7. Extension activities organized during XI Plan

Sl. NO.	Activity organized	Nos.(Nos. of farmers)
1	Resham Krishi Mela	5 (1,259)
2	Audio-visual programme	51 (2435)
3	Field Day	51 (2516)
4	Exhibition	53 (3406)
5	Awareness programme	62 (2698)
6	Farmers' & Trainers' Training programme	62 (2380)

3.9. Human Resource Development

Various HRD programmes were organised for Transfer of Technology in view of sustainable development of sericulture. Regular training was imparted to the farmers/participants on different activities of sericulture, such as, mulberry cultivation, silkworm rearing technologies, disease & pest management etc., developed by the Institute.

3.10. Field Survey Findings from Research Extension Centres

Table 3.8. Research & Development projects by REC, Nabagram

Area of Research	Name of the Projects taken up	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective
Improvement in soil health and fertility	Popularization of Soil test based Fertilizer application	Ongoing	5.66% improvement in leaf yield
	Validation of Sulphur fertilizer application	Concluded	10.77% improvement In leaf yield

Table 3.9. Research Extension Centre, Mothabari, Malda

Name of Technology/Process/ R&D Project	Method of Technology Transfer (1.e. On field Demonstration, Training etc.	Approx No. of farmers benefited till date	Comment on overall acceptability of these technologies by the beneficiaries	Impact of the technology on Productivity & Quality
Use of Sericilline as bed disinfectant	Through demonstration	155	The technology accepted by the beneficiaries	Application of sericilline increases cocoon yield and avg. GOC of 9.35%. Exploitation required.
Planting of S 1635 in 2'x2' spacing	Through demonstration	60	Due to high leaf yielder variety is gradually exploiting.	High yielder than traditional mulberry variety with GOC of 8.76%
Rearing of M x Bi during unfavorable season (Bhaduri crop)	Through demonstration	5	Gradually beneficiaries changing their old concept(M x M) rearing	Average yield/100 dfls of MxBi is higher than traditional M x M combination

Vermicompost	Through demonstration	68	Although the technology is likely to be beneficial but not interested to prepare permanent pit & its cover for want of Govt. subsidy.	Application of Vermicompost enhances leaf yield with GOC is 9.0%.
Rearing package	Through field demonstration	80	The technology is accepted by the beneficiaries.	Acceptance of the technology as a whole increases quality cocoon production with GOC is 11.90%.
Shelve Rearing	Through demonstration	24	The technology is accepted by the beneficiaries but due to lack of enough rearing space most of the beneficiaries (marginal) not able to prepare the shelve.	Shelve Rearing technology increases quality cocoon yield with a gain of 7.14% over the control.

Table 3.10. R&D activities of REC, Maheshpur Raj, Dist: Pakur, Jharkhand

Name of Technology/Process/ R&D Project	Method of Technology Transfer (I.e. On field Demonstration, Training etc.	Approx No. of farmers benefitted till date	Comment on overall acceptability of these technologies by the beneficiaries	Impact of the technology on Productivity & Quality
MOE-3396: Technology assessment through institute Village Linkage Programme (Phase-II(2007-2010).	Technical supervision /demonstration advice at farmers level for implementation of the project. (Pertaining to this unit only)[Door to door]	50 IVLP farmers + 70 general farmers	Package of practices of mulberry (e.g. improved mulberry variety, recommended fertilizer dose, manure, Biofertiliser, disease control measure etc.) and that of silkworm rearing(improved silkworm race/ combination, disinfection of rearing house incubation, black boxing, use of labex for control of silkworm diseases etc.) has been adopted by the farmers more or less	Sustainable productivity is maintained by the farmers

Programme: Technology assessment through institute Village Linage Programme (Phase-II)(2010-2013)	-do-	-do-	-do-	-do-
CSS-2107: Development of forecasting, forewarning and system of mulberry diseases.	Our part is Survey and collection of data of mulberry diseases from framers field as per schedule	9 farmers	This unit forwarded the report (collected data) to CSR&TI, Berhampore for compilation ad analysis. Further farmers will be forewarned about the diseases well in advance.)	Protect the crop and benefitted from crop loss.
Popularization of soil test based ready reckoner for NPK fertilizer application for mulberry under ToT programme. (2010-11,11-12)	On the basis of soil analysis report i.e. soil test based NPK doze applied. Recorded leaf yield, green leaf wt. & submitted data to CSR&TI, Berhampore(W B) for overall compilation and analysis	Experiment under continuation (3 farmers)	Experiment under continuation	Experiment under continuation
Testing of newly developed silkworm hybrid at farmers' level. (2010-11,11-12).	Technical supervision /Demonstration advice at farmers level for implementation of the programme (limited scale)	Experiment at 3-4 farmers house	This unit forwarded the report (collected data) to CSR&TI, Berhampore for overall compilation and analysis.	Sustainable productivity is observed at the farmers level
Demonstration of silk worm corp protection measure (with Sericillin) (2010-11)	Technical supervision/De monstrationadvice at farmers level for implementation of the project. (Pertaining to this unit only)[Door to door]	Experiment at 10 farmers house	This unit forwarded the report (collected data) to CSR&TI, Berhampore for overall compilation and analysis.	Sustainable productivity is observed at the farmers level

Table 3.11. Training programs of REC, Maheshpur Raj, Dist: Pakur, Jharkhand during XI Five Year Plan

Year	Total Trainings/ Demonstration Conducted (Nos.)	Total Participa nts (Nos.)	SC participants (Nos.)	ST participants (Nos.)	Female Participants (Nos.)
2007-08	5	25	--	--	--
2008-09	5	32	--	--	--
2009-10	5	87	--	--	--
2010-11	5	129	--	--	--
2011-12	3	151	--	--	--

Table 3.12. R&D activities of REC Shillong during XI Plan

Name of Technology/Process/ R&D Project	Method of Technology Transfer (1.e. On field Demonstration, Training etc.	Approx No. of farmers benefitted till date	Comment on overall acceptability of these technologies by the beneficiaries	Impact of the technology on Productivity & Quality
TAR through IVLP-	On field Demonstration, Training, supply of disinfectants, biofertilizers, etc	50	Farmers are accepting the technology and are benefited from such programme	Had increase the knowledge in technology adopted in sericulture and had help to improve productivity
Demonstration of Silkworm Crop Protection measures with Sericillin.	On field Demonstration, Training, supply of disinfectant	20	Farmers are accepting the technology and are benefited from such programme	The use of Sericillin is very useful in crop protection especially during chawki rearing gaining by 15 %.
Promotion of Vermicompost.	On field Demonstration, Training	10		Farmers under going in this programme are highly motivated by the yield they obtained after application of compost
Testing of Rearing package.	On field Demonstration, Training,	50		Using proper rearing appliances really help to gain more cocoon production than traditional practice
Soil test Fertilizer Application.	On field Demonstration, Training, soil test at CSB Institute	15		After soil test, and application of NPK as per recommendation leaf yield had increase tremendously due to healthy plant

	and recommendation			
Bivoltine seed cocoon generation programme	On field Demonstration, Training, supply of seed & disposal	40		Farmers have been benefitted by supplying their cocoon at higher rate to outside State
Expansion of new mulberry acreage	On field Demonstration, Training, supply of saplings through DOS	25		More than 62.5 acres of mulberry acreage have been expanded through this programme with new plantation
Testing of newly developed multi x bi and bi x bi hybrids	On field Demonstration, Training, supply of dfls	12		Under evaluation stage

Table 3.13. Training programs undertaken by REC Shillong during XI Plan

Year	Total Trainings/Demonstration Conducted (Nos.)	Total Participants (Nos.)	SC participants (Nos.)	ST participants (Nos.)	Female Participants (Nos.)
2007-08	12	410		410	85-90%
2008-09	14	432		432	85-90%
2009-10	12	425		425	85-90%
2010-11	18	682		682	85-90%
2011-12	20	775		775	85-90%

Table 3.14. New Sericulture R&D technologies adopted by beneficiaries under REC, Banjetia, Murshidabad, Berhampore

Year	Name of Technology/Process/Product/Best Sericulture Practice adopted	Implemented by CSB/DOS/NGO Others	Whether Beneficial (1= Yes 2= No)	Impact on sericulture yield/productivity / Quality or other benefits
2007-08	S1635, 2'x2', FYM, Nitrofert, Phosphofert, Reduced Chemical fertilizer, Vermicompost, PGR, Irrigation, Disease-Pest Management	CSB	1	Mulberry leaf and Cocoon yield was enhanced with better quality, leading to enhancement in income.
2008-09	S1635, 2'x2', FYM, Nitrofert, Phosphofert,	CSB	1	Mulberry leaf and Cocoon yield was

	Reduced Chemical fertilizer, Vermi-compost, PGR, Irrigation, Disease-Pest Management			enhanced with better quality, leading to enhancement in income.
2009-10	S1635, 2'x2', FYM, Nitrofert, Phosphofert, Reduced Chemical fertilizer, Vermi-compost, PGR, Irrigation, Disease-Pest Management	CSB	1	Mulberry leaf and Cocoon yield was enhanced with better quality, leading to enhancement in income.
2010-11	S1635, 2'x2', FYM, Nitrofert, Phosphofert, Reduced Chemical fertilizer, Vermi-compost, PGR, Irrigation, Disease-Pest Management	CSB	1	Mulberry leaf and Cocoon yield was enhanced with better quality, leading to enhancement in income.
2011-12	S1635, 2'x2', FYM, Nitrofert, Phosphofert, Reduced Chemical fertilizer, Vermi-compost, PGR, Irrigation, Disease-Pest Management	CSB	1	Mulberry leaf and Cocoon yield was enhanced with better quality, leading to enhancement in income.

Table 3.15. New Sericulture R&D technologies adopted by beneficiaries under REC, Deogarh, Berhampore

Year	Name of Technology/Process/Product/Best Sericulture Practice adopted	Implemented by CSB/DOS/NGO/Others	Whether Beneficial (1= Yes 2= No)	Impact on sericulture yield/productivity/Quality or other benefits
2007-12	High yielding Variety C 1730	CSB	1	Cocoon yield has improved by 5- 6 %
	Chawkie Worms supplied in time	DOS	1	Rearing starts in time and uniform variety received.
	Advance technology for late age rearing	CSB	1	Yield increase and controls disease.

	Use of Biofertiliser instead the chemical fertilizer	CSB	1	Leaf yield gain achieved from 10-14 %
	Use of bed disinfectant	CSB and DOS	1	Yield has increased.
	Timely crop inspection	CSB & DOS	1	Awareness and skill on rearing has improved. Better yield.

Table 3.16. Details regarding the new sericulture R&D technologies adopted by REC, East Khasi Hills, Shillong

Year	Name of Technology/Process/Product/Best Sericulture Practice adopted	Implemented by CSB/DOS/NGO/Others	Whether Beneficial (1=Yes 2=No)	Impact on sericulture yield/productivity/Quality or other benefits
2010-11	IVLP	CSB	1	Increased production
2011-12	Vermi import	CSB	1	Leaf yield & increase

CHAPTER IV

EVALUATION OF R&D ACTIVITIES OF CENTRAL SERICULTURE RESEARCH & TRAINING INSTITUTE (CSR&TI), PAMPORE, DURING XI PLAN

4.1. Introduction

CSR&TI, Pampore, Jammu & Kashmir, is a pioneering Institute in the field of temperate and sub-tropical Sericulture in North Western India. The Institute has been catering to the needs of the silk industry by consistent R&D and extension activities through its wide spread network of RSRs, RECs and CDCs located in the states of J&K, Himachal Pradesh, Punjab, Haryana, Uttarpradesh, Uttarakhand and Rajasthan. It has nested under it two Regional Sericultural Research Stations (RSRs) at Jammu (J&K), 13 Research Extension Centres (RECs) at Y.K.Pora, Gorakhpur, Chhmalpur, Gonda, Fatehnagar, Ghumarwin, Naduan, Una, Sujampur, Udham Singh Nagar, Bageshwar, Nowshera, Barnoti with five sub units of the RECs Tikri, Bandipora, Tral, Bhadrasi, Panchakula. Further, five of the centres viz., Tral (J&K), Bandipora (J&K), Tikri (J&K), Nowshera (J&K) and Kalsi (Uttarakhand) are functioning as Cluster Development Centres (CDCs).

Major research focus areas are (a) Mulberry Improvement, (b) Mulberry production, (c) Crop protection (d) Silkworm Improvement, (e) Gene pool and (f) Seed production.

4.2. R&D Activities of CSR&TI Pampore

As a result of the impact of technology on pruning and leaf harvesting, about 20% improvement in leaf yield has been recorded across all the test sites in North India during the year 2011-12. **Table 4.1** provides details regarding the number of R&D projects undertaken during XI Plan and the status of each project.

Table 4.1. Details regarding R&D Projects during XI Plan

Year	Number of Projects	Status of project		
		Completed	Work in Progress	Technology Transferred (Lab to Land initiative)
2007-08	30	06	24	OFT: 06
2008-09	27	07	20	OFT: 05
2009-10	24	03	21	OFT: 03; TOT: 02
2010-11	29	05	24	OFT:06; TOT:03
2011-12	30	03	27	OFT:06;TOT:03

Table 4.2. Research & Development projects undertaken by CSR & TI Pampore and its nested units during XI Plan

Area of Research	Name of the Projects taken up	Amount sanctioned in the area of research (Rs Lakhs)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers benefitted from the project
1	2	3	4	5	6
Development of high yielding silkworm breeds and their food plants (Mulberry & Vanya silk host plants)	Breeding of early sprouting and high yielding variety(ies) amenable to propagation by stem cuttings and high survival ability for rainfed cultivation in Kashmir and other temperate regions of North (PIB 3392)		Completed	11 selections were shortlisted based on Average Evaluation Index. Many of them obtained higher leaf yield/plant as compared to Chinese white and Rokokuyaso and at par with popular mulberry genotype Goshorami, besides the 11 genotypes are good rooters.	Before releasing the sections to farmers, these 11 genotypes will be put up for further tests by laying out multilocation al trials. Three out of eleven selections are undergoing MLT.
	Identification of region specific mulberry varieties for different eco zones of Jammu Division (J&K STATE) Project Code: PIE-3397	42.55	Completed	Genotype Chak Majra was found an ideal genotype which could remain suitable for wide range of environment.	Process is on to put the variety on large scale exploitation.
	Assessment of mulberry genotypes as trees brought from other states (OFT)- SAHASPUR (SAH CP 6)		Completed	During the study, it was recommended that mixed plantation of V1, RFS175, S146 and Br-2 is an ideal combination for farmers.	The technology is being transferred to respective DOS

	Evaluation of superior genotypes under Jammu conditions (PIE 3398)		Completed	Nursery evaluation technique for preliminary selection of genotypes under sub-tropical conditions of Jammu was developed by using joint scoring technique. The performance of LC-8 was found to be at par with S146.	Efforts are being made to popularize the technology and has been used in MBG section of CSR&TI, Pampore
	Evaluation of promising mulberry genotypes in different eco-zones of Himachal Pradesh (SAHASPUR)-MLT (PPA 3389)		Completed	Alongwith. S-1365 and S-146, the other genotypes Tr-10, S-34, S-13 and S-1 have been found good for different eco-zones of H. P.	
	Evaluation of elite mulberry genetic resources for biotic and abiotic stress under in hot spot locations (PAMPORE) PIE 3170	Collaborated with CSGRC, Hosur	Completed	Among the 13 varieties received from CGRC, Hsour, ME-0210, ME-0211 and ME-0182 and control Tr-10 recorded more than 20 tons leaf yield per hectare.	
	Evaluation of elite mulberry genetic resources for biotic and abiotic stress under in hot spot locations (SAHASPUR PIP 3256	Collaborated with CSGRC, Hosur r	Completed	No one genotype among the 13 received from CSGRC, Hsour have surpassed the local chak S-146, however, UP-22 and ITI-1 were found at par with S-146 statistically.	
	Acquisition, Conservation, Characterization and Utilization of mulberry germplasm under temperate conditions. (Pampore)		On-going (Continuous)	Out of 76 genotypes of mulberry maintained in mulberry gene pool bank, 70 are being evaluated for different traits. The evaluation is to promote utilization, classification of mulberry and subsequent utilization in breeding programme.	A catalogue entitled "Catalogue on temperate mulberry germplasm" has been popularized.
	Evaluation of F1 selections of mulberry (Morus spp.) for their suitability under various eco-zones of temperate conditions of Jammu & Kashmir.		On-going	The study has been taken up for identification of mulberry genotype suitable under the varied eco-zones of temperate conditions of Kashmir.	The guideline has been taken up at three sites in Kashmir division under MLT.
	Maintenance and characterization of mulberry germplasm (SAHASPUR) PIB 3212		On-going (Continuous)	82 mulberry genotypes are being maintained in the mulberry gene pool bank of RSRS, Sahaspur and are being evaluated for different parameters.	

Maintenance of silkworm germplasm (PAMPORE) AIE 3056		On-going	165 bivoltine silkworm races are being maintained at CSR&TI, Pampore and are being evaluated for different traits. The evaluation is to promote utilization, classification of mulberry silkworm and subsequent utilization in breeding programme.	
Maintenance and evaluation of silkworm germplasm (SAHASPUR) [AIB-2016]		On-going	46 bivoltine silkworm races are being maintained at RSRS, sahaspur and are being evaluated for different traits. The evaluation is to promote utilization, classification of mulberry and subsequent utilization in breeding programme.	
Maintenance of silkworm Breeders' stock. (PAMPORE)- AIE 3202		On-going	10 bivoltine races are being maintained as breeds stock	
Maintenance of silkworm Breeders' stock. (SAHASPUR)		On-going	16 bivoltine races are being maintained as breeds stock	
Maintenance of Breeders stock JAMMU		On-going	07 bivoltine races are being maintained as breeds stock	
Introduction of silkworm hybrid RSJ3 x RSJ1 (TOT-Jam)		On-going		
Introduction of silkworm hybrid Dun17 x Dun18 (OFT-Pam8)		On-going		
Evaluation of five mulberry genotypes as trees under different locations (OFT-Pam3)		On-going	To identify suitable genotype (S) among five improve genotypes as trees under different locations of temperate region.	
Evaluation of identified bivoltine silkworm hybrids for summer and monsoon rearing (OFT_ Sahaspur) OFT-Pam-7		On-going	The study is being taken to study the sustained of bivoltine sericulture in different parts of the state including Doon valley and accordingly season specific hybrids will be prepared.	
Improvement of silkworm <i>Bombyx mori</i> L. (Col. Proj. Pam/Jam/Sah) [AIB-		On-going	Evaluation of high yielding silkworm breeds suitable for rearing under sub-optimal/poor	

	Pam-1]			conditions.	
	Evolution of BmNPV tolerant bivoltine breeds of silkworm <i>Bombyx mori</i> L. (AIB-3475)		On-going	Breeding of BmNPV tolerant bivoltine silkworm breeds for temperate and sub-tropical areas and identification of suitable bivoltine hybrids for utilization in the field to improve the cocoon productivity for the sustainable sericulture in North India.	
	Evaluation of elite bivoltine silkworm germplasm under different climatic conditions (AISGEP Phase-II) Pam/Jam/Sah		On-going	Identification of suitability of bivoltine silkworm germplasm for specific agro-climatic area. To identify the potential germplasm as parent for silkworm hybridization programme suitable for different agro-climatic conditions.	
Improvement in health and fertility	On farm trial of genotypes in sodic soil (OFT)-SAHASPUR		Completed	The plantation of AR-14, AR-12, S-1635, BR-2 and S-13 was done at REC, Badrasi and shall serve as stock plantation for further multiplication by REC.	
	To study the effect of biofertilizers applied in nursery on the growth and yield of mulberry under field conditions (OFT)-PAMPURE	-	Just Completed	The saplings inoculated by biofertilizers at nursery level can enhance the leaf yield from 4000 to 7000 kg / hectare after transplanting them in field. .	The technology has been transferred to the DOS.
	Identification, characterization and popularization of Local strains of nitrogen fixing bacteria in integrated Nutrient management system for mulberry grown in soils Of Dehradun area (SAHASPUR)- PIP 3404		Just completed	Three strains of nitrogen fixing bacteria have been isolated and purified from the soils of mulberry garden. Out of these strains, one fast growing efficient strain, which can multiple at wide range of temperature, has been identified as <i>Stenotrophomonas maltophilia</i> .	The same is under perseveration and will be utilized for preparation of region specific nitrofert biofertilizer.
	Soil assessment studies of mulberry farms/fields in		On-going	The present study is to study the status of soil	

	Jammu province (CSS)			under mulberry farming in Jammu province.	
	Nutrient analysis of soils and mulberry plantation under temperate conditions (SS-Pam-1).		On-going	The present study is to study the status of soil under mulberry farming in Kashmir valley.	
	Chemical analysis of soils and mulberry plantation under temperate conditions (SS-2105)		Completed	pH is high in autumn as compared to spring.	
Cultivation practices	Unified package of practices for mulberry cultivation under rainfed conditions in North India (PPA3200)	81.58	Completed	Region wise package of practices for mulberry tree cultivation has been developed	Transfer of technology is in progress
	Multiplication of stock of the screened mulberry genotypes at DOS locations for plantation in tree mode by DOS-SAHASPUR (OFT)		Completed	Nursery of elite mulberry genotypes S1635 and S146 were raised and supplied to DOS Uttarakhand for further multiplication and supply to farmers	
	Package of practices for mulberry cultivation on sloppy land in hilly areas of Uttarakhand (PPA3287)		Completed	Package of practices for mulberry tree plantation has been developed for sloppy land areas.	
	Studies on the effect of organic farming on the bush and tree type plantation of mulberry in Doon valley (PPA-3389)		Completed	It was found that by continuously adopting whole organic package of practices of mulberry cultivation, the leaf yield improved 18.07% besides, improvement in the quality of mulberry leaves and the package of practices of tree and bush type of plantations have been developed for Doon valley.	
	Mulberry tree cultivation in North India (TOT) PPR-02	72.398	Just completed	Transfer of technology with regard to Package of practices for tree cultivation in North India has been given to 40 farmers under 02 RECs under temperate conditions and 50 farmers under sub-tropical conditions.	The technology has also been demonstrated before the staff of DOS for its further transfer.
	Vermicomposting technology for organic farming under Jammu conditions (OFT)-PPR-03		On-going	Vermeries have been prepared at farmers places of Nowshera, Sujampur, Barnoti and Tikri and technology	

				with regard to production of vermicompost will be demonstrated to farmers.	
	Pruning and leaf harvesting technology for mulberry trees under sub-tropical conditions of North India (TOT) PPR-01		On-going	The technology is being transferred to 50 farmers in Jammu and Sahaspur.	
	Technology for application of fertilizers for scattered mulberry trees (TOT) [OFT-Pam-4]		On-going	Technology with regard to application of fertilizers for scattered tree type of plantation is being transferred to 30 farmers under temperate conditions.	
Development of disease management and disease forecast forewarning systems	Disease control in silkworm and improvement in cocoon yield through dietary supplementation of inorganic tissue salts at farmers level (OFT)-SAHASPUR		Completed	An increase of 17 to 29% cocoon yield was recorded in organic tissue salts supplemented batches of silkworm compared to control	
	Studies on bionomics and management of termites infesting the mulberry plant in Jammu region		Completed.	Survey observation for extent of seasonal loss and damage by termites has been recorded. Overall 10 termite species have been found in mulberry gardens and old trees.	-
	Integrated management of mulberry pests and diseases in Kashmir Division (PPE-3320)	26.37	Completed	Glyphodes pylolis was found to be the major pest incurring a loss of leaf yield in mulberry. The range of loss is from 6.11% in Kasuga to 27.02% in Chinese White. A number of diseases were also observed to cause damage to mulberry plants in a number of days.	Management of the pests and diseases of the mulberry were carried out through eco-friendly management by developing IPDM module. .
	Studies on population dynamics and management of Dermestid Beetles (collaborative)-ARE-3391		Just completed		

	Forecasting and forewarning of silkworm and mulberry pest and diseases (CSS)		On-going	The studies are being taken up with the object to record prevalence, severity and distribution of various mulberry and silkworm pests and diseases at different isolated agro-climatic regions and also to co-relate their incidence with environmental conditions to develop a model for forecasting of pests and disease incidence well in advance.	
	Validation of IPDM module for mulberry in Kashmir (OFT-Pam5)		On-going	To evaluate the IPDM Module in large scale at multiple locations and chalk out the economics of the module.	
Economic farming models & practices	Development of low cost rearing technology suitable for temperate conditions Kashmir region.	12.51	Completed	Mulberry silkworm rearing could be conducted in poly house without an adversity on quality and productivity of cocoons. Besides, during late age rearing, space may be increased by fabrication of rearing shelves from locally available materials.	
	Integration of sericulture with medicinal industries (SAHASPUR)-EFP		Completed	Intercropping of Plumbago, Cyperus, Asparagus, Andrographis and Acorus under 10' x 10' and Rauwolfia, Cyperus and Plumbago under 6' x 6' spacing of mulberry under tree system has been found suitable.	Efforts are being put to transfer the technology to farmers by DOS.
	Intercropping of medicinal and aromatic plants with mulberry for better economic returns under temperate and sub-tropical conditions of Jammu & Kashmir state.		Just completed	An additional income of Rs. 64,000/ha/yr can be made by intercropping of Lavender with tree type of mulberry cultivation under temperate conditions without having any significant effect on production and productivity of mulberry leaf. Under sub-tropical conditions, intercropping of Cympogen, CCN-5 can be taken up to generate additional income of Rs. 60,000/ha/yr.	OFT has been laid at the Institute and P4, BSF, Manasbal for its demonstration to the visiting farmers.

	Intercrop of lavender with mulberry (OFT-PAMPORE) OFT-Pam-2		On-going	To evaluate the efficacy of lavender as an intercrop with mulberry under farm conditions.	
Product development & diversification	Industrial exploitation of mulberry by-products in Jammu & Kashmir for sustainable Sericulture (JAMMU) [PIA-3364]		Completed	Technology for utilization of mulberry leaf for human consumption, technology for utilization of waste cocoons in handicraft industry and utilization of mulberry fruits in preparation of Jam, Jelly, Squash has been developed.	47 women members were given training in silkworm cocoon handicrafts technology. Training was also provided to women members of the Women societies for making Jam and Syrup.
IT initiative	Website developed and leased line installed.				
Any other (Please specify)	RACE AUTHORISATION PROGRAMME (PAMPORE, SAHASPUR)		On-going		
	PROVINCIAL RACE AUTHORISATION PROGRAMME (PAMPORE, SAHASPUR)		On-going		
	Women empowerment in North India through sericulture technologies (Ext. Project) Code: MOT-3460 (Pampore/Jammu/Sahaspur)		On-going	Impact of technologies adopted by women will be assessed by comparison of their knowledge before and after training of current sericulture technologies.	180
	All India Coordinated experimental trial for mulberry (AICEM) Phase-III (Pampore/Jammu/Sahaspur)		On-going	The trail is being carried out at 05 test centres in North India and the trail involves testing of 03 new entries namely C208, FTY/99-G4 and Suvarna-2 at three locations of Kashmir division and one location in Jammu division of J&K and at Sahaspur, Dehradun. At Sahaspur, Tr-23 is also being tested	

Table 4.3. Funding of R& D Projects and Expenditure during XI Plan

Sl. No.	Source of Grants/Funds/Sponsors	Approximate Annual Funding (In Rs. Lakhs)				
		2007-08	2008-09	2009-10	2010-11	2011-12
a)	State Government					
b)	CSB (under the R&D scheme)	194.33	231.95	361.39	472.00	443.08
c)	Industries					
d)	International Bodies					
e)	Others (Specify)					
	Total Funding					
	Expenditure	161.01	275.01	285.26	519.03	311.77

Table 4.4. Number of Research papers published during XI Five Year Plan

Year	No. of Research Papers published (Nos)
2007-08	RESEARCH PAPERS: 105 ; BULLETINS: 05
2008-09	RESEARCH PAPERS: 86 ; TECHNICAL WRITE UPS: 02 ; BOOKS: 02
2009-10	RESEARCH PAPERS: 92 ; BULLETINS: 08 ; BOOK CHAPTERS: 04 ; BOOKS: 01
2010-11	RESEARCH PAPERS: 111 ; BULLETINS: 04 ; BOOK CHAPTERS: 02
2011-12	RESEARCH PAPERS: 76 ; BOOK CHAPTERS: 08 ; BOOKS: 03

4.3. Training and Extension activities

The Institute and its RSRs imparted training to 461 DOS officials of J&K, Punjab, HP, Uttarakhand and UP states on various aspects of sericulture, moriculture and extension technologies. 768 farmers were trained during 2011-12 under 7 Farmers Field Schools. 140 beneficiaries have been trained in various skills under Integrated Skill Development Scheme (ISDS) of Ministry of Textiles, in seven batches in north India. Under the women empowerment programme in North India, 693 women farmers were trained. Apart from the regular training programmes, 1143 students/farmers were trained on various aspects of sericulture.

The Institute is having a network of 13 Extension Centres and 5 sub units spread over seven states and the extension services provided during XI Five Year Plan are given in **Table 4.5**.

Table 4.5. Extension Activities of CSR&TI, Pampore

Season	No. of DFLs reared	No. of farmers covered	Total Cocoon production (Kg)	Average Yield/100 DFLs (Kg)
Spring, 2011	121987	1838	50515.110	41.41
Summer 2011	5075	73	1501.453	29.59
Monsoon 2011	7085	100	2463.050	34.76
Autumn, 2011	53481	1198	14896.859	27.85
Total/Average	187628	3209	69376.472	

During the year 148 Group Discussions, 32 Awareness Programmes, 54 Film Shows, 55 Farmers Field Days and 19 Vichar Goshtis were conducted. Two Krishi Melas, Two workshops were also organized during the period. Study tours were conducted for farmers to Bangalore and Tamil Nadu.

It may be noted from **table 4.6** that CSR& TI, Pampore organized 118 training programmes and a total of 4424 participants took advantage of these training programmes.

Table 4.6 Training programmes and participants

Year	No. of Training Programme	Total no. of Participants
2007-08	19	429
2008-09	23	562
2009-10	18	480
2010-11	24	1084
2011-12	34	1869
Total	118	4424

Table 4.7 Initiatives Planned for the XII Five year Plan

Sl. No.	Name of the Initiative	Objectives / Targeted stake Holders
1.	Mulberry Production	
a	Long term	Mulberry cultivation technology suitable for different agro-climates of North India.
b	Short term	Under this initiative, following objectives are targeted: <ul style="list-style-type: none"> • Soil and rainwater conservation and management. • Recycling of farm residues to supplement soil nutrients like generating compost, vermin-compost, using bio fertilizers etc., • Mixed / inter-cropping and integrated framing system to be

		<p>developed;</p> <ul style="list-style-type: none"> Integrated nutrient management to be standardized for each state of North India depending upon soil nutrient status and cropping Pattern.
2	Mulberry Protection	
a	Long term	Detailed study to be taken up on different diseases, taking into account the virulence of different physiological/morphological types of spores noticed in the field
b	Short term	<ol style="list-style-type: none"> Prevalence, Severity and distribution of mulberry pests and diseases under different agro climatic conditions of North; Development of integrated pest and disease management.
3	Mulberry improvement	
a	Long term	<ul style="list-style-type: none"> Breeding studies on mulberry to be intensified to get the desired characters in the breed lines with regard to better growth, tolerance to drought, salinity, frost, pest & disease. Molecular characterization of different mulberry genotypes maintained in germplasm bank will be taken up. Re-orientation of the breeding approaches by effective utilization of biotechnology as a whole and integrating with conventional breeding so as to achieve the targeted goals.\ Biotechnological methods developed at different research institutes to be tried and incorporated at various levels of breeding.
b	Short term	<ul style="list-style-type: none"> Mulberry improvement for early sprouting, frost resistance and better rooting under temperate conditions; Mulberry improvement for resistance of drought and late senescence under sub-tropics with better water retention capacity in leaf.
4	Silkworm Cocoon Production	
a	Long term	<ul style="list-style-type: none"> Identification and development of season and region specific silkworm breeds to increase the number of commercial cocoon crops in the North India. Quality linked cocoon marketing facilities in each state, emphasis on time bound green cocoon marketing. Diversification of mulberry as well as silk products for value addition to fetch extra income for the sericulturists. Strengthening of post cocoon sector in each state to utilize its cocoons for value addition
b	Short term	<ul style="list-style-type: none"> Recommended bivoltine breed rearing package of practices to be developed and transferred in the field. Periodic study to be carried on the hybrid vigour of races, presently under commercial use. Development of suitable package for production of quality silkworm seed. Identification of suitable mounting material for different eco-zones of north India to minimize defective cocoon percentage and improve the cocoon quality.
5	Silkworm Crop	

	Protection	
a	Long term	<ul style="list-style-type: none"> • Silkworm breeding programme to evolve bivoltine hybrids suitable for summer and autumn climates of North India to be intensified. • Development and introduction of suitable silkworm hybrids tolerant to high temperature, humidity and diseases. <p>Evolve and introduce disease forecasting and forewarning system for silkworm in the field</p>
b	Short term	<ul style="list-style-type: none"> • Regular monitoring of disease incidence during commercial and seed rearing at different centers during rearing season for better disease surveillance and thereby the management. • Special emphasis on disinfection and control measures of silkworm diseases to increase the cocoon production quantity and quality wise at field level. • Development and use of eco-friendly botanicals / chemicals to improve the tolerance of silkworms against diseases and adversities.
6	Silkworm improvement	
a	Long term	<ul style="list-style-type: none"> • Molecular characterization of silkworm races maintained in germplasm bank will be taken up for targeted breeding programme. • Breeding studies on silkworm to be intensified to get the desired characters in the bred lines with regard to higher cocoon production, tolerance to diseases and adversities. • Re-orientation of the breeding approaches by effective utilization of biotechnology as a tool and integrating with conventional breeding so as to achieve the targeted goals. • Quantitative Trait Loci (QTL) to be identified for each important economic traits and marker assisted selection or gene tagged breeding to be introduced and practiced. • Development of disease resistant breeds / hybrids by adopting biotechnology for achieving sustainable cocoon yields and stability of crop performance. • Detailed study to be taken up on different diseases, taking into account the virulence in different seasons in the field.
b	Short term	<ul style="list-style-type: none"> • Identification of silkworm hybrids for higher cocoon production in spring season and hardy breeds for monsoon and autumn season with special emphasis on disease tolerant character.
	Sericulture Extension and Development	<ul style="list-style-type: none"> • Institute Village Linkage Programme to be adopted in North India for vertical growth of silk industry; • Development of Cluster Development Development Projects for both horizontal as well as vertical development. • Regular Knowledge and skill enhancement programmes for extension staff.

Table 4.8. Details regarding the new Sericulture R&D technologies adopted during last five years by REC Haldwani

Year	Name of Technology/Process / Product/Best Sericulture Practice adopted	Implemented by CSB/ DOS/ NGO/ Others	Whether Beneficial (1= Yes 2= No)	Impact on sericulture yield/productivity/ Quality or other benefits
2008-09	Plantation tech.	CSB-DOS	1	Estt. Plants With maximum sustivity
2009-10	Pruning Training	CSB-DOS	1	Pruning Periodically
2010-11	Rearing Training	CSB-DOS	1	Production of cocoon more then periodically year
2011-12	Rearing Training	CSB-DOS	1	-do-

CHAPTER V

EVALUATION OF R&D ACTIVITIES OF CENTRAL SERICULTURE RESEARCH & TRAINING INSTITUTE (CTR&TI), RANCHI DURING XI PLAN

5.1. Introduction

CTR&TI, Ranchi, is the pioneer research institution in the field of tasar culture engaged in generating useful information and technologies suited to the tropical and temperate tasar sectors, through Research & Development and their effective transfer to the field. The ultimate aim is to improve the socio-economic condition of the stakeholders (Tribals) associated with tasar culture. The network of Regional Tasar Research Stations (RTRSs) – Dumka (Jharkhand), Jagdalpur (Chhattisgarh), Bangriposi (Orissa), Bhandara (Maharashtra) for tropical areas and Imphal (Manipur), Bhimtal (Uttanchal) and Batote (J&K) for temperate areas, Research Extension Centres (RECs) – Hatgamaria (Jharkhand), Katghora (Chhattisgarh), Bangriposi (Orissa), Bhadrachalam (AP), Robertsganj & Jhansi (UP), Purulia (WB), Nasik (Maharashtra) for tropical areas, two RECs for temperate areas, viz., Palampur (HP) and Gopeshwar (Uttarakhand) and three Oak Tasar Extension Centres cum BSMTCs Umrangshu, Yaikongpao and Kikruma under the control of RTRS Imphal, extend the support in transfer of technology. Three p4 stations – Chkradharpur, Jarmundi (Jharkhand) and Kargi Kota (Chhattisgarh) extend their support in the production of quality elite seeds for tropical tasar ecoraces. RTRS, Batote has started functioning as p4 station for temperate tasar silkworm.

5.2. Host Plant Improvement, Production and Protection

For utilization of the host plant germplasm, 231 accessions of *Terminalia* sp. were characterized for 55 traits and a catalogue has been prepared. Ten superior accessions of *Terminalia* sp. (*T. arjuna*-06 and *T. tomentosa*-04) were isolated based upon qualitative and quantitative parameters. The same is under in-house multiplication for field transfer. Three plus trees of *Terminalia* sp have been identified from different locations based on seed and germination traits and the seedlings have been transplanted in field for leaf yield trials.

5.3. Silkworm Improvement, Production and Protection

The morphometric analysis was made for cocoon and moth. Gut amylase activity in *Laricia ecorace* fed on Sal and Asan was studied and Low glycogen accumulation in fat bodies results in improper diapause leading to emergence of moths of *Laricia ecorace* in winter season (Dec-Jan). Similarly, high tannin and phenolics content in Sal leaves cause digestive imbalance and in turn low water content in gut, which seems to be one of the reasons for low yield on Sal. Project on in situ *Laricia* conservation being implemented in collaboration with Forest Dept. and DOS, Jharkhand at Ormanjhi was continued. Life cycle was allowed to continue in natural condition. Overlapping of generations was observed.

Studies on Reactive Oxygen Species indicated higher values in non-diapausing generations compared to diapausing ones.

5.4. Post Cocoon Technologies

Solar operated wet reeling machine with steam line has been developed. The machine has 3 basins and 18 ends. For heating water (45-50° C), a steam line is attached to it. This machine yields 600-700 g raw silk per basin per day (8 H). A solar operated vertical reeling cum spinning machine has been developed jointly with DOS, Jharkhand. The machine is compact, handy and yields 200 g twisted silk per day. The yarn produced can be directly used both as warp or weft, without any additional twist.

5.5. Patents Filed

Patent applications have been filed for following technologies with NRDC:

1. Jeevan Sudha-a botanical formulation for control of bacteriosis and virosis
2. Novel technique for collection of bioactive enzyme Cocoonase from *Antheraea mylitta*
3. Development of wet reeling machine for tasar silk cocoons
4. Silk spinning and twisting machine _ solar operated (Samridhi)

5.6. Regional Tasar Research Stations

RTRS, Warangal conducted field trials of the evolved BC-IV line of Andhra Local, which yielded 35 cocoons/ dfl over the parents (Andhra Local – 12 cocoons and Daba TV- 20

cocoons/df). TRRS, Baripada maintained the germplasm of rejuvenated Sukinda (TV) and supplied of basic seeds to State department and BSM&Cs for multiplication. A total of 4,285 dfls were supplied. The Station has preserved 3700 seed coons to maintain the elite race in the GPB of this station. The programme on conservation of local ecorace Modal has been continued. The RTRS, Jagdalpur extended technical guidance to DOS for organizing Raily conservation camps in different parts of Bastar in Chhattisgarh.

Besides, RTRS, Jagdalpur extended technical guidance to DOS, Chhattisgarh under Cluster Promotion Programme (CPP). A total of 14.21 lakh cocoons @ 53.8 cocoons/ dfl were produced under commercial rearing. Towards introduction of daba BV rearing in the region, RTRS, Bhandara extended technical support. Out of 24,500 dfls of Daba BV 14.96 lakh cocoons (61 cocoons/ dfl) were produced which indicated feasibility of Daba BV in second crop in the region.

Two productive lines of oak tasar silkworm have been developed by RTRS, Imphal with cocoon yield of 65 and 74 cocoons/ dfl, as against the parents (A. pernyi ad A. proylei), wich yielde d 39 and 35 cocoons/df, respectively.

5.7. Human Resource Development

A total of 1626 persons were provided training under different programmes (structured course 29 in two batches; Training initiatives-1012; integrated skill developmet scheme-29; Ad-hoc programmes-556; DBT project-42).

5.8. Extension and Transfer of Technology

The highlights of extension and transfer of technologies by the nested units is given below:

Farmer's Meet cum Exhibition	29
Kisan mela	10
Field day	33
Farmers day	25
Vichar Gosthi	06

5.9. Details regarding R&D Projects during XI Plan

Table 5.1. Number of Projects undertaken by the Research Institute during XI Plan

Year	Number of Projects	Status of project		
		Completed	Work in Progress	Technology Transferred (Lab to Land initiative)
2007-08	31	9	22	2
2008-09	28	9	19	2
2009-10	25	8	17	
2010-11	20	11	9	
2011-12	10	6	4	

5.10. Research & Development projects undertaken by the institute as well as in its nested units during XI Plan

Table 5.2. Details regarding the R&D Projects taken up and its status, Impact and the benefits to the farmers

Area of research	Name of the Projects taken up	Amount* sanctioned in the area of research (Rs Lakh)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality <i>vis a vis</i> proposed objective	No. of farmers benefitted from the project
Development of high Yielding silkworm breeds and their food plants (Mulberry & Vanya silk host Plants)	[PIB 4673] Improvement of host plants of tasar silkworm through induction of polyploidy and mutagenesis (Apr 2007 - Mar 2010)	9.80 (including salary & wages)	Completed	As per project objectives, the polyploids developed have been found superior in terms of leaf quality and laminar thickness over the diploids. Efforts are on to develop triploids for commercial exploitation.	
	[PIE 4633]Exploration, collection, evaluation and maintenance of <i>Terminalia</i> , <i>Lagerstroemia</i> and <i>Anogeissus</i> spp.(Oct 2001 – Mar 2008)	2.02	Completed	Collection of germplasm 231 accessions of host plants were collected from different parts of the country.	Germplasm Bank developed at the Institute
	[AIB 4653] Improvement of stock in tropical tasar silkworm <i>A. mylitta</i> D. through reciprocal recurrent selection.	36.15 (including salary & wages)	Completed	Cross combination D5S5 was identified as best cross in both the crops based on percentile ranking.	Basic information generated

Area of research	Name of the Projects taken up	Amount* sanctioned in the area of research (Rs Lakh)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers benefitted from the project
	(Aug. 2004 to Nov. 2007)			A comparison of magnitude due to GCA to SCA has indicated predominantly higher GCA values for fecundity. Both the parents (Sarihan and Daba) need to be maintained for stock improvement	
	[AIG 4669] Selection aided molecular marker system for improvement in tropical tasar silkworm <i>Antheraea mylitta</i> Drury- Collaborative project with I.I.T Kharagpur (April 2006 – March 2010)	28.20(including salary & wages)	Completed	Basic information has been generated on Cocoon and shell weight specific markers which are highly reproducible	Basic information generated for future breeding programme
	[AIB 4646] Isolation and purification of Sarihan ecorace of <i>A.mylitta</i> D. (Apr 2003- Mar 2008) RTRS, Dumka	60.19(including salary & wages)	Concluded	Pure lots [90-93% pure] of the Sarihan ecorace have been isolated and being maintained by RTRS, Dumka for multiplication and supply to farmers	About 50 farmers in Sarihan belt benefitted
	[ARP 4655] Characterization and rejuvenation of tasar ecorace – Sukinda (Oct 2004 - Mar 2008) RTRS, Baripada	16.32 (including salary & wages)	Concluded	Three different groups/ lines were isolated, purified and characterized from Sukinda. In all the three lines, yellow coloured cocoons dominated [>99%], confirming the race character. The purified race is being maintained at RTRS, Baripada	Seeds are supplied as and when demanded by State/ stakeholders
	[ARP 4654] Improvement of Raily ecorace <i>A.mylitta</i> D. through hybridization (2004-2009) RTRS, Jagdalpur	40.74(including salary & wages)	Concluded	The F1 hybrid obtained by crossing Raily x Daba was found to be stable and productive than the parents. The parent lines are	

Area of research	Name of the Projects taken up	Amount* sanctioned in the area of research (Rs Lakh)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers benefitted from the project
				being maintained at RTRS, jagdalpur	
	[AIB 4677] Development of races superior to existing races of oak Tasar Silkworm through interspecific hybridization (Apr2007 - Mar2012) RTRS, Imphal	63.061(including salary & wages)	Concluded	Two productive lines of oak tasar silkworm have been developed with cocoon yield of 65 and 74 cocoons/df as against the parents (<i>A. pernyi</i> and <i>A. proylei</i>), which yielded 36 and 35 cocoons/df, respectively. Improvement in average fecundity, cocoon weight, shell weight and filament length was also recorded in the hybrids. These are subjected to on-farm evaluation.	Under validation
	[PIP 4678] Morpho-Physio-Anatomical Characterization Of <i>Terminalia</i> spp. (Jan 2008 - Dec 2012)	50.906(including salary & wages)	Ongoing	--	--
	[PIG 4682] Evaluation of genepool of tropical tasar silkworm host plants with respect to yield and quality of tasar silk- Funded by DBT, New Delhi (Apr 2007 – Oct 2010)	26.36	Concluded	Based upon the overall ranking of the accession, four accessions [<i>T. arjuna</i> -03, <i>T.tomentosa</i> -01] have been selected for multiplication and use in breeding programmes.	Utilized in breeding programmes
	Phylogeography of tropical tasar silkworm <i>Antheraea mylitta</i> and muga silkworm <i>Antheraea assamensis</i> - (Collaborative with SBRL) - Funded by DBT, New Delhi (Jan 2006 to Dec 2008)		Concluded	Acquired basic information, which established that the ecoraces studied were genetically distant. <i>In-situ</i> localities were identified	Basic information generated. Based upon this, wild ecorace conservation project was initiated.

Area of research	Name of the Projects taken up	Amount* sanctioned in the area of research (Rs Lakh)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers benefitted from the project
				for ecoraces studied	
	[PIB 4686] Studies on various provenances of <i>Terminalia arjuna</i> Bedd. and <i>T.tomentosa</i> W&A (Aug 2008 - July 2011)	20.954(including salary & wages)	Completed	Three plus trees of <i>Terminalia</i> sp have been identified from different locations based upon seed and germination traits and the seedlings have been transplanted in field for leaf yield trials.	Under analysis
	[AIB 4687]Improvement of Andhra ecorace of <i>Antheraea mylitta</i> D through back cross method (Nov 2008 - Oct 2011) RTRS, Warangal	16.70(including salary & wages)	Completed	Increase in cocoon production from 12 (Andhra Local) to 35 (improved line) has been achieved. The improved line is under evaluation in the region through DOS, Andhra Pradesh,.	Under trial with farmers in State (Andhra Pradesh)
	[APR 4693] Studies on the biology and ecology of Laria ecorace of <i>Antheraea mylitta</i> Drury on sal flora (Feb 2012 – Jan 2015)	37.64	Ongoing	--	--
	[AIB 4694] Improvement of Daba ecorace of <i>Antheraea mylitta</i> Drury for higher fecundity (Jan 2012 – Dec 2014)	9.10	Ongoing	--	--
	Conservation and utilization of local ecorace Laria (Funded by DOS, Jharkhand) (Apr 2010 - Mar 2013)	12.00	Ongoing	--	--
	[ARP 4691] Induction of tolerance to AmCPV (<i>Antheraea mylitta</i> cytoplasmic polyhedrosis virus) in commercilly	8.83	Ongoing	--	--

Area of research	Name of the Projects taken up	Amount* sanctioned in the area of research (Rs Lakh)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality <i>vis a vis</i> proposed objective	No. of farmers benefitted from the project
	exploited tasar eco-races of Daba B.V. and T.V (Oct 2010 – Sep 2014)				
Development of clonal propagation techniques	[PIP 4666] Standardization of micropropagation protocols for elite genotypes of primary tasar food plants (<i>Terminalia Tomentosa</i> W&A and <i>Shorea Robusta</i> G) (Apr 2006 - Mar 2011)	37.00(including salary & wages)	Completed	Protocol has been developed for <i>in vitro</i> multiplication of <i>T.tomentosa</i> and <i>T. arjuna</i> from embryo and <i>Shorea robusta</i> G. from shoot bud cultures. Still under trial for perfection.	Under validation at Institute
	[PPA 4650] Studies on the regeneration of <i>T.arjuna</i> and <i>T.tomentosa</i> through tree cuttings. (July 2003 to June, 2008)	27.296 (including salary & wages)	Completed	Protocol has been developed for vegetative propagation of <i>Terminalia</i> sp. through stem cuttings. The isolated superior accessions are being multiplied by the method.	Training being imparted for adoption of technology
	[PPA 4679] Studies on the regeneration system for certain genotypes of Primary Tasar Food Plants (<i>Terminalia arjuna</i> , <i>T. tomentosa</i> and <i>Shorea robusta</i>) (Apr 2007 - Mar 2010)	19.50(including salary & wages)	Completed	Protocol for regeneration of callus was developed for different genotypes. However, since the protocol for micro propagation of the host plants was developed in the project PIP 4666, further works were not undertaken.	--

Cultivation practices	[PPS 4665] Effect of secondary nutrients on quality and leaf yield of <i>Terminalia arjuna</i> and <i>T. tomentosa</i> (Apr 2006 - Mar 2011)	23.64(including salary & wages)	Completed	Application of secondary nutrients combination SM5 on tasar host plants [Asan and Arjun] increased the leaf yield by 27.45% with improvement in leaf quality and silkworm rearing performance.	Under field evaluation
	[PPS 4664] Studies on the deficiency symptoms of essential plant nutrients in <i>Terminalia arjuna</i> and <i>Terminalia tomentosa</i> (Apr 2006 - Mar 2011)	12.12	Completed	An observation to correlate the deficiency in the plant in relation to nutrients.	A pictorial booklet developed for the farmers to identify the deficiency symptoms to take corrective measures.
	[PPA 4685] Development of pruning and fertilization package for tasar Chawki garden under two crop System (Jan 2009 - Dec 2010)			Package has been developed for chawki garden suitable for two crop system. The same is under validation with nested units.	Under validation
	[PPA 4689] Studies on effect of pruning of <i>Quercus serrata</i> Thumb On leaf production and rearing of <i>Antheraea proylei</i> J. in different seasons in Uttarakhand (Dec 2008 - Nov 2010) RTRS, Bhimtal	22.76(including salary & wages)	Completed	Leaf yield remained directly proportionate to the height of the plants, it being maximum in 5 ft high pruning.	Under popularization in NW India.
Development of Pest/disease management, disease /Pest forecast, forewarning system	[PRP 4667] Screening of the germplasm of <i>Terminalia arjuna</i> Bedd. & <i>T. tomentosa</i> W.A. for tolerance against three major foliar diseases (July 2006 - June 2009)		Completed	20 accessions of <i>T. arjuna</i> and 12 accessions of <i>T. tomentosa</i> , have been isolated as major fungal foliar diseases tolerant/resistant accessions. These will be used for future breeding programmes and	A calendar with control measures prepared for the benefit of farmers

				multiplication.	
[ARP 4660] Causes and prevention of secondary contamination of pebrine in tasar silkworm <i>Antheraea mylitta</i> D (April 2005 to March 2008)	24.869(including salary and wages)	Completed	Mechanical method was proved to be effective approach to contain the menace of <i>Canthecona</i> sp., a secondary pebrine contamination source in silkworm.	Mechanical control through sticky trap is in use at farmers' level	
[ARP 4671] Field evaluation of screened botanical extracts against virosis of tasar silkworm, <i>A. mylitta</i> D. (Apr 2006 - Mar 2009)	27.79(including salary & wages)	Completed	A botanical formulation has been developed for suppression of Virosis by 37% with improvement in cocoon yield by 8 - 11 cocoons per dfl..	Under trial at farmers level	
[ARP 4672] Development of vaccine for effective control of virosis (Apr 2006 - Mar 2009)	31.46(including salary & wages)	Completed	Vaccination with inactivated CPV [<i>per os</i>] to silkworm [I / II instar] before infection significantly reduced the Virosis by 30-38% with 12-15% improvement in cocoon production . The same is however not found viable.	Not found viable	
[PRE 4663] Control of Gall insect, <i>Trioza fletcheri</i> minor crawf. (homoptera:Psyllidae) a major pest of primary tasar food plants through eco-friendly plant pesticides (July 2005 to December 2008)	22.205(including salary & wages)	Completed	Developed IPM against gall insect for use in field to reduces the gall infestation, which is being utilized in field.	Adopted by farmers in systematic plantations	
[ARP 4676] Distribution, Survey, Isolation, Characterization and	81.99(including salary & wages)	Completed	The pathogen of Tiger-band disease was	Under validation	

	Control of Tiger-Band Disease Affecting Oak Tasar Silkworm (Apr 2007 - Mar 2011)			identified as NPV virus. Botanical based control measure has been developed.	
	[ARP 4681] Identification and Characterization of disease causing pathogens (microsporidians and bacterial infections) of tropical tasar silkworm, <i>Antheraea mylitta</i> –Funded by DBT, New Delhi(Apr 2007 – Sep 2010)	27.12	Completed	Basic information on disease causing pathogens of tropical tasar silkworm. Identified isolates of microsporidia (10) and bacteria (17) were registered with NCBI as specific to <i>A.mylitta</i> for future reference.	Basic study
	[PRP 4690] Screening of the germplasm of <i>Terminalia arjuna</i> Bedd. & <i>T. tomentosa</i> W.A. for tolerance against three major foliar diseases (Aug 2009 – July 2012)	23.963	Completed	Screening completed for remaining accessions. Disease resistant accessions were identified and being utilized under breeding programme	
	[PRE 4692] Studies on forecasting and forewarning system for management of pests of tasar host plants and silkworms of tropical tasar culture (Sep 2010 – Aug 2013)	15.056	Ongoing	--	--
	[ARP 4695] Identification of pebrinised and cytoplasmic polyhedrosis virus infected stock through enzyme marker system in <i>Antheraea mylitta</i> Drury (Dec 2011 – Nov 2013)	7.00	Ongoing	--	--
Economic farming models & practices	[PPA 4668] Integrated farming system in Tasar culture (June 2006 - June 2009)	30.068(including salary & wages)	Completed	Intercrop concept in tasar farm was developed which can be used in block	Awareness programme included under various training

				plantations by farmers in private land to increase their additional income.	courses.
Improved reeling, weaving & processing devices	[CFC 4688] Development of Protocol for Production of Organic Tasar Silk Textiles and Exploration for Its Marketability (Oct2008 - Sept 2010)	28.47	Stopped mid-way by RC	--	--
Any other - Silkworm improvement, grainage and Rearing management	[AIP 4659] Effect of temperature on diapause status and adult eclosion in tasar silkworm <i>A.mylitta</i> (Lepidoptera: Saturniidae). (April 2005 to Dec 2009)	56.93(including salary & wages)	Completed	Based on the information a new project for development of technology for prevention of erratic emergence and improvement of grainage efficiency has been taken up.	Basic study relevant for future technology
	[AIP 4642]Sustainable production of 2nd crop in oak tasar (Apr 2003- Mar2007)	32.62	Complete	The grainage technology and brushing/rearing schedule developed for taking second crop during July-August is being utilized in the State.	Under Popularization
	[AIP 4670} Formulation of semi-synthetic diet for tasar silkworm <i>Antheraea mylitta</i> Drury (Lepidoptera: Saturniidae) (Jan 2006 - Dec 2008)	26.321(including salary & wages)	Completed	The technology has been developed for indoor chawki rearing on semi-synthetic diet and has been found viable in field.	Under validation
	[APR 4652] Studies on determination of development and accumulative temperature for synchronization of emergence and hatching in <i>Antheraea mylitta</i> D. (Jul 2005 - Jun 2009)		Completed	The findings have been included in the new project for development of technology for prevention of erratic emergence and improvement of grainage efficiency.	Basic study relevant for future technology
	[APR 4661] Standardization of suitable indoor rearing techniques of Tasar silkworm <i>Antheraea mylitta</i> D	39.233(including salary & wages)	Completed	Technology has been standardized for indoor silkworm rearing, which is under in-	Under validation

(April 2005 to March 2009)			house refinement and validation	
[AIP 4651] Studies on the interaction and performance of <i>A. mylitta</i> D. on its host plants with special reference to <i>Shorea robusta</i> R. - Collaboration with NCL, Pune (April 2004 to March, 2007)	71.498(including salary & wages)	Completed	Findings indicated that <i>S.robusta</i> is not a choice food for tasar silkworm.	Basic study
[ARP 4656] On-farm stock maintenance and multiplication of Andhra Local – an ecorace of <i>A. mulitta</i> D	34.76(including salary & wages)	Completed	The technology on grainage and rearing has improved the grainage efficiency at seed production level of Andhra Local ecorace.	Under practice by RTRS, Warangal for multiplication of Andhra Local ecorace
[AIP 4662] Studies on seed cocoon preservation, grainage and rearing for crop stabilization in ecorace Bhandara of <i>A.mylitta</i> D. (2005-08)- RTRS, Bhandara	38.59 (including salary and wages)	Completed	The findings indicated improvement in grainage efficiency but the prevailing climatic conditions are not conducive to make the seed crop (July-Aug) viable in Bhandara region.	Not succeeded
[APS 4658] Improvement of oak tasar seed production technology (Feb 2005 - Feb 2008) RTRS, Imphal	21.97	Completed	Information generated is being utilized in oak tasar grainage for quality seed production.	Under practice for Oak tasar seed multiplication
[AIP 4675] Biochemical changes in the diapausing pupae of Oak Tasar Silkworm, <i>Antheraea proylei</i> and its impact on moth eclosion (Apr2007 - Mar 2010) RTRS, Imphal	45.35(including salary & wages)	Completed	Basic information has been generated	Basic study
Stabilization of Autumn crop at different altitudes of Uttarakhand and Himachal Pradesh (Apr 2007 - Mar 2011) [APR-4674] RTRS, Bhimtal	9.52	Completed	Improved grainage, incubation and chawki rearing technologies for temperate tasar during Autumn	Under practice for Oak tasar production

				crop has been developed. Using the technology quality seed is being supplied to the farmers.	
	[AIP 4680] Ecogenetic analysis of diapause and reproduction in tropical tasar silkworm, <i>Antheraea mylitta</i> Drury- funded by DBT, New Delhi (Apr 2007 – Oct 2010)	28.00	Completed	Basic information generated has been used for a new project submitted to DBT for funding for further studies.	Basic study. Information generated
	[PIC 4684] Phytosterol profile at different maturity level of leaves of tasar food plants and its effect on growth and development of tropical tasar silkworm, <i>Antheraea mylitta</i> Drury (Lepidoptera : Saturniidae) - Collaborative with SFTRRD, Bhubaneswar (Apr 2009 – June 2012)	21.19 (6.66-STFRRD component)	Completed	Under compilation	
HRD	[MOE 4683] Establishment of tasar technology complex for socio-economic empowerment of tribals through skill development in tasar culture (Jan 2008 – Apr 2011)	19.58	Completed	A total of 748 tribal farmers (464 men, 284 women) have been trained. Improvement in rate of technology adoption by 104.5% and cocoon yield from 31 to 47 per dfl was observed due to adoption of technologies.	748 tribal farmers were benefitted

Table 5.3. Funding and Expenditure of the R& D Projects during XI Plan

Sl. No.	Source of Grants/Funds/Sponsors	Approximate Annual Funding (In Lakhs)				
		2007-08	2008-09	2009-10	2010-11	2011-12
a)	State Government (DOS, Jharkhand)	--	--	--	3.36	2.50
b)	CSB (under the R&D scheme)	1212.45	1795.40	2206.01	2437.29	3265.89
c)	Industries					
d)	International Bodies					
e)	Others (Specify) DBT, New Delhi	54.57	17.57	17.23	17.91	--
	NABARD, Ranchi	--	--	3.07	1.77	--
	Total Funding	1267.02	1812.97	2226.31	2456.97	3265.89
	Total Expenditure	1247.28	1807.12	2239.66	2445.75	3256.11

Table 5.4. Number of Patents applied and awarded during XI Five Year Plan

Year	No. of Patents Applied (Nos)	No. of Patents Awarded (Nos)
2007-08	01	--
2008-09	05	--
2009-10	--	--
2010-11	--	--
2011-12	04	01

Table 5.5. Number of Research papers published during XI Five Year Plan

Year	No. of Research Papers published (Nos)		
	TOTAL		
2007-08	Journals: 29	Seminar/Symposia Proceedings: 48	Popular articles: 10 = 87
2008-09	Journals: 32	Seminar/Symposia Proceedings: 30	Popular articles: 22 = 84
2009-10	Journals: 42	Seminar/Symposia Proceedings: 07	Popular articles: 15 = 64
2010-11	Journals: 43	Seminar/Symposia Proceedings: 18	Popular articles: 06 = 67
2011-12	Journals: 38	Seminar/Symposia Proceedings: 24	Popular articles: 11 = 73

Table 5.6. Number of training Programmes conducted during XI Five Year Plan

Year	No. of Training Programme	Total no. of Participants
2007-08	3	49
2008-09	5	451
2009-10	5	739
2010-11	6	1801
2011-12	7	1626

5.11 Overall level of acceptability of new technology among the End Users

The technologies developed by the Institute are adopted by the tasar growing States, which has led to achieving the present level of production of tasar silk in the country. Recent socio-economic surveys conducted in Jharkhand indicated about 40% adoption of the improved technologies by the framers practicing tasar culture in natural plantations. Under such conditions the level of adoption of rearing technologies are higher than plant maintenance technologies.

Table 5.7. Initiatives Planned for the XII Plan

Sr. No.	Name of the Initiative	Objectives/Targeted stake holders	Provisional Fund Requirements (Rs.)
1	Construction of cocoon preservation chamber	Diapause regulation to manage erratic emergence of moths	21.42 Lakhs- Deposited with CPWD for construction
2	Rearing house	Development of disease resistant race	39.41 Lakhs- Deposited with CPWD for construction
3	Training Block	To create proper facilities for imparting training and enhancing skill	2.18 Crores- Deposited with CPWD for construction

5.12 Suggestion for improving the scheme during the XII Plan

- Schemes having applied value and with scope for both horizontal and vertical growth need to be incorporated.
- Majority of the scientists are in age group of 50+, therefore recruitment of young scientists is needed.
- Quality comes from satisfaction, therefore promotional avenues and career progression need due consideration under HRD.

5.13. Field Survey Findings of Beneficiaries

Table 5.8. Research Extension Center, Amritpur, Maheshpur Raj, Pakur, Jharkhand
Details regarding the new Sericulture R&D technologies adopted during last five years

Year	Name of Technology/Process/Product/Best Sericulture Practice adopted	Implemented by CSB/DOS/NG O/ Others	Whether Beneficial (1= Yes 2= No)	Impact on sericulture yield/productivity/Quality or other benefits
2007-08	<ul style="list-style-type: none"> • Improved Mulberry variety • Use of Morizyme (Plant Growth hormone) • Disinfection of Rearing House • Use of sricillin • Incubation of Dfls • Use of Labex 	CSB	1	Increased Yield
2008-09	<ul style="list-style-type: none"> • Improved Mulberry variety • Use of Morizyme (Plant Growth hormone) • Disinfection of Rearing House • Use of sricillin • Incubation of Dfls • Use of Labex 	CSB	1	Increased Yield
2009-10	<ul style="list-style-type: none"> • Improved Mulberry variety • Use of Morizyme (Plant Growth hormone) • Disinfection of Rearing House • Use of sricillin • Incubation of Dfls • Use of Labex 	CSB	1	Increased Yield
2010-11	<ul style="list-style-type: none"> • Improved Mulberry variety • Use of Morizyme (Plant Growth hormone) • Disinfection of Rearing House • Use of sricillin • Incubation of Dfls • Use of Labex 	CSB	1	Increased Yield
2011-12	<ul style="list-style-type: none"> • Improved Mulberry variety • Use of Morizyme (Plant Growth hormone) • Disinfection of Rearing House • Use of sricillin • Incubation of Dfls • Use of Labex 	CSB	1	Increased Yield

Table 5.9. RTRS, Dumka, Jharkhand

Details regarding the new Sericulture R&D technologies adopted during last five years

Year	Name of Technology/ Process/ Product/ Best Sericulture Practice adopted	Implemented by CSB/ DOS/ NGO/ Others	Whether Beneficial (1= Yes 2= No)	Impact on sericulture yield/productivity/ Quality or other benefits
2010-11	Rearing	CSB	1	Yield/ Quality
2011-12	Seed Granage	CSB	1	Yield/Quality

Table 5.10. REC & PPC, Gumla, Jharkhand

Details regarding the new Sericulture R&D technologies adopted during last five years

Year	Name of Technology/Process/ Product/Best Sericulture Practice adopted	Implemented by CSB/DOS/ NGO/ Others	Whether Beneficial (1= Yes 2= No)	Impact on sericulture yield/productivity/ Quality or other benefits
2007-08	Plantation	CSB & DOS	1	Enhancement in leaf Yield & Cocoon Productivity
2008-09	Rearing	CSB & DOS	1	Do
2009-10	Rearing	CSB & DOS	1	Do
2010-11	Rearing	CSB & DOS	1	Do
2011-12	Rearing	CSB & DOS	1	Do

Table 5.11. REC CUM CDC, Haldwani, Ranchi, Jharkhand

Details regarding the new Sericulture R&D technologies adopted during last five years

Year	Name of Technology/Process/ Product/Best Sericulture Practice adopted	Implemented by CSB/DOS /NGO/ Others	Whether Beneficial (1= Yes 2= No)	Impact on sericulture yield/productivity/ Quality or other benefits
2008-09	Plantation Tech.	CSB-DOS	1	Maintained Plantation
2009-10	Vermi compost unit establishment Training Pruning Training	CSB-DOS	1	Estt. Vermi compost unit & input continue stage plants are proved preceding
2010-11	Rearing Training	CSB-DOS	1	Production of cocoon more then preceding year
2011-12	Rearing Training	CSB_DOS	1	Produce more cocoon & quality is better which

				fetal more increase.
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Table 5.12. New Sericulture R&D technologies adopted during last five years

Year	Implemented by CSB/DOS/ NGO/Others	Whether Beneficial (1= Yes , 2= No)	Impact on sericulture yield/productivity/ Quality or other benefits	Remarks
2007-08	CSB	01	The overall income was Rs. 8000/- annually through Tasar culture.	Tasar culture is the main source of income in the region.
2008-09	CSB	01	The overall income was Rs. 10000/- annually through Tasar culture.	Tasar culture is the main source of income in the region.
2009-10	CSB	01	The overall income was Rs. 12000/- annually through Tasar culture.	Tasar culture is the main source of income in the region.
2010-11	CSB	01	The overall income was Rs. 17000/- annually through Tasar culture.	Tasar culture is the main source of income in the region.
2011-12	CSB	01	The overall income increased was Rs. 20000/- annually through Tasar culture.	Tasar culture is the main source of income in the region.

CHAPTER VI

EVALUATION OF R&D ACTIVITIES OF CENTRAL MUGA, ERI RESEARCH AND TRAINING INSTITUTE (CMER&TI), LAHDOIGARH, DURING XI PLAN

6.1. Introduction

CMER&TI, Lahdoigarh has its hinterland in all the North Eastern States, West Bengal, UP and AP. There are three Regional Research Stations working under CMER&TI, e.i., Regional Muga Research Station, Boko, Assam; Regional Eri Research Station, Mendipathar, Meghalaya and Regional Eri Research Station, Shadnagar, AP with three Research Extension Centres for Muga (Lakhimpur in Assam, Tura in Meghalaya, Coochbehar in West Bengal), four RECs for Eri (Diphu and Kokrajhar in Assam, Fatehpur in UP, Shadnagar in AP and one Composite REC at Mangaldoi, Assam.

6.2. Muga host plant improvement

CMER&TI has conducted research for hardening of micro-propagated plantlets of muga host plants *Persea bombycina*. Culture of 168 nos. of nodal segments of s3 and S6 plants for shoot initiation have been carried out in MS and Woody Plat (Hi-media Ltd.) medium. The nodal segments were subjected to antifungal (bavistin) and antibiotic (streptomycin) treatment to reduce the microbial contamination. Sprouting of buds in few explants has been observed and aseptically transferred to shoot elongation media containing Gibberallic acid.

6.3. Muga Silkworm improvement

Endocrine regulation of reproduction and enhancement of fecundity in the muga silkworm was studied. The effect of two neuro hormones (JH-III and 20-hydroxy ecdysone) on reproductive behavior and rearing performance of Muga silkworm was studied. The problem of retention of eggs by *A. assamensis* moths (which reduces the number of hatched worms) can be mitigated by application of both JH-III and 20-E. However, retention of eggs by the moths was minimum under treatment of 20-E (8 nos.). Topical application of 15ug 20-e enhanced fecundity (from normal 100-115 eggs to 150-166 eggs), survivability i.e. formation of cocoons (from normal 51-

65% to around 80%), pupal and shell weight (6.10g and 0.67g, respectively). Protein content in the pupal eggs, pharte adult eggs, normal and retained eggs were significantly higher when the worms were treated with 15uf 20-E (9.66mg/ml to 13.86 mg/ml). Similar effect was observed in case of haemolymph of larvae and ovarian development.

6.4. Regular Programme

Induction of indoor rearing technique for *antheraea assamensis* through field trails was conducted. About 200 nos. of potted plants were raised for indoor rearing of silkworms. Multi-locational trial of castor accessions was conducted. The accession Acc-003 and Acc-004 were evaluated as promising castor genotype for eri silkworm rearing. The test was conducted in 4 locations of Assam in different agro-climatic Zone and results are at par with institute's findings.

On farm trial for development and standardization of an improved process for cooking and reeling of muga cocoons were conducted. Training and demonstration programmes are being conducted in the farmer's field in different locations and also popularized.

6.5. Extension and Communication Programme

A large number of extension and communication programmes have been conducted by the CMER&TI Lahdoigarh as given below:

Krishi Mela	03
Exhibition	13
Field day	32
Technology awareness	15
Workshop	01
Seminar	01
Advertisement campaign	05

6.6. R&D Projects during XI Plan

CMER&TI, Lahdoigarh has undertaken a number of R&D projects during XI Plan (**Table 6.1**). Many of these projects are of continuing nature and the work is in progress. During the XI Plan, the institute has developed and transferred to land 36 new technologies in the area of Muga and Eri culture.

Table 6.1. R&D Projects undertaken by the Research Institute during XI Plan

Year	Number of Projects	Status of project		
		Completed	Work in Progress	Technology Transferred (Lab to Land initiative)
2007-08	23	5	18	6
2008-09	17	10	7	5
2009-10	22	7	15	5
2010-11	15	7	8	8
2011-12	17	1	17	12

Table 6.2. Research & Development projects under taken by in the institute and nested units During XI Plan

Area of Research	Name of the Projects taken up	Amount sanctioned in the area of research (Rs Lakhs)	Status of the Project (e.g. Ongoing, completed, implement ed on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers Benefitted from the project
Development of high yielding silkworm breeds and their food plants (Mulberry & Vanya silk host plants)	National Agriculture Technology Project (NATP) on Plant Biodiversity	-	Completed	All germplasm were maintained in the GCC, Chenijan with regular cultural operations and for silkworm rearing	NA
	Selection of promising Som, <i>Persea bombycina</i> Kost, genotype for improvement of muga cocoons production.	38.78	Completed	Established a germplasm bank of 39 som genotypes at the Institute. Identified 3 superior plus trees on the basis bioassay and other growth parameters	The superior varieties are being multiplied To supply to the farmers.
	Phylo-geography of <i>A mylitta</i> and <i>A assamensis</i> (Collaborative with SBRL, Kodathi, Bangalore)	4.50	Completed	Three populations of wild muga silkworm were analyzed using 15 SSR primers. In addition to the above, thirty seven microsatellite loci were screened for polymorphism in six different genotypes of muga silkworm. Out of these, eleven SSR loci showed “within genotype” and “in between genotype” polymorphism	NA

	Production and evaluation of <i>Antheraea assamensis</i> Helfer hybrid	16.76	Completed	One superior hybrid has been identified on the basis of hybrid vigour.	The hybrid will be exploited for commercial production of cocoons.
	In situ conservation of <i>Antheraea assamensis</i> Helfer	25.57	Completed	8 wild muga silk Worm stocks are Collected and kept Under ex-situ Conservation and utilized in breeding.	Conservation of <i>A assamensis</i> (Phase-II) is being continued in a programme mode as per suggestion of 23 rd RAC Utilization in breeding program.
	Development of high yielding Muga silkworm breeds through population improvement	7.05	Ongoing	Development of High Shell weight and High breeds is under progress.	NA
	Exploration, collection, characterization and cataloguing of wild sericigenous insects available in North East India	21.55	Ongoing	NA	NA
	Induction of indoor rearing technique for <i>Antheraea assamensis</i> Helfer through field trails	18.79	Ongoing	Technology under field trial or fine tuning	NA
	Isolation, identification and characterization of insect stimulants from Muga silkworm host plants and its functional properties	31.748	Ongoing	NA	NA
	Identification, characterization and diagnosis of some important muga silkworm diseases	28.75	Completed	Three bacteria viz., <i>Bacillus thuringiensis</i> , <i>Aromonus salmoniceda</i> and <i>Streptococcus bombycis</i> and 6 fungi were isolated from diseased Muga silkworms which are pathogenic to the worm. Lahdoi-A chemical formulation has	More than two thousand farmers are benefited from the technologies

				been developed to control the muscardine diseases of muga silkworm	
	Development of diagnostics of Muga and Eri related silkworm in NE region	4.0	Ongoing	NA	NA
	Studies on improvement of seed production of muga silkworm, <i>Antheraea assamensis</i> Helfer	18.33	Ongoing	Long term preservation of Schedule of muga seed cocoons to skip unfavourable seed crop seasons is being developed	Technology under fine tuning
	Development of egg preservation schedule in muga silkworm <i>Antheraea assamensis</i> Helfer	7.96	Ongoing	Detection of different developmental stages of muga silkworm embryos Has been done. Egg can be preserved upto 20 days without much adverse effect on hatching	NA
	Endocrine regulation of reproduction and enhancement of fecundity in the muga silkworm, <i>Antheraea assamensis</i> Helfer	21.61	Ongoing	Topical application of 15µg 20-E enhanced fecundity (from normal 100-115 eggs to 150-166 eggs), survivability i.e. formation of cocoons (from normal 51-65% to around 80%), pupal and shell weight (6.10g and 0.67g, respectively).	Technology under fine tuning
	Evaluation of superior genotype (s) of Castor (<i>R. communis</i> L) for eri silkworm rearing	8.03	Completed	Identified two superior Castor accessions: Acc-003 showed 13.79 MT leaf yield per hectare, which is 37.90 % above benchmark i.e., 10 MT/ha/year and 14.92% than earlier record (12MT/ha/year) and Acc-004 showed 13.38 MT leaf yield per hectare, which is 33.80 % above benchmark and 11.50% than earlier record.	Popularized the accessions among the farmers to utilize in commercial rearing.

	Collection, characterization, evaluation and conservation of perennial host plants for eri silkworm rearing	10.04	Ongoing	NA	NA
	Eri silkworm (<i>Samia ricini</i>) rearing and cocoon production in relation to host plant castor (<i>Ricinus communis</i>) genotypes raised under different soil fertility levels under rain fed conditions in semi-arid region	7.64	Ongoing	NA	NA
	Characterization of eri silkworm (<i>Samia ricini</i>) with morphological characters and molecular markers	-	Completed	A preliminary study on the DNA fingerprinting using the fifteen eco-races (Acc. No. 001 to 006) and genetic distance is lowest between Acc. 003 and Acc. 005 (0.0654) and highest between Acc. 002 and Acc. 006 (0.3811). The high phenotypic and genetic similarity as well as gene flow between populations of Acc. 002 and Acc. 005 suggests its common origin and later progression into different populations by adapting to the varying climatic conditions.	NA
	Development of Eri silkworm <i>Samia ricini</i> (Donovan) breeds with higher fecundity and shell weight	14.699	Completed	Two breed C1 and C2 with higher shell weight were developed by hybridization between two potential parents Genung (SRI-018) X Borduar (SRI-001), C2 breed showing shell weight 0.47 ± 0.05 g and fecundity 390.29 ± 58.39 and recommended for commercial exploitation after field trial.	Filed trial in different location in still continuing and C2 breed utilized for technical demonstration at farmers field

	Evaluation and identification of suitable strain (s) and eco race (s) of eri silkworm <i>Samia ricini</i> Donovan	5.61	Ongoing	Evaluation of rearing and reproductive performance was made for the eco- races during winter season; collected 5 eco- races	NA
	Development of egg preservation technique of eri silkworm <i>Samia ricini</i> (Donovan)	21.58	Ongoing	Preservation of eggs in BOD incubator at 5 ⁰ C showed normal hatching 70-80% up to 30 days preservation.	NA
	Technology assessment and refinement for sustainable development in eri cocoon production in the Brahmaputra valley of Assam.	-	Concluded	Project conducted through farmers participatory mode revealed that adoption of improved technology packages on eri host plant management as well as silk worm rearing in integration could increase productivity of cocoons by 63.85 enhancing Benchmark BCR 1.05 to 1.44.	Integrated approach should be done in adoption of farmers. Similar studies to be conducted in other potential districts.
	Muga sericulture based integrated farming system	-	Concluded	Muga and livestock farming contributed 96.68% income to the farming enterprise	More than 2000 farmers
	Popularization of improved eri spinning device through demonstration and training at farmers' level.	-	Concluded	Popularize eri spinning machine among farmers through peripatetic mode of training	More than 1000 farmers
Development clonal propagation techniques	Development of clonal propagation technique of production of quality planting stock of som, <i>Persea bombycina</i> (king Ex. Hoo F.) Kost	-	Concluded	Different techniques like single leaf and bud cuttings, chip budding, veneer and cleft grafting <i>etc.</i> were tried for clonal propagation of Som plants and single leaf and bud cuttings technique was found best with 80% rooting and 62-83% survival.	The technique is being utilized for multiplication and farmers are utilizing the techniques
	Micro propagation of muga host plant, <i>Persea bombycina</i> (King) Kost	30.734	Concluded	Developed protocol for <i>in vitro</i> shoot and root proliferation of Som using modified MS media fortified with IAA, IBA and NAA.	NA

Improvement in soil health and fertility	Development of organic farming system of muga host plant Som (<i>Persea bombycina</i> Kost)	-	Completed	Incorporation with <i>Dhaincha</i> (<i>Sesbania rostrata</i>) with application of 5 MT FYM and 1 MT Vermicompost has found to be better with the leaf yield of 16.83 MT/ha which is at par with recommended doses of inorganic fertilizer (N:P:K 150:50:50 kg/ha) without affecting quality of leaves. This is also a cost effective technology with a cost benefit ratio of 1: 1.63.	Technology is popularized among the farmers
	Characterization of soils in different Muga rowing areas of N.E. region in relation to productivity	23.32	Completed	Developed a model for fertilizer recommendation for som cultivation based on soil test value. Correlation of soil fertility with cocoon productivity was analyzed. Besides, correlations of leaf nutrients with cocoon productivity and soil character with leaf nutrients have been analyzed.	More than 2000 farmers
Development of disease management, disease forecast, forewarning system	Studies and control of Stem borer, <i>Zeuzera indica</i> , a pest of muga food plants, Som and Soalu.	24.35	Concluded	Package of practices for control of Stem Borer attack through the use of Botanical and mechanical control measures formulated.	More than 2500 farmers
	Studies on leaf blight disease of muga food plant, <i>Litsea monopetala</i> (Roxb.) Pers. (Soalu)	14.114	Concluded	Causal organism of leaf blight has been identified as <i>Coletrotricum gloeosporioides</i> . Plant extract of <i>Bougainvillea spectabilis</i> results 86.3% reduction in disease severity. Cost benefit ratio was 1: 3.48 in <i>B. spectabilis</i> against 1:2.77 in control. The product is named as Phytoblighon and applied for patent.	More than 500 farmers
	Forecasting and Forewarning of Pest & Diseases of Muga Host Plants and	20.104	Ongoing	A forewarning chart has been developed against major diseases of host plants and muga silkworms	NA

	Silkworms				
	Identification of stable source of resistance against major foliar diseases of muga host plants Som (<i>Persea bombycina</i>)	-	Ongoing	Recently initiated	
Economic farming models & practices	Development of Muga and eri based intercropping system	22.98	Completed	Intercropping of Ginger, Turmeric and Colocasia as well as Chilli has been introduced in Som and Kesseru plantation. The intercrops grow well without affecting usual growth and leaf yield of host plant. An additional net income can be generated from intercropping.	More than 2000 farmers
Product development & diversification	Development and standardization of an improved process of cooking and reeling of Muga cocoons	6.95	Completed	A new chemical formulation, "Muga Silk Plus" has been developed for cooking (softening) of muga cocoons which increases raw silk recovery upto 55%.	Under field trail

Table 6.3. Sources of Funding and Expenditure of R&D Projects during XI plan

Sl. No.	Source of Grants/Funds/Sponsors	Approximate Annual Funding (In Lakhs)				
		2007-08	2008-09	2009-10	2010-11	2011-12
a)	State Government	-	-	-	-	-
b)	CSB (under the R&D scheme)	125.21	239.12	235.40	296.04	369.41
c)	Industries	-	-	-	-	-
d)	International Bodies	-	-	-	-	-
e)	Others (Specify)					
	Total Funding	125.21	239.12	235.40	296.04	369.41
	Expenditure	489.73	825.59	1067.92	1129.57	1272.27

6.7. Achievements in terms of R&D projects taken up during XI Plan

Significant achievements have been made by the institute during XI plan resulted in positive impacts in the field for delivering fruitful R&D outputs. The R&D programmes of the institute was mainly focused on important aspects of research on priority basis i.e. selection and evaluation of superior genotypes of som and castor for higher leaf yield, evaluation of wild muga

silkworm for higher fecundity and survivability, preservation of muga cocoons to overcome unfavourable seasons, increase in silk recovery percent from cocoon etc.

Among the important achievements of the institute made are evaluation of superior plus trees of som in terms of disease resistance and better rearing performances, evaluation of superior genotypes of castor, collection and maintenance of seven accessions of muga silkworms from different pockets of Northeastern region, semi-synthetic diet for rearing of muga silkworm up to 2nd instar, muga silkworm breeds for higher productivity, juvenile hormone application to enhance the reproductive efficiency of muga silkworm, new technology for long term preservation of muga cocoons to overcome unfavourable seasons, a new bio-formulation viz. *Phyto-blighton* for management of leaf blight diseases etc.

6.8. Patents and research Publications

CMER&TI applied for 5 patents during the XI Plan. However, no patent were awarded yet (**Table 6.4**). The scientists of the institutes published a large number of articles and book chapters during XI Plan (**Table 6.5**).

Table 6.4. Number of Patents applied and awarded during XI Plan

Year	No. of Patents Applied (Nos)	No. of Patents Awarded (Nos)
2007-08	1	Nil
2008-09	2	Nil
2009-10	1	Nil
2010-11	0	Nil
2011-12	1	Nil

Table 6.5. Number of Research papers published during XI Plan

Year	No. of Research Papers published (Nos)
2007-08	48+15 (popular articles)+7 (book chapter) =70
2008-09	64+11(popular articles)= 75
2009-10	36+14(popular articles)+11(book chapter)=61
2010-11	75+14 (popular articles)+11(book chapter)=100
2011-12	40+15(popular articles)+10(book chapter)=65

6.9 Training and extension Work

Many types of training activities have been organized by the institute during XI Plan and a large number of Eri and Muga farmers and entrepreneurs took advantage of these training programmes (Table 6.6).

Table 6.6. Number of training Programmes conducted during XI Five Year Plan

Year	No. of Training Programme	Total no. of Participants
2007-08	8 (type of training)	456
2008-09	8(type of training)	308
2009-10	8 (type of training)	799
2010-11	6 (type of training)	1634
2011-12	20 (type of training)	2876

6.10. IT initiatives during XI Plan

CMER&TI developed a large number of new technologies in the area of Eri and Muga culture during XI Plan (Table 6.7). IT tools such as audio visual, power point presentation of the new technologies have been shown to farmers and entrepreneurs at various locations resulting in substantial benefits to all in terms of improving quality and productivity.

Table 6.7. Details of IT Initiative undertaken to propagate new technologies developed by the R & D institute during XI Five Year Plan

Sl. No	New Technology Developed	IT Initiative details	Whether successful (1=yes 2=No)	Impact of the Initiative
1	Clonal propagation of som through single leaf bud cutting	Prepared audiovisual power point presentation for demonstration among the farmers	1	Effective for clonal propagation
2	Intercropping of cash crops with som plantation	Do	1	Additional income generation
3	Control of Stem borer	Do	1	Biocontrol method
4	Management of leaf blight disease of soalu	Do	1	Do
5	Semi synthetic Diet	Do	1	In trial
6	Chawki rearing	Do	1	Survivability of young inster larvae increasing
7	Box type bamboo moutage for mounting of mature worms	Do	1	Easy method for cocooning
8	Biological control of uzi fly	Do	1	Biological control method
9	Lahoi-a formulation for management	Do	1	Management of the

	of muscardine disease			muscardine diseases
10	BANI- a muga weft reeling machine	Do	1	Cost effective reeling machine
11	Muga Cocoon Drying chamber	Do	1	Easy method for cocoon drying
12	Muga silk plus - an effective cooking chemical for muga cocoon	Do	1	Higher silk recovery
13	Package of practices for castor cultivation	Do	1	Agro-technology for castor
14	Package of practices for kesseru cultivation	Do	1	Agro-technology for kesseru
15	Intercropping of cash crops with kesseru plantation	Do	1	Additional income generation
16	Platform rearing technology of eri silkworm	Do	1	Effective method for eri silkworm rearing
17	Bamboo strip type moutage for cocooning	Do	1	For cocooning
18	Organic manure based farming system for muga host plant	Do	1	Organic based farming system

6.11. R&D activities planned for XII Plan

Table 6.8. R&D Activities Planned for XII Plan

SI. No.	Name of the Initiative	Objectives/ Targeted stake holders	Provisional fund Requirements
1.	Improvement of Andhra local BC-IV line of <i>Antheraea mylitta</i> drury for survival.	To evolve potential lines of developed breed for quantitative and qualitative characters. & To assess the field performance of lines and release for commercial exploitation. & To maintain pure lines of parents BC-IV for comparative studies.	Rs. 14.63 lakhs
2.	Conservation of Andhra local ecorace.	TO improve the local ecorace for large scale multiplication. & To work out an improved working model for conservation of Andhra local ecorace.	Rs. 25.00 lakhs (approx)
3.	Study on the bioecology of <i>A. frithi</i> Moor. In Manipur.	To study the details of the Bilecology of <i>A. frithi</i>	Rs. 3.64 lakhs

4.	Research Projects/ programmes/ extension communication programme/ training.	1030	373.45 lakhs
5.	Research Projects/ programmes/ extension communication programme/ training.	1030	410.80
6.	Research Projects/ programmes/ extension communication programme/ training.	1030	451.50
7.	Research Projects/ programmes /extension communication programme/ training.	1030	496.60
8.	Research Projects/ programmes/ extension communication programme/ training.	1030	546.26
9.	Evaluation and identification of eco-race(s) of eri silkworm <i>Samia ricini</i> (donovan) suitable to semi-arid areas of Andhra Pradesh and popularization of the identified race in the field.	Identification of promising eco-race(s) and field testing.	NIL
10.	Eri silkworm (<i>Samia ricini</i> Donovan) rearing and cocoon production in relation to host plant castor genotypes (<i>Ricinus communis</i> Linn.) raised under rain-fed conditions in semi-arid region.	Identification of promising high leaf yielding seasonal and perennial castor genotypes suitable eri silkworm rearing.	NIL
11.	Popularization of cost effective rearing technology (platform rearing and conducting of disinfection & hygiene maintenance.	Popularization of platform rearing technology and conducting of complete disinfection and hygiene maintenance with bleaching powder and lime.	NIL
12.	Development of semi-dwarf, improved food plants and screening of existing germplasm.	Development of chawki rearing practices.	30.00
13.	Development of pest and disease forecasting and forewarning systems.	To forewarn the farmers for disease occurrence timely and control measures.	25.00
14.	Enrichment of gene pool through collection of wild stock and establishment of germplasm bank and their characterization.	To evolve superior breeds/hybrids.	40.00
15.	Development of high yielding hybrid line(s).	For farmers/rearers.	20.00

16.	Development of transgenic silkworm.	For farmers/ rearers.	60.00
17.	Isolation of disease and high temperature / Humidity resistant/ tolerant line (s).	For farmers/rearers.	35.00
18.	Development of integrated technology package for stabilization of seed crops.	For farmers/rearers.	10.00
19.	Improvement of realized fecundity by means of physiological approaches.	For farmers/ rearers.	15.00
20.	Understanding and management of Pebrine, Flacherie and viral diseases.	For farmers/rearers and R&D peoples.	60.00
21.	Management of pests, especially.	For farmers/ rearers.	10.00
22.	Development of technology for seed preservation.	For farmers/ graineurs.	80.00
23.	Development of suitable device for removal of eri pupa form cocoons.	For reelers/ farmers.	50.00
24.	Processing of eri pupa for human consumption.	For consumers/food industry.	25.00
25.	Fine tunine of machineries under post cocoon technology for improving the raw silk recovery in muga cocoons.	For reelers/farmers.	20.00
26.	Technology translation and absorption amongst the farmers/reelers.	For reelers/ farmers through demonstration, training programmes etc.	100.00

CHAPTER VII

EVALUATION OF R&D ACTIVITIES OF SILKWORM SEED TECHNOLOGY LABORATORY (SSTL), KODATHI, BANGALORE, DURING XI PLAN

7.1. Introduction

Silkworm Seed Technology Laboratory (SSTL), Kodathi, Bangalore, is mandated with development of technologies for improvement of silkworm seed sector and to monitor the silkworm diseases.

7.2. Objective of the Institute

- Development of technologies for seed crop rearing, seed production and seed handling.
- R&D support to silkworm disease management in seed areas and multiplication levels.
- Preservation schedules for mulberry silkworm seed.
- Quarantine testing and certification for export and import of silkworm eggs
- Dissemination of technologies
- Human Resource Development

7.3. Long Term Preservation of Silkworm Seed

Long term preservation technique was developed for Nistari hybrids viz., crossbreed (Nistari x NB4D2 and Nistari x CSR2) and multivoltine hybrids (Nistari x M12W and M12W and M12W x Nistari) employing double step refrigeration method. The Nistari hybrids could be preserved upto 70 days for crossbreed and 50 days for multi hybrids without affecting hatching and crop yield. The evaluation studies in silkworm seed production centres of NSSO would be initiated during 2012.

7.4. Collaborative Project with TERI, Bangalore

The solar passive rearing house built under the collaborative project with The Energy and Resources Institute (TERI) was utilized for the evaluation of CSR2 and CSR4 seed crop rearing

during winter season to test the efficiency. The results indicated that the crop performance was on par with control and test verification would continue in summer and rainy season in 2012.

7.5. Developmental Biology

Incubation techniques based on the effective accumulated temperature points (EATP) for the prediction of exact day of hatching were standardised for popular bivoltine silkworm breeds and their hybrids.

Preservation schedules for two bivoltine, SK6 & SK7 and one univoltine, Barpat silkworm breeds are being evaluated under 4, 6, 8 and 10 months schedules, following 10, 20, 40 and 60 days aestivation.

7.6. Disease Monitoring Survey

Seasonal Joint Silkworm Disease Monitoring Survey involving DOS (Karnataka, Andhra Pradesh and Tamil Nadu) and NSSO was conducted for the incidence of silkworm diseases especially pebrine. A total of 1242 lots (319 Bivoltine & 923 Multivoltine) and 1394 samples (Bivoltine 393 & Multivoltine 1001) were tested in seed areas at Anekal and Kungul (Karnataka), Hosur and Denkanikottai (Tamil Nadu) and Hindupur and Meadanapalle (Andhra Pradesh).

Basic seed farms viz., P4, Hassan (CSRTI, Mysore) and P3, Mysore (NSSO, Bangalore) were also monitored for pebrine incidence and its containment in seed crop rearing and basic seed production.

7.7. Human Resource Development & Extension

Thirteen training programmes on various aspects of seed technology were conducted in 22 batches under regular courses, Central Sector Schemes, Third Contry (JICA) and additional training programmes as per the request of concerned State Sericulture Department. 306 candidates from various State Sericulture Departments/agencies (Karnataka, Tamil Nadu, Andhra Pradesh), CSB, NSSO, RSPs of West Bengal and Third Country Trainees from Ethiopia, Ghana, Kenya, Uganda, Nepal, Egypt, Nigeria, Fiji, Haiti were imparted training.

Integrated Skill Development Scheme- Training was given to 20 candidates in Silkworm Seed Crop Rearing and Silkworm Seed Production Techniques & Grainage Management.

7.8. Transfer of Technology

Ten TOT programmes (Karnataka, Tamil Nadu and Andhra Pradesh) were conducted for the benefit of technical officers/officials of Department of Sericulture, field functionaries, seed farmers and seed producers covering 736 personnel in long-term preservation technology for crossbreed laying (PMx CSR2), egg handling techniques, silkworm disease.

7.9. Sub-Unit, BSF, Yediyur

436 DFLs of Pure Mysore were reared and 249.65 kg of cocoons were generated with an average yield of 60.80kg/100 DFLs and supplied to SSPCs of NSSO for CB dfls production.

7.10. Training for LSPs

SSTL, Kodathi, organized two training programmes each every year during XI Plan for the benefit of Licensed Seed Producers (LSPs). A large number of LSPs took advantage of these training programmes (Table 7.1).

Table 7.1. Number of Training Programmes Conducted During XI Plan

Year	Training Programme Details	Total no. of Participants
2007-08	Empowerment of LSPs by Skill Development	15
	Quarantine Testing of silkworm eggs under mulberry	08
2008-09	Empowerment of LSPs by Skill Development	14
	Quarantine Testing of silkworm eggs under mulberry	38
2009-10	Empowerment of LSPs by Skill Development	24
	Quarantine Testing of silkworm eggs under mulberry	34
2010-11	Empowerment of LSPs by Skill Development	30
	Quarantine Testing of silkworm eggs under mulberry	-
2011-12	Empowerment of LSPs by Skill Development	68
	Quarantine Testing of silkworm eggs under mulberry	-

CHAPTER VIII

EVALUATION OF R&D ACTIVITIES OF CENTRAL SERICULTURE GERMPLASM RESOURCES CENTRE (CSGRC), HOSUR, TAMIL NADU, DURING XI PLAN

8.1. Introduction

The Central Sericulture Germplasm Resources Centre (CSGRC), Hosur, Tamil Nadu is the national nodal centre for conservation of Sericultural Germplasm in the country for collection, characterization, evaluation, maintenance, supply of mulberry and silkworm genetic resources for pre-breeding of elite mulberry and silkworm races in India. The activities of the centre are oriented to achieve set mandate. CSGRC has been recognized as National Active Germplasm Site for Silkworm Germplasm in the country by National Bureau of Agriculturally Important Insects (NBAIL), Bangalore, similar to Mulberry Germplasm recognized by National Bureau of Plant Genetic Resources (NBPGR), New Delhi during the year 2006.

CSGRC has two separate divisions dealing with mulberry plants and silk worms such as Mulberry Division and Silkworm Division. The supply of germplasm for utilization of crop improvement programmes is the major mandate. 331 mulberry accessions were supplied to 13 indenters in 15 spells for research and biodiversity conservation. 65 silkworm multivoltine accessions were supplied to six indenter and 48 silkworm bivoltine accessions were supplied to 7 indenters in equal number of spells for research institutes and postgraduate studies in universities.

8.2. R&D Projects undertaken during XI Plan

CSGRC, Hosur, has undertaken many R&D projects during XI Plan. Since the projects are of long term nature, the work is in progress for many projects (**Table 8.1**). Details regarding these R&D projects are given in **Table 8.2**.

Table 8.1. Number of Projects undertaken by the Research Institute during XI Plan

Year	Number of Projects	Status of project		
		Completed	Work in Progress	Technology Transferred (Lab to Land initiative)
2007-08	7	--	7	Not Applicable
2008-09	8	3	5	-do -
2009-10	8	--	8	-do -
2010-11	12	1	11	-do -
2011-12	11	3	8	-do -

Table 8.2. Research & Development projects taken up in the institute and nested units during XI Plan

Area of Research	Name of the Projects taken up	Amount sanctioned in the area of research (Rs Lakhs)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers benefited from the project
Development of high yielding silkworm breeds and their food plants (Mulberry) [Collection, characterization, evaluation and conservation and supply of mulberry and silkworm genetic resources]					
	2007-08	221.96			
	PIE-3380: Collection, Introduction, Characterisation, Evaluation, Conservation and Supply of Mulberry Genetic Resources	The total budget allotted to the centre has been utilized	Ongoing	9 added to gene bank Total collection: 1109 39 characterized 90 accessions were supplied	India being signatory to Convention of Biological Diversity (CBD) & to protect the IPR rights, the mulberry and silkworm germplasm is collected evaluated and conserved in gene bank to preserve the germplasm resources for posterity & for sustainable utilization by all stake holders in silk improvement programme.

	PIP-3256: Evaluation of Elite Mulberry Genetic Resources for abiotic and Biotic Stresses in Hotspot Locations		Ongoing	9 added to gene bank Total collection: 1109 39 characterized 90 accessions were supplied	- do -
	AIE-3381: Collection, Introduction, Characterisation, Preliminary Evaluation, Conservation and Supply of Silkworm Genetic Resources			2 BV collected ; total collection: 339; 25 silkworm accessions to 10 indenters	-do-
	AIP-3382: Biochemical Characterisation and Evaluation of Silkworm Genetic Resources			Genetic variability studied in 21 BV SWGRS for 3 isozymes	-do-
	CYR-7027: Evaluation of Silkworm Genetic Resources for Post-cocoon Traits (Collaborative research project with CSTR, Bangalore).			30 BV were evaluated for reeling traits	-do-
	AIG-3383: Molecular Characterisation of Silkworm (<i>Bombyx mori</i> L.) Genetic Resources (Phase-III)			20 MV and 4 BV DNA samples analyzed with 15 UBC primers using ISSR PCR	-do-

	BT/PR5224/PBD/19/117/2004: Identification of DNA Markers Associated with Diseases and Pest Resistance in Mulberry (<i>Morus</i> spp.) [Funded by DBT]	17.1	Ongoing	Natural incidence of diseases and pests were recorded in 144 mulberry accessions	
	2008-09	324.76			
	PIE-3380: Collection, introduction, characterization, evaluation, conservation and supply of mulberry genetic resources	The total budget allotted to the centre has been utilized	Completed	42 accessions were collected; total in gene bank : 1120 ; 455 accessions supplied to 11 institutes	India being signatory to Convention of Biological Diversity (CBD) & to protect the IPR rights ,the mulberry and silkworm germplasm is collected evaluated and conserved in gene bank to preserve the germplasm resources for posterity & for sustainable utilization by all stake holders in silk improvement programme.
	PIT- 3254: Cryopreservation of promising mulberry genetic resources collected through different geographical region of India (Collaborative Project with NBPGR, New Delhi)		Ongoing	30 mulberry accessions cryopreserved in NBPGR, New Delhi. 15 tried for <i>in-vitro</i> regeneration	At NBPGR cryo gene bank the mulberry buds are cryopreserved in LN as a safety backup and these buds can be retrieved anytime and through tissue culture mulberry plant can be retrieved.

	AIE-3381: Collection, introduction, characterization, preliminary evaluation, conservation and supply of silkworm genetic resources		Completed	432 Silkworm germ plasm genetic resources conserved.21 MV 14 BV supplied to 10 indenters	CSGRC, Hosur ecognized as National Active Germplasm site for protection of mulberry and silkworm genetic resources in country. The centre assign national accession numbers for all breeds developed in country through NBAIL, Bangalore to protect breeders rights
	AIP-3382: Biochemical characterization and evaluation of silkworm genetic resources		Completed	41 MV evaluated for thermo stable esterase	-do-
	AIG-3383: Molecular characterization of silkworm (<i>Bombyx mori</i> L.) genetic resources (Phase-II)		Ongoing	12 Silkworm genetic resources characterized with 10 ISSR random primers	-do-
	CYR-7027:Evaluation of silkworm genetic resources for post cocoon traits (Collaborative project with CSTR, Bangalore)		Completed	22 BV accessions evaluated for Post cocoon traits	-do-
	BT/PR5224: Identification of DNA markers associated with disease and pest resistance in mulberry (<i>Morus</i> spp.) (Collaborative Net working Project with DBT fund)	0.54	Ongoing	15 mulberry acc. identified for further studies against powdery mildew, root knot and tukra	The identified genotypes to be used as parent source material for developing disease resistant mulberry variety

IT initiate -ve	FSL-3417: Development of database management system for mulberry genetic resources		Ongoing	Window version of MGIS initiated	Database utilized by scientists of mulberry division
	2009-10	317.07			
	PIE-3433: Collection, introduction, characterization, evaluation, conservation and supply of mulberry genetic resources	The total budget allotted to the centre has been utilized	Ongoing	41 mulberry samples collected. Total Collections in gene bank - 1136. Supplied 123 accessions to 5 Institutes	India being signatory to Convention of Biological Diversity (CBD) & to protect the IPR rights ,the mulberry and silkworm germplasm is collected, evaluated and conserved in gene bank to preserve the germplasm resources for posterity & for sustainable utilization by all stake holders in silk improvement programme
	PIG-3432: Physiological characterization of selected mulberry genetic resources with reference to water and nitrogen use efficiency		Ongoing	Project initiated with 120 diverse mulberry accessions Raised in nursery for experiments	New project formulated to Develop drought /heat tolerant mulberry varieties
	PIT-3254: Cryopreservation of promising mulberry genetic resources collected through different geographical region of India (Collaborative Project with NBPGR, New Delhi)			30 mulberry accessions cryopreserved at NBPGR,N.Delhi. 15 acc. <i>in vitro</i> regeneration	At NBPGR cryo gene bank the mulberry buds are cryopreserved in LN as a safety backup and these buds can be retrieved any time and through tissue culture mulberry plant can be retrieved

	AIE-3434: Collection, Introduction, Characterisation, Preliminary Evaluation, Conservation and Supply of Silkworm Genetic Resources		Ongoing	10 BV collected 441 SWGRs are conserved. Supplied 159 MV and 43 BV supplied to 15 indenters	CSGRC, Hosur recognized as National Active Germplasm site for protection of mulberry and silkworm genetic resources in country. The centre assign national accession numbers for all breeds developed in country through NBAII, Bangalore to protect breeders rights
	CYR-7027: Evaluation of silkworm germplasm for post cocoon characteristics [collaborative]		Ongoing	16 BV evaluated for post cocoon traits	-do-
	AIP-3430: Biochemical characterization and evaluation of promising silkworm germplasm through enzyme kinetics to screen hardiness among silkworm genetic resources		Ongoing	10 MV & 10 BV for esterase and alkaline protease kinetics	-do-
	AIG-3431: Molecular characterization of silkworm Genetic Resources through Expressed Sequence Tagged Sites (EST) for associating gene specific markers with productive traits		Ongoing	10 MV & 2 BV were characterized through SSR markers and related to productive traits	-do-

IT initiative	FSL-3417: Development of database management system for mulberry genetic resources		Ongoing	Data on 1065 accessions were recorded in digital form and updated	Database used by the scientists
	2010-11	365.18			
	PIE-3433: Collection, introduction, characterization, evaluation, conservation and supply of mulberry genetic resources		Ongoing	48 mulberry samples collected. Total collections: 1180 47 Accessions supplied to 8 indenters	India being signatory to Convention of Biological Diversity (CBD) & to protect the IPR rights, the mulberry and silkworm germplasm is collected, evaluated and conserved in gene bank to preserve the germplasm resources for posterity & for sustainable utilization by all stake holders in silk improvement programme
	PIG- 3342 :Physiological characterization of selected mulberry genetic resources with reference to water and nitrogen efficiency		Ongoing	Experimental Plantation with 120 accessions taken up under ARBD along with check variety	-do-
	PIE: 3443 : Screening of mulberry germplasm accessions for tolerance to abiotic stress (alkalinity and salinity) conditions		Ongoing	Initiated the experiment for abiotic stress with 25 accessions	-do-

	PIT- 3254 : Cryopreservation of promising mulberry genetic resources collected from different geographical regions of India. (Collaborative with NBPGR, New Delhi)		Ongoing	36 accessions cryopreserved using dehydration and slow freezing protocol. So far 338 accessions cryopreserved	At NBPGR cryo gene bank the mulberry buds are cryopreserved in LN as a safety backup and these buds can be retrieved anytime and through tissue culture mulberry plant can be retrieved.
	AIE-3434 : Collection, Introduction, Characterization , reliminary Evaluation, Conservation and Supply of Silkworm Genetic Resources.		Ongoing	Two silkworm accessions were collected. Total collection : 443 ; 79 BV and 71 MV were supplied to 18 indenters	India being signatory to Convention of Biological Diversity (CBD) & to protect the IPR rights, the mulberry and silkworm germplasm is collected, evaluated and conserved in gene bank to preserve the germplasm resources for posterity & for sustainable utilization by all stake holders in silk improvement programme
	CYR-7027 : Evaluation of silkworm germplasm for post cocoon characteristics [collaborative]		Ongoing	11 BV were evaluated or post cocoon parameters	-do-
	AIP-3430 : Biochemical characterization and evaluation of promising silkworm germplasm through enzyme kinetics to screen hardiness among silkworm genetic resources		Ongoing	72 MV acc. categorized based on esterase enzyme activity	-do-

	AIG-3431 : Molecular characterization of silkworm Genetic Resources through Expressed Sequence Tagged Sites (EST) for associating gene specific markers with productive traits		Ongoing	30 MV were characterized 3 EST markers	-do-
	PIE-3451 : DNA marker aided analysis of mulberry gene bank towards a core assembly for sustainable conservation and enhanced utilization in crop improvement (DBT collaborative project with CSRTI, Mysore)	0.47	Ongoing	616 acc. short listed towards establishment of core assembly	-do-
	AIT-3450 : Long-term preservation of eggs, embryos of silkworm genetic resources through cryopreservation - DBT sponsored project.		Ongoing	The eggs of silkworm were dechorionated and hatching recorded	The silkworm accessions will be preserved to prevent from extinction

IT initiate -ve	FSL-3417 : Development of database management system for Mulberry genetic resources		Completed	Mulberry Database CD prepared with 1065 acc.	Data base utilized by the scientists of mulberry and silkworm division
IT initiate -ve	FSL-3447 : Development of database management system for Silkworm genetic resources		Ongoing	Window version of Silkworm Germplasm Information System is initiated	-do-
	2011-12	344.44			
	PIE-3433 : Collection, introduction, characterization, evaluation, conservation and supply of mulberry genetic resources		Completed	17 mulberry samples were collected , Total accessions in gene bank : 1239; Supplied 331 acc. to 16 institutes	India being signatory to Convention of Biological Diversity (CBD) & to protect the IPR rights, the mulberry and silkworm germplasm is collected, evaluated and conserved in gene bank to preserve the germplasm resources for posterity & for sustainable utilization by all stake holders in silk improvement programme
	PIG- 3432 : Physiological characterization of selected mulberry genetic resources with reference to water and nitrogen efficiency		Ongoing	20 selected accessions were subjected to water stress and identified top ranking accessions	-do-
	PIE-3443 : Screening of mulberry germplasm accessions for tolerance to abiotic stress (alkalinity and salinity) conditions”		Ongoing	22 accessions were screened at two levels of salinity, pH 8.5 and found tolerant accessions.	-do-

	PIT - 3254 : Cryopreservation of promising mulberry genetic resources collected from different geographical regions of India. (Collaborative with NBPGR, New Delhi)		Completed	45 accessions were cryopreserved totaling 383 accessions cryopreserved in NBPGR, New Delhi and CSGRC, Hosur	At NBPGR cryo gene bank the mulberry buds are cryo preserved in LN as a safety backup and these buds can be retrieved anytime and through tissue culture mulberry plant can be retrieved
	AIE-3434 : Collection, Introduction, Characterization , preliminary Evaluation, Conservation and Supply of Silkworm Genetic Resources.		Completed	All 443 SWGRS were conserved National Accession Number from NBAIL, Bangalore obtained. Supplied 65 MV and 48 BV to 22 indenters	India being signatory to Convention of Biological Diversity (CBD) & to protect the IPR rights, the mulberry and silkworm germplasm is collected, evaluated and conserved in gene bank to preserve the germplasm resources for posterity & for sustainable utilization by all stake holders in silk improvement programme
	CYR-7048 : Evaluation of silkworm germplasm for post cocoon characteristics [collaborative]		Completed	5 BV and one MV accessions were evaluated for 16 post cocoon traits	-do-
	AIP-3430 : Biochemical characterization and evaluation of promising silkworm germplasm through enzyme kinetics to screen hardiness among silkworm genetic resources		Ongoing	100 BV and 30 MV were screened for genetic hardiness by Enzyme inhibitor kinetics. 14 BV and 13 MV were identified with thermo tolerant character	-do-

	AIG-3431 : Molecular characterization of silkworm Genetic Resources through Expressed Sequence Tagged Sites (EST) for associating gene specific markers with productive traits		Ongoing	130 BV and 30 MV were screened for productivity through growth and yolk protein gene. 3 alleles were identified relating to productivity	-do-
	AIG-3454 : Evaluation of elite bivoltine silkworm germplasm in different agro climatic conditions: All India Silkworm Germplasm Evaluation Programme (AISGEP), Phase -II		Ongoing	10+1 BV accessions were evaluated in 7 network centers under spring rearing for identifying potential accessions	Promising region and season specific silkworm accessions will be identified for the use of Breeders.
	PIE-3451 : DNA marker aided analysis of mulberry gene bank towards a core assembly for sustainable conservation and enhanced utilization in crop improvement (DBT collaborative project with CSRTI, Mysore)	6.27	Ongoing	Established plantation of 520 short listed accessions under ARBD and supplied samples of 194 mulberry accessions to CSRTI, Mysore for molecular characterization	The core collections of mulberry can be established for sustainable conservation and enhanced utilization in crop improvement

	AIT-3450: Long-term preservation of eggs, embryos of silkworm genetic resources through cryopreservation - DBT sponsored project.		Ongoing	Protocol for dechorination of silkworm eggs developed and bioassay studies completed. Initiated studies on cryo protectant and chill sensitivity.	The core collections of mulberry can be established for sustainable conservation and enhanced utilization in crop improvement
IT initiatives	FSL-3447 : Development of database for silkworm genetic resources		Completed	Database management module for rearing and reeling data completed and photo images linked with individual accessions.	Database utilized by the scientists of silkworm division
Total		1597.79			

Table 8.3. Sources of Funding and Expenditure of R&D Projects during XI Plan

Sl. No	Source of Grants/Funds/Sponsors	Approximate Annual Funding (In Lakhs)				
		2007-08	2008-09	2009-10	2010-11	2011-12
a)	State Government	--	--	--	--	--
b)	CSB (under the R&D scheme)	221.96	324.76	317.07	365.18	344.44
c)	Industries	--	--	--	--	--
d)	International Bodies	--	--	--	--	--
e)	Others (Specify) DBT	17.1	0.54	--	0.47	6.27
	Total Funding	239.06	325.30	317.07	365.65	350.71
	Expenditure	239.06	325.30	317.07	365.65	350.71

8.3. Institute's achievements during XI Plan

Mulberry accessions 1217 (Indigenous : 885 Exotic: 332) were supplied to 56 institutions for research, fruit yielding trees and Biotechnological studies. 263 bivoltine and 340 multivoltine silkworm genetic resources were supplied to 67 Institutes for research / PG studies and breeding purposes. The scientists have published a large number of articles in research journals and popular print media and also organized a large number of seminars (Table 8.4).

Table 8.4. Number of Research papers published during XI Plan

Year	No. of Research Papers published (Nos)
2007-08	48 (Research articles in journals : 21 , popular : 7, Seminars : 20)
2008-09	61 (Research articles in journals : 16 , popular : 8, Seminars : 37)
2009-10	27 (Research articles in journals : 17 , popular : 7, Seminars : 3)
2010-11	27 (Research articles in journals : 7 , popular : 5, Seminars : 15)
2011-12	24 (Research articles in journals : 7 , Seminars : 17)

Table 8.5. Number of training Programmes conducted during XI Plan

Year	No. of Training Programme	Total no. of Participants
2007-08	1 (Training on Biochemical and molecular characterization)	14 PG students
2008-09	1 (Training on Biochemical and molecular characterization)	7 PG students
2009-10	1 (Training on Biochemical and molecular characterization)	12 PG students
2010-11	13 as Resource Persons	300 farmers
2011-12	1 (Silkworm Germplasm Conservation and maintenance; 1 (Basic Computer, MS Office, Internet and e-mail)	1 (Scientist from CSRTI, Pampore) 31 (Staff of CSGRC and Eri SSPC, Hosur)

8.4. IT Initiative of CSGRC, Hosur, during XI Plan

CSGRC, Hosur, has developed two IT tools for the propagation of new technologies developed for the benefit of scientists and general public (Table 8.6). These IT initiatives include statistical package for Mulberry and silkworm Germplasm database development and analysis such as Win-MGIS and Win-SGIS.

Table 8.6. Details of IT Initiative undertaken to propagate new technologies developed by the R &D institute during XI Plan

Sl. No	New Technology Developed	IT Initiative details	Whether successful (1=yes 2=No)	Please explain the Impact
1	Statistical package for Mulberry and silkworm Germplasm data analysis	Installed in mulberry and silkworm Division of CSGRC and being used by the scientists to select top performing mulberry and silkworm germplasm varieties out of their experiments	1	Useful for the data analysis for selection of top performing accessions based on multiple traits and other basic statistics

2	Win-MGIS and Win-SGIS	Database for systematic storage and retrieval of germplasm data for future use	1	Being used by scientists of mulberry and silkworm division of CSGRC, Hosur
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8.5. R&D Activities planned for XII Plan

CSGRC, Hosur, has planned four new R&D initiatives during XII Five Year Plan. These initiatives include prebreeding of Mulberry and silkworm, cryopreservation of mulberry and silkworm, soil fertility and soil health management and water harvesting technologies.

Table 8.7. R&D Initiatives planned for the XII Plan

Sl.No.	Name of the initiative	Objectives/Targeted stake holders
1	Pre-breeding of mulberry and silkworm	To evolve breeding lines for quality based breed development
2	Cryopreservation of mulberry and silkworm	For long term conservation of mulberry and silkworm genetic resources
3	Soil fertility and soil health management	To improve the soil fertility and increasing organic soil components
4	Water harvesting technologies	For recharging ground water level

8.6. Suggestions for improving the R&D Activities during XII Plan

- Survey and exploration of mulberry and silkworm genetic resources in unexplored areas within the country.
- Introduction of mulberry and silkworm genetic resources of exotic origin through international channels.
- Establishment of backup centers for conservation of mulberry and silkworm genetic resources in different agro climatic zones.
- Long term conservation of mulberry and silkworm genetic resources through cryopreservation technology.

CHAPTER IX

EVALUATION OF R&D ACTIVITIES OF CENTRAL SILK TECHNOLOGICAL RESEARCH INSTITUTE (CSTRI), BANGALORE DURING XI PLAN

9.1. Introduction

Central Silk Technological Research Institute (CSTRI) has its head quarters at Bangalore and the sub-units spread across the country. CSTRI has 11 Demonstration Cum Technical Service Centres (DCTSC) at Dharwad, Hindupur, Darmapuri, Jammu, Malda, Suri, Hagalpur, Varanasi, Dehradun, Bhandara and Cuttack, 6 Silk Conditioning and Testing Houses (SCTH) at Bagalore, Dharmavaram, Kancheepuram, Jammu, Srinagar and Malda, 4 Textile Testing Laboratories (TTL) at Bangalore, Jammu, Bhagalpur and Varanasi, 1 Zonal Office at Bilaspur, 2 Raw silk Testing Centres (RSTC) at Sidlaghatta and Kollegal, 2 Cocoon Testing Centres (CTC) at Ramnagaram and Coimbatore and 1 Regional Silk Technological Research Station (RSTRS) at Khanapara.

Ushma Shoshak unit was developed to reduce the fuel consumption for production of raw silk. The unit along with 1000 LPD insulated water tank was installed at Multi end reeling unit at Sidlaghatta. The comparative properties of fabrics made of Chinese bivoltine, Indian bivoltine and Indian multivoltine silk were analyzed. There was significant difference in drape co-efficient between the fabrics and Indian multivoltine. Fabrics made of Indian multivoltine were more lustrous than other silks and under subjective analysis; fabric made of Indian multivoltine scored the highest ranking. It has better drape which is a desirable quality for sarees and dress materials. Silver nano particles were synthesized using sericin for imparting durable anti microbial properties to silk textiles. It was observed that the raw silk fabric does not possess antimicrobial properties while degummed silk fabric and AgNP treated fabrics showed antimicrobial properties. AgNP treated samples showed more than 90% reduction against *Klebsiella pneumoniae* (ATCC 4352) and *Staphylococcus aureus* (ATCC 6538), whereas controlled showed no bacterial reduction. Cytotoxicity test of AgNP treated samples showed is under progress.

9.2. Product design, development and Diversification

The following fabrics were developed:

- Gents shawl using 2/40s peduncle yarn
- Ladies shawl using 2/40s peduncle yarn
- Fabrics made from eri spun yarn
- Furnishing fabrics from mill spun peduncle yarn
- Tasar sari produced on power-loom using wet reeled tasar yarn
- Solapur chadars
- Aurangabad chadars
- Eri napkins
- Imroo shawls
- Prayer mats

9.3. Training and Testing

136 candidates were trained on post cocoon activities under training programmes conducted by the main Institute. In addition, 24 candidates were trained in the Trainers' Training Programme under Integrated Skill development Scheme (ISDS). 1032 lots (cocoon, raw silk, fabric, water, etc.) were tested under physical, chemical and eco parameters have been tested at Main institute and revenue of Rs.686 lakhs was earned.

9.4. CDP Implementation

The main institute along with the sub-units implemented the various schemes of the post cocoon sector under the XI Plan catalytic Development Programme (CDP). The details regarding the R&D activities undertaken during XI Plan in the Post Cocoon sector are given in **Table 9.1**.

Table 9.1. Number of Projects undertaken by the Research Institute during XI Five year Plan

Year	Number of Projects	Status of project		
		Completed	Work in Progress	Technology Transferred (Lab to Land initiative)
2007-08	15	01	14	6
2008-09	14	10	04	6
2009-10	11	08	03	11
2010-11	03	01	02	1
2011-12	07	03	04	2

The sub units of CSTRl were involved in organizing various training programmes, conducting technology demonstrations and field interaction programmes, implementation and monitoring of various XI Plan CDP schemes. The sub-units were also involved in adoption of reeling, weaving, twisting and dyeing units for continuous monitoring for overall improvement. Testing services is the other major activity of the sub units. The progress of the R&D activities and its impact are given in **Table 9.2**.

Table 9.2. Area in which Research & Development projects have been taken up in the institute as well as in its nested units during XI Plan

Area of Research	Name of the Projects taken up	Amount sanctioned in the area of research (Rs Lakhs)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective
Post Cocoon Technology (PCT)	Utilisation of inferior quality cocoons as raw material for the production of lustrous silk tow: CYR 7020	7.76	Completed	Prototype tow silk producing machinery has been fabricated. Silk tow samples, both raw and twisted have been produced. Process parameters for the production of silk tow have been standardized.
PCT	Design and development of conveyor cooking machine - Phase II: CYR 7029	14.57	Completed	Modifications and fine tuning of conveyor cocoon machine developed during Phase I was carried out.
PCT	Development of reeling process parameters for the cocoons produced under unfavourable (monsoon) season for achieving better reeling performance and quality of silk: CYR 7028	7.99	Completed	Reeling technology package using multiend reeling machinery for the cocoons produced under unfavourable season has been developed by which considerable improvement in terms of reelability, productivity and quality characteristics of raw silk can be achieved.
PCT	Evolving process norms for silk reeling on cottage basin and multiend reeling units: CYR 7035	9.15	Completed	Process norms for silk reeling on cottage basin and multiend reeling have been developed which would help in improving the efficiency, thereby productivity, raw silk recovery and quality of silk in the reeling sector.
PCT	Development of tasar reeling technology package to produce superior quality tasar silk: CYR 7019	14.44	Completed	Tasar reeling package has been developed by which superior quality tasar silk yarn can be produced.
PCT	Development of silk fancy yarn: CYR 7023	24.24	Completed	Various types of fancy yarns like chennile, feather, boucle and slub yarns have been produced by using tasar spun silk yarn of different counts for product development in non-mulberry as well as mulberry silk.

PCT	Production of Non-Mulberry mill spun silk yarn, fabric and its characterisation: CYR 7024	14.44	Completed	Specific degumming recipe has been developed for Eri cocoons under this project. High quality eri spun yarn of 2/80s , 2/120s count has been manufactured in bulk scale successfully in worsted spinning system.
PCT	Dyeing of eri spun silk yarn: CYR 7026	13.63	Completed	Suitable methodology and recipe for degumming/scouring, bleaching and dyeing for both hand and mill eri spun silk yarn have been developed.
PCT	Detection & quantification of heavy metal present on different races of mulberry & non mulberry cocoons, undegummed, degummed & bleached yarn (Indian & Chinese): CFC 7034	4.15	Completed	This study revealed that the heavy metals present in the cocoons and yarns may come from unexpected source i.e.; mulberry leaf. Cd, Cu and Zn were detected in all the samples more than the permissible limit as per the MST standards for eco parameters.
PCT	Studies on abrasion resistance of woven silk fabrics in wet and dry conditions: CFW 7033	6.00	Completed	The study helped in better understanding of how abrasion affects the surface of soft silk, taffetta and dupion silk fabrics. With the importance of crimp distribution established, it is possible that abrasion characteristics of a fabric can be altered by any factor which will modify the crimp balance. Parameters responsible for abrasion of silk fabrics were found out.
PCT	Studies on stretch and growth properties of woven fabrics in wet and dry conditions: CYF 7038	8.23	Completed	The wet and dry stretch and growth properties of different types of silk fabrics were compared in this study. It was found that growth in woven mulberry silk fabrics (except crepe) was less than 1 percent. Crepe, dupion and tasar fabrics need more confide.
PCT	Investigation into optimum physical and structural properties required for making zari yarn - Comparison of multiend raw silk and cottage basin silk: CYR 7036	11.18	Completed	This study has brought to focus a comprehensive understanding of the two reeling systems used for manufacturing raw silk yarn used in the making of zari. Based on the outcome of the study, a set of guidelines are now available to Multiend reelers which can guide them to produce raw silk yarn quality similar to the domestic basin in order to cater to the requirements of zari manufacturers.
PCT	Techno economics of cottage basin and multiend silk reeling: CYR 7039	6.95	Completed	The impact analysis showed that the cottage basin reeling is making adequate profits due to low investment and also lower operational costs while multiend reeling is not generating adequate profits due to the high investment at the time of establishment and higher operational and fixed costs for the production of better quality raw silk. The analysis also indicated that the cost of quality, which the multiend reelers are incurring in terms of the

				high investment at the time of establishment and higher cost of conversion for production of better quality of silk, is not adequately compensated by the value of quality in terms of price of raw silk offered by the market. Hence the support in terms of investment subsidy and production incentive is essential in multiend reeling for improvement in quality standards of Indian raw silk.
	Studies on factors influencing productivity and quality of fine denier raw silk: CYR 7041	8.00	Completed	Fine denier raw silks of 10/12, 12/14 and 14/16 denier were evaluated for quality parameters of bivoltine and multivoltine cocoons at different reeling speeds. The results showed that with increase in reeling speed, there is decrease in reelability (%) and increase in silk waste (%). It was also inferred that, with the increase in reeling speed cohesion increases and visual characteristics like neatness and cleanness (%) decrease in the case of both of bivoltine and multivoltine silk of different deniers.
PCT	Effective by-products utilisation through the development of silk non wovens: CFW 7031	11.77	Completed	Possibilities of production of silk non-wovens from different silks and silk wastes were explored and the processes were standardised. The developed silk non-wovens were characterised.
PCT	Study of influence of weaves on silk fabric properties: CFW 7032	5.73	Completed	Under the project, the influence of basic weaves like plain, twill and sateen on silk fabric properties (mechanical and total handle values) was studied. The information generated would be helpful to weavers for producing efficient and optimal silk fabric.
PCT	Study of comparative functional and aesthetic properties of cloth woven with parallel and swing beat-up: CFW 7045	4.44	Completed	The study showed that the over all flexural rigidity of parallel and swing beat-up fabrics was significantly different and hence considering the bending properties of both the fabrics, the fabric woven with parallel beat-up was stiffer than the fabric woven with swing beat-up. However the drape coefficient percentage of fabrics woven with parallel and swing beat-up was not significantly different, therefore, both the fabrics had similar draping quality. Based on the results, fine-tuning of the five-wheel take-up to facilitate the parallel beat-up mechanism developed by CSTRI on frame and pit handlooms has been completed.
PCT	Studies on application of stain guard finishes on silk yarn / fabric: CYF 7044	6.23	Completed	The standard recipe and optimum process parameters for the application of stain guard finish has been successfully developed for both mulberry and tasar silk yarn and fabric. This finish can withstand 15 to 20 washes in case of all the varieties of the fabrics studied. Breakability of the treated fabrics was retained.
PCT	Studies on application of	13.92	Completed	A recipe for dyeing of mulberry silk with lac

	lac dye on mulberry silk: CFC 7025			dye with out using any mordent has been successfully developed.
PCT	Studies on application of fire retardant finish to silk fabrics: CYF 7042	10.59	Completed	The standard recipe and optimum process parameters for the application of fire retardant finish for silk fabrics has been successfully developed.
PCT	Studies on application of solar heating system in multiend reeling unit: CYR 7043	17.42	Completed	This study would provide information required to plan efficient usage of solar energy resulting in reduced fuel consumption / cost and help in controlling deforestation.
PCT	Studies on the comparative properties of the fabrics woven with Indian multivoltine, Indian bivoltine and Chinese bivoltine silk with reference to the consumer preference: CFW 7040	8.05	Completed	Comparative study of the fabric characteristics made from Chinese bivoltine, Indian bivoltine and Indian multivoltine silk would help in better understanding of the performance of fabrics made out of Indian silk vis-à-vis Chinese silk
PCT	Application of silver nano particles synthesised using sericin for imparting durable antimicrobial properties to silk textiles: CFC 7050	6.75	Completed	The project would result in technology for imparting durable antimicrobial finish to silk fabrics and other health products Application of silver nano particles synthesised using sericin for imparting durable anti microbial properties to silk textiles was studied. It was observed that AgNP treated samples showed more than 90% reduction against Klebsiella pneumoniae (ATCC 4352) and Staphylococcus aureus (ATCC 6538), whereas controlled showed no bacterial reduction. Further cytotoxicity test of AgNP treated samples was conducted which was negative.
PCT	Study on piling resistance of eri silk knits: CFW 7048	2.585	Continued	To be completed during 2012-13
PCT	Investigation on causes for poor dimensional stability of tasar fabrics and remedial measures: CYF 7049	3.00	Continued	To be completed during 2012-13
PCT-NMR	Development of low cost eight end multiend reeling machine for production of superior quality tasar and muga silk yarn: CED 7046	5.00	Continued	To be completed during 2013-14
PCT-NMR	Fabrication of single end sizing machine for tasar silk: CED 7047	3.00	Continued	To be completed during 2013-14

Table 9.3. Source of funds and expenditure for R & D Projects

Sl. No.	Source of Grants/Funds/Sponsors	Approximate Annual Funding (In Lakhs)				
		2007-08	2008-09	2009-10	2010-11	2011-12
a)	State Government					
b)	CSB (under the R&D scheme)	223.01	214.34	211.40	167.48	244.44
c)	Industries	--	--	--	--	--
d)	International Bodies	--	--	--	--	--
e)	Others (Specify)	--	--	--	--	--
	Total Funding	--	--	--	--	--
	Total Expenditure	937.96	1302.96	1624.78	1521.91	1708.52

Table 9.4. Demonstration cum Technical Service Centre, Suri, Birbhum, W.B

Name of Technology/Process/ R&D Project	Method of Technology Transfer (i.e. On field Demonstration, Training etc.)	Approx No. of farmers benefitted till date	Comment on overall acceptability of these technologies by the beneficiaries
Propagation of Tasar reeling cum twisting on MRTM	Through awareness/ Demonstration, training etc.	250	Found satisfactory
Propagation of Tasar spinning packages on MSM	-Do-	230	Found satisfactory
Implementation of certified silk loom under 11 th plan scheme (along with SCTH, Malda)	Through awareness & demonstration	67	Fully accepted by the weavers and producing quality fabrics by utilizing new supplied looms.
Implementation of silk loom up-gradation programme under 11 th plan scheme(along with SCTH, Malda)	-do-	23	Fully accepted by the weavers and producing quality fabrics by utilizing new up-graded looms.
Establishment of silk wet processing unit(yarn dyeing & Fabric dyeing) under 11 th plan scheme (along with SCTH, Malda)	Through awareness, motivation and demonstration	2 Units	Accepted and utilizing the supplied equipments for producing quality dyed yarn and fabrics by the beneficiaries.

9.5. Highlights of the research outcome of CSTRI during the XI Plan

The following technologies were developed by CSTRI, Bangalore during the XI Plan Period.

- **Eight end multiend reeling machine for mulberry cocoons**

Eight-end-Multi-end reeling machines have been designed and developed. It was demonstrated in important reeling clusters and was well received.

- **CSTRI sorting machine for grading tasar cocoons**

This machine facilitates sorting of tasar cocoons as per the grade scientifically within short span of time.

- **Motorised cum pedal operated spinning machine**

This machine is used for spinning not only Vanya silks but also mulberry silk (pierced and cut cocoons). The device improves productivity and quality of the spun yarn ensuring better returns and has been adopted by spinners in NE India.

- **CSTRI Motorized Reeling Cum Twisting Machine (MRTM)**

This machine has helped in removing the drudgery, improving the productivity and quality of the tasar / muga yarn. It has been adopted by tasar / muga reelers in North & NE India.

- **CSTRI 2 in 1 Reeling-Cum Twisting Machine for Production of Twisted & Untwisted Raw Silk**

2- in-1 reeling cum Twisting machine has been developed to get both twisted and untwisted silk yarns on each side of the machine separately suitable for tasar and muga cocoons. It has been adopted by tasar & muga reelers in North and NE India.

- **Low cost solar operated spinning machine**

A low cost solar operated spinning machine has been developed to improve the quality of hand spun yarn, reduce production cost and drudgery and has been adopted by spinners in NE India.

- **CSTRI improved handloom Model-II (Frame loom / Pit loom)**

This loom improves productivity and enhances quality of the fabric produced. It has been adopted by weavers in various handloom clusters.

- **Parallel beat-up mechanism for handloom (Frame loom / Pit loom)**

This mechanism for handlooms improves the fabric cover and retains the lustre of zari and has been adopted by handloom weavers.

- **CSTRI Pneumatic Jacquard lifting mechanism (PLM) for handloom (frame loom or pit loom)**

This mechanism eliminates drudgery, increases professional lifespan of weavers, improves productivity and encourages women / new generation to take up design weaving. It has been widely accepted by handloom weavers.

Standard recipe and optimum process parameters for the application of stain guard finish for both mulberry and tasar silk yarn and fabric.

The standard recipe and optimum process parameters for the application of stain guard finish has been developed for both mulberry and tasar silk yarn and fabric. This finish can withstand 15 to 20 washes and retaining the breathability of the fabrics. It has been adopted by exporters.

- **Application of neem extract and lac dyes on mulberry silk**

These eco friendly recipes have been developed and adopted in the field.

9.6. Technologies transferred to the field during the XI Plan

- **Automatic Silk Reeling Machine**

Helps in bulk production international grade raw silk. It has been adopted by few reelers in South India.

- **Automatic Dupion Reeling Machine**

Helps in bulk production of international grade dupion silk. It has been adopted by few reelers in South India.

- **Silk Twisting Machine**

Improves quality of the twisted silk due to direct interaction with the users (weavers), helps in marketing and creates value addition to the reelers. It has been adopted by multiend reelers.

- **Tub Dyeing**

Improves the quality of yarn dyeing, fastness properties and luster of the fabric, improves working conditions in the unit and is environment friendly. It has been adopted by dyers in important clusters across the country.

- **Arm Dyeing Machine**

Improves the quality of yarn dyeing, fastness properties and luster of the fabric, improves working conditions in the unit, reduces manpower and is environment friendly. Due to low liquor ratio the fuel consumption and pollution load is less. It has been adopted by many dyers across the country.

- **Fabric Dyeing Machine**

Improves the quality of dyeing, fastness properties and luster of the fabric, improves working conditions in the unit, reduces manpower and is environment friendly. It has been adopted by few dyers across the country.

- **Aasu Machine**

Reduces drudgery, increases the productivity in weft preparation for tie & dye fabric and reduces labour significantly. It has been adopted by handloom weavers in Pochampalli and Jangoan clusters of Andhra Pradesh.

- **Shuttleless Loom**

Facilitates high quality fabric production, increases productivity and reduces cost, helps in preparation of export oriented fabric, dress material, furnishing, etc. It has been adopted by weavers in different clusters across the country.

- **Cluster Specific Handloom with Jacquard**

This has been promoted to suit the specific style of weaving of each handloom cluster in the country. It has been adopted by handloom weavers in different clusters across the country.

- **Loom Upgradation (dobby, jacquards and pirn winding)**

Increases the design making capability of the weavers, value addition, reduces drudgery, improves quality and increases margins for the weavers. It has been adopted by handloom weavers in different clusters across the country.

- **Computer Aided Textile Design (CATD) System**

It includes computer (hard & software), card punching, lacing, scanner, etc. CATD System reduces cost of designing, saves manpower, help in faster creation of better designs, helps in storage, retrieving and modifications of designs and creation of design library by the designer. It has been adopted by designers in weaving clusters across the country. Low Cost Electronic Jacquard for Handloom & Powerloom: Reduces cost of designing considerably because there is no use of cards, ease of changing designs instantaneously and longer design life. All designs created can be stored (physical storage of cards is cumbersome and space consuming). It has been adopted by few weavers.

Table 9.5. Technologies transferred to the field during the XI Plan

Sl.No.	Particulars	Number
1	Multiend reeling machine	150
2	Automatic reeling machine	5
3	Twisting machine	144
4	Shuttleless looms	40
5	Certified looms	2746
6	Loom Upgradation	3693
7	Computer Aided Textile Design (CATD) System	332
8	Tub Dyeing	95
9	Arm dyeing	19
10	Fabric processing	14
11	Motorised reeling cum twisting machine	35
12	Motorised spinning machine	20

Table 9.6. Number of Patents applied and awarded during XI Plan

Year	No. of Patents Applied (Nos)	No. of Patents Awarded (Nos)
2007-08	02	-
2008-09	-	-
2009-10	03	-
2010-11	-	-
2011-12	-	-

Table 9.7. Number of Research papers published during XI Plan

Year	Number of Research Papers
2007-08	18
2008-09	25
2009-10	26
2010-11	40

Table 9.8. Number of training Programmes conducted during XI Plan

Year	No. of Training Programme	Total no. of Participants
2007-08	16	176
2008-09	24	354
2009-10	20	205
2010-11	14	183
2011-12	14	136

9.7. Suggestions for improving the scheme during XII Plan

- The reeling Technology needs to be improved because the technology has been developed 15 years ago. To make this technology more acceptable to the reelers, improvements are required.
- Reeling of silk uses a lot of water. Effort are required to recycle the water by using simple technologies
- In reeling process, alternate sources such as solar energy need to be tapped to reduce the dependence on wood. Also the shole process will be made more energy efficient.
- Non mulberry silk will be reeled by using wet reeling machines. CSTR I developed machine will be modified as per the requirement of reelers of Vanya silk
- New machineries need to be developed for Vanya silk / twisting and soaking. Methods need to be standardized for efficient reeling
- Objective gradation method of tasar silk is not available. This needs to be developed, which will help the reelers and wavers in sorting out price disputes and it will help in improving the quality of tasar silk.
- Tasar, Eri and Muga silk needs more attention in product development, standardization of processes etc., research will be conducted in these areas.
- The chemical processing of silk yarn/ fabric needs a lot of intervention. The colour fastness of silk fabrics needs to be improved by standardizing machines, dyestuff, process parameters, chemicals, etc. Though these are some how standardized for mulberry silk, a lot needs to be done for vanya silk.
- Dimensional stability is major concern for any silk fabrics. Finishing processes needs to be developed to solve the instability problem.

- More development needs to be made towards utilizing natural dyes for processing silk. This will help in bringing more value as worldwide there is an increased demand for natural products.
- Effluent treatment will be emphasized.
- Various applications of silk and its by-products in technical textiles will be developed.

CHAPTER X

R&D ACTIVITIES OF SERI BIOTECH RESEARCH LABORATORY (SBRL), BANGALORE, DURING XI PLAN

10.1. Introduction

The Seri biotech Research Laboratory (SBRL), Bangalore, is involved in research on various disciplines of Biotechnology i.e., Silkworm and Host Plant Genomics, Proteomics and Molecular Pathology through CSB and DBT funded programmes. The highlights of the research activities during the XI Plan period have been evaluated in the following sections.

10.2. Silkworm Proteomics

Quantitative expression by Real-Time PCR showed enhanced gene expression of the host-response proteins revealing activation of immune pathway, melanization events, proteolysis and Cellular apoptosis after uzifly infection. DDC showed up regulation at 48h after infection whereas down regulation at 72h. Phenol oxidase (PO) activity in integument showed a slow increase over ages with highest activity at 96h after infection indicating lower level of melanization events. Candidate gene expression studies showed activation of Toll Pathway genes such as BmToll, Spatzle, Dorsal and Relish. Real Time analysis of these genes in the integument showed early up regulation of most these genes, which showed the immune competence of integument of B. Mori against the parasitoid attack. Chaperone such as Hsp70 and Chaperonin showed an early up regulation after infection. RT-PCR studies from integument and haemocytes showed variability in expression of Ras1, PPO2 and PPAE between tissues and ages. Hsp70 was identified as one of the major stress protein that showed enhanced expression after the infection. To identify the interacting proteins of Hsp70 expressed during infection, interacting proteins were identified from integument and haemocytes.

10.3. Silkworm Genomics

The complete sets of raw and normalized data have been deposited in the NCBI Gene Expression Omnibus (GEO) repository (accession number GSE35622). A total of 638 genes were up regulated and 1136 genes were down regulated at 18 hrs after oviposition, whereas, 675 genes were found to be unregulated and 595 genes down regulated at 30 hrs after oviposition. Further, 115 genes were stably unregulated, while 117 genes stably down regulated at both 18 as well as 30hrs. The genes were classified based on functions into seven groups, viz., Immune, metabolism, stress, signal transduction, cell cycle, transcription, and apoptosis. The number of genes expressed under transcription mechanism increased in diapause eggs at 30 hrs compared to 18 hrs; where as in non diapause eggs the number of genes decreased. The genes involved in metabolism in non-diapause eggs at 18 hrs was 6% while, no genes were expressed at 30 hrs. Under stress mechanism, no genes were expressed in non-diapause eggs at 18 hrs while, at 30hrs 12% of the expressed genes fall under stress mechanism. In the signal transduction category there was not much difference in the number of genes expressed in diapause eggs at 18 and 30hrs while in non-diapause eggs the number of genes expressed decreased from 24% at 18hrs to 9% at 30hrs. The overall genes expressed at 18hrs was higher than that at 30hrs under both diapause and non-diapause conditions indicating that crucial biological processes for initiation or termination of the diapause mechanism occur during 18 hour time period.

Another approach to develop NPV resistant bivoltine has been taken up by using double stranded RNA interference techniques. The four important genes of the NPV i.e. ie1, leff1, lef3 and P74 have been targeted. Following the technology number of transgenic lines developed at CDFD, Hyderabad. In This project three transgenic silkworm lines MEF 118B, MEF 154D and MEF 164B have been selected. The recipient lines which are regularly being used as parents for making crosses like CSR 4 CSR 27 have been selected. The transfer of the transgenes has been introgressed by back cross breeding program. Thus six combinations of the bivoltine lines have been generated. The donor parents are being selected every time by observing eye color (DS red protein gene as a marker) associated with the transgene. Now the lines are at BC4F2 generation.

10.4. Molecular Pathology

Five mulberry insect pests' viz., Lime butterfly (*Papilio demoleus*), Common mormon (*Papilio polytes*), Crimson Roso (*Pachliopta hector*), Common Indian crow (*Euplea core*) and plain tiger (*Danaus chrysippus*) from the mulberry fields of Kolar, Chickaballapur and Bangalore Districts have been collected. Except *Danaus chrysippus*, remaining four insect pests found to have microsporidian infection. Studies on spore morphology (phase contrast), pathogenicity, mode of transmission and cross infectivity were carried out. Cross infectivity studies revealed that, except *Euplea core* others can infect the silkworms with low virulent nature. The molecular analysis in order to know the species status of the identified microsporidian by using SSU-rRNA gene analysis has been carried out. The nucleotide sequence homology showed that these microsporidian belongs to the genus, *Nosema*. Out of eighteen isolates of microsporidian species identified from the tasar silk moths from different states of Andhra Pradesh and Jharkhand, DNA was isolated from the six microsporidian species. The small subunit ribosomal RNA (SSU-rRNA) sequence gene was amplified, cloned, and sequenced from each of the 6 microsporidian isolates. These sequences were compared with 32 other microsporidian SSU-rRNA sequences to develop a phylogenetic tree for the microsporidian isolated from the tasar silk moth, *Antheraea mylitta*. Of the 6 microsporidian isolates, one isolate has gene sequence similar to *Vairimorpha* and others have the sequence homology with the *Nosema*.

Table 10.1. Number of Projects undertaken by the Research Institute during XI Plan

Year	Number of Projects	Status of project		
		Completed	Work in Progress	Technology Transferred (Lab to Land initiative)
2007-08	6	4	2	
2008-09	3	1	1	
2009-10	5	1	4	
2010-11	6	1	5	
2011-12	9	4	5	

Table 10.2. Area in which Research & Development projects have been taken up during XI Plan

Area of Research	Name of the Projects taken up	Amount sanctioned in the area of research (Rs Lakhs)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers benefitted from the project
Development high yielding silkworm breeds and their food plan (Mulberry & Vanya Silk plants)	Identification and mapping of DNA markers linked to NPV resistance in silkworm <i>Bombyx mori</i> L. [joint with APSSRDI, Hindupur] [(Dec 04-March 08) (July 09-June 12)]	65.65+31.10	Just Completed	Identified DNA markers and genes Associated with NPV tolerance.	Nil
	Phylogeography of <i>Antheraea mylitta</i> (tropical tasar silkworm) and <i>Antheraea assamensis</i> (muga silkworm)-in collaboration with CDFD, Hyderabad; CMERTI, Jorhat and CTRTI, Ranchi.)2005-2008)	54.49	Completed	Genetic Distance and relationship under Stood The highly divergent Breed in Tasar and Muga identified	The information Provided To respective Institutes
	Characterization of Eri silkworm (<i>Samia ricini</i>) with morphological characters and molecular markers. [(In collaboration with CEMRTI, Jorhat (2005-08)]	In house	Completed	Genetic Distance and relation Ship under Stood The highly divergent Breed in Tasar and Muga identified	The information Provided To respective Institutes
	Development of RNA interference (RNAi) based nuclear polyhedrosis virus resistance transgenic silk moth. [(jointly with CDFD, Hyderabad, APSSRDI, Hindupur) (Under Center of excellence on Genetics and	27.05	On going	Evolving NPV Tolerant Silkworm breed	NA

	Genomics of silk moth tp CDFD Hyderabad – Phase II). [sep 09-june 11) (Aug 11-Sep 16)]				
	Isolation and characterization of Microsatellites in mulberry (<i>Morus spp.</i>) genome.(2011-14)	In house	On going	Evolving High Yielding Mulberry breeds	NA
Development disease management, disease forecast/ forewarning	Biology of microsporidians infecting silk moth.[<i>Bombyx mori Antheraea mylitta</i>] (june 09-May 12)	30.37	Just Completed	Identifying new Pebrine Causing Pathogens. Virulent and Nonvirulent microsporidians identified	Yet to Release Informatic techniques
	Identification isolation and molecular characterization of major pathogens associated with flacherie disease in <i>Bombyx mori</i> .(2011-13)	In house	On going	Identifying Pathogens associated with flacherie disease	NA
	Molecular characterization of the flacherie causing virus in <i>bombyx mori</i> with specific reference to RdRp (RNA Dependent RNA polymerase gene and the regulatory elements in the viral genome(2012-14).	In house	On going	Identify Association of RNA Viruses With Disease.	NA
Product development diversification	PCR-based detection of silkworm diseases	In house	Developed New Diagnostic technique	Completed	Technique being use in basic seed farm
Any other (please specify)	Studies on diapauses related gene expression in diapauses induced eggs of multivoltine silkworm race of	39.17	Just Completed	Identified Genes Associated With Diapause character	NIL

	<i>Bombyx mori</i> (june 09-May 12)				
	Molecular mechanism of stress in silkworms <i>Bombyx mori</i> and <i>Samia Cynthia ricini</i> (July- 2009 June2012)	30.35	Just Completed	Identified Genes Associated with pest infestation in silkworm	NIL
	Cloning expression ,and characterization of yolk protein receptors from Indian silkworms(2010-2013)	29.57	On going	To identify Genes Associated With Yolk Protein Expression.	

Funding of SBRL during XI Plan increased from Rs. 117.18 lakhs in 2007-08 to Rs 245.73 lakhs in 2011-12 (Table 10.3)

Table 10.3. Annual funding and expenditure of the R&D projects

Sl. No.	Source of Grants/Funds/Sponsors	Annual Funding (In Lakhs)				
		2007-08	2008-09	2009-10	2010-11	2011-12
a)	State Government	--	--	--	--	--
b)	CSB (under the R&D scheme)	41.26	83.64	50.16	33.26	31.00
c)	Industries	--	--	--	--	--
d)	International Bodies	--	--	--	--	--
e)	Others (Specify)	14.13	07.48	79.18	31.19	16.16
	Total Funding	55.39	91.12	79.18	64.45	47.16
	Total Expenditure	117.18	203.24	129.34	232.57	245.73

The SBRL had applied for only one patent during XI Plan, however, it was not awarded yet (Table 10.4). It was reported that 17 research papers have been published by the scientists of the institute during XI Plan (Table 10.5).

The SBRL had conducted 11 training programmes and a total of 54 persons got the benefit during XI Plan (Table 10.6)

Table 10.4. Number of Patents applied and awarded during XI Five Year Plan

Year	No. of Patents Applied (Nos)	No. of Patents Awarded (Nos)
2007-08	-	-
2008-09	1	-
2009-10	-	-
2010-11	-	-
2011-12	-	-

Table 10.5. Number of Research papers published during XI Five Year Plan

Year	No. of Research Papers published (Nos)
2007-08	1
2008-09	2
2009-10	4
2010-11	5
2011-12	5

Table 10.6. Number of training Programmes conducted during XI Five Year Plan

Year	No. of Training Programme	Total no. of Participants
2007-08	1	6
2008-09	2	6
2009-10	2	10
2010-11	4	22
2011-12	2	10

10.5. Achievements of the Institute during XI Plan

During the XI Plan a number of initiatives have been taken up to utilize modern scientific knowledge to (i) evolve robust silkworm breeds (ii) techniques to diagnose silkworm disease very precisely (iii) identify association of genes with NPV tolerance, diapause mechanism, pest infestation, quality and quantity of eggs. There are fruitful attempts to find out pathogens associated disease like flacherie and pebrine so that appropriate control measures may be taken up. Simultaneously efforts were made to unravel genetic structure of *A.Mylitta*, *A.assamensis* and *Samia cyntia ricni* population so that breed improvements could be implemented in non mulberry sector too.

CHAPTER XI

SUMMARY AND RECOMMENDATIONS

11.1. Introduction

This Chapter summarizes the findings of both physical and financial achievements of the Research & Development, Transfer of Technology, Training and IT Initiatives scheme implemented by the nine R&D institutions of CSB and its nested units during XI Five year plan. This chapter also provides the recommendations with respect to focus areas to make the scheme more effective during the XII Plan.

11.2. Financial progress of the R&D Scheme

Table 11.1 presents the XI Plan outlay and the actual expenditure towards the end of XI Five Year Plan based on 13 sub components of the scheme. It may be noted that the revised outlay had substantially increased from the original outlay of Rs.94.71 crores to Rs.144.55 crores by the end of XI Plan. Among the 13 sub components of the scheme only 3 subcomponents exceeded the initial plan outlay in terms of actual expenditure. These sub components are R&D activities of CSB institutes. The expenditure almost doubled in this subcomponent as it increased from R.60.01 crores to Rs.119.72 crores in the revised outlay. Similarly, R&D support for establishment of farmer's field schools and transfer of technology marginally exceeded the initial outlay. Financial progress was very less in the vase of some subcomponents such as IT Intitiatives (14.5%). Product development cell (32%), training initiatives (47%), remote sensing and GIS in sericulture development (62%) etc. Component wise outlay and expenditure and revised outlay has been given in **Table 11.1**.

Table 11.1: Component wise distribution of outlay and expenditure for R&D, Transfer of Technology/Training/IT initiatives during XI Plan

Sl.No.	Scheme / Components	XI Plan Outlay	Expenditure during 11 th Plan	Expenditure as % of Plan Out lay
1	R & D activities of CSB Institutes	60.01	123.41	205.65
2	Establishment of Regional Silk Technology Research Station, Assam	7.20	7.20	100.00
3	Establishment of Regional Eri Research Station	5.00	0.66	13.20
4	Strengthening of CTR & TI, Ranchi	1.00	0.66	66.00
5	Strengthening of CMER& TI, Ladoigarh	1.00	0.29	29.00
6	Establishment of Soil Science & Agro Chemistry facility	1.00	0.59	59.00
7	R & D support for establishment of Farmers' Field Schools	1.00	0.43	43.00
8	Disease forecasting & Forewarning	1.00	0.44	44.00
9	Remote Sensing & GIS in Sericulture Development	2.50	2.50	100.00
10	Training Initiatives	5.00	2.01	40.20
11	Transfer of Technology(ToT)	5.00	5.39	107.80
12	Product Development Cell	1.00	0.02	2.00
13	IT Initiatives	4.00	0.82	20.50
	Total for R & D, Training, ToT & IT Initiatives	94.71	144.60	152.68
	Non-Recurring	38.71	59.15	152.80
	Recurring	56.00	85.45	152.59

11.3. Physical progress of Research & Development, Transfer of Technology, Training & IT initiatives

R&D is the mainstay for the development of sericulture industry, which has been exclusively taken care of by Central Silk Board through a network of Research Institutes for all the sectors. During the year 2001, the Department of Science and Technology, Government of India has declared Central Silk Board as a Science and Technology (S&T) organization as a tribute to its pioneering research in the field of sericulture. Being an S&T organization, research and

development, extension and training are the major activities of the CSB, which are carried out through 9 major research institutes, 21 Regional Sericultural Research Stations and 55 Research Extension Centers, 6 Silk Conditioning and Testing Houses (SCTHs) & 9 Demonstration Cum Training Centers (DCTCS) in post Cocoon technology in Mulberry, Tasar, Muga & Eri.

The three main research institutes for mulberry sericulture are located at Mysore (Karnataka), Berhampore (West Bengal) and Pampore (J&K). An institute functioning exclusively for Tasar is located at Ranchi, Jharkhand, and for Muga and Eri, at Ladoigarh, Assam. An exclusive Research and Training Institute (CSTRI) for tackling post cocoon issues is functioning at Bangalore. In order to give focused attention to seed, a Silkworm Seed Technology Laboratory (SSTL) is functioning at Bangalore, for preserving and maintaining mulberry and silkworm genetic materials, a Central Sericultural Germplasm Resources Centre at Hosur and to exploit the bio-technological knowledge in sericulture, a Seri-biotechnological Laboratory is functioning at Bangalore. Each institute along with the Regional Research Stations carry out research on a variety of fields, the output of which are transmitted to field after undertaking testing and fine tuning at Research Extension Centers. In short, the sector is loaded with a number of exclusive research institutions and supportive units to develop, fine tune and propagate findings and technologies which ultimately benefit the sericulture industry.

The R&D activities on sericulture is under the exclusive domain of CSB and over the years, these institutes have contributed significantly to the development of silk industry in terms of increasing production, improving productivity and enhancing quality norms matching with international standards. Almost all the host plants being used by sericulture farmers are developed through R&D efforts along with the new silkworm breeds, package of practices, post cocoon technologies, disease management and a number of other technologies and findings which are readily accepted by farmers over the years. The development and introduction of improved cross breed and Bivoltine hybrids for tropical Indian conditions have heralded for major improvements in sericulture industry and the country is steadily but slowly reducing the demand supply gap.

The output derived from the R&D has translated into productivity improvements in spite of drastic reduction in host plant cultivation. During the XI Five Year Plan period, raw silk

production per Hectare has grown from 86.12 kg to 90.55 kg and renditta (quantity) of cocoons required to produce 1 kg Raw silk) decreased from 8.2 kg to 7.95 kg. The improvements in productivity parameters have helped the industry to attain the annual average growth rate of 4.25% during the XI Plan period.

A summary of the new technologies developed by various R&D institutions and the number of new technologies disseminated during XI Plan are given in **table 11.2**.

Table 11.2. Details of technologies developed and disseminated during XI Plan

Sl.No.	Name of R & D Institute	No. of Technologies developed during XI Plan	No. of Technologies Disseminated during XI Plan
1	CSR & TI, Mysore	48	30
2	CSR & TI, Berhampore	23	18
3	CSR & TI, Pampore	8	-
4	CST & RI, Bangalore	19	5
5	CTR & TI, Ranchi	10	1
6	CMER & TI, Lahdoigarh	8	3
7	SSTL, Bangalore	4	3
Total		120	60

The progress of the training programme imparted by R&D units during the plan period is given in **Table 11.3**. It may be noted that achievements always outpaced the targets set for the first Four years of XI Plan.

Table 11.3: Training Program during XI Plan – Targets and Achievements

Item	2007-08		2008-09		2009-10		2010-11		2011-12
	Target	Achmt	Target	Achmt.	Target	Achmt	Target	Achmt	Target
Standard Courses	40	52	50	41	40	41	40	49	40
Capsule Courses	300	407	410	442	450	1263	480	779	500
Adhoc Courses	1200	1975	1500	2298	1500	2163	1800	1593	3260
Skill Devt. & Other Trainings	--	--	--	--	1010	1788	2500	3591	3000
Total	1540	2434	1960	2781	3000	5255	4820	6012	6800

CSB has also collaborated with IGNOU for a course on certificate in sericulture under distant education mode with compulsory practical training in the Research Institutes of CSB.

The progress on IT development in CSB are; upgraded networking and server with high speed internet connectivity, started with centralized application on MIS, web based Email facility to entire CSB units & staff, developed a data centre in CSB with 24x7 operational capabilities and hosted CSB website and other applications in CSB itself, strengthened IT infrastructure by replacing old and out-dated computers across CSB, networking of research Institutes completed at Ranchi & Ladoigarh, developed information kiosk on sericulture in different regional languages and installed at different states, and IVRS installed at CSRTI, Mysore to assist sericulture farmers for immediate information on sericulture practices.

11.4. Gist of the Observations of R&D Scheme implemented during XI Plan

- The new variety, “Anantha” gave about 60 MT in South India under irrigation. Another new variety, Vishala stood no.1 throughout the country and yielded 60 MT under irrigated conditions.
- 18 new hybrids (8 bivoltines, 7 multi x bivoltines and 3 multivoltines) were authorised during 2010, with high productivity.
- The deadly papaya mealy bug infestation on mulberry plant was effectively contained.
- Around 40 innovations were filed for patenting, of which 16 technologies have been commercialized.
- Integrated Nutrient Management [INM], Integrated Pest Management (IPM), Integrated Farming Systems suitable for mulberry were developed and promoted in the field.
- Developed and popularized improved sericulture equipments to the field,
- Pneumatic Lift for looms, improved Reeling cum twisting machines, motorized charkha, improved spinning wheel, improved handlooms have reduced drudgery and improved productivity and quality of silk, and
- Dupion silk reeling machine developed and is being popularized.
- A tetraploid genotype of Terminalia arjuna having succulent lamina and shorter internodal length was developed.
- A semi synthetic diet for tasar silkworm was developed and patented.
- Solar power source was used for spinning machines to spin upto 280 g of yarn per day. The income of spinner per day increased to Rs.175/-.
- Control of muscardine disease of muga silkworm by using newly developed anti-muscardine “Lahdoi” can save 60-70% muga cocoon crop during winter.
- Heterozygosity in muga silkworm populations both in domestic and wild was identified. This probably provides a scope for silkworm improvement programme.
- A diapause stock of muga silkworm has been isolated having a pupal diapause of 135 days pupal period during September-October season.

- A box type mountage has been designed and fabricated for cocooning of muga silkworm which require less man power (saving of 60%) and smaller space and produce superior quality cocoons.
- A new chemical formulation named, 'Muga Silk Plus' has been developed for cooking of muga cocoons that could improve silk recovery from the existing level of 40-45% to 50-55%.
- An improved, power operated muga reeling machine (BANI) has been developed for reeling untwisted yarn for weft. It can be operated by a single person and the productivity is 120-150 g per day against 40-60 g per day per two reelers by bhir.
- A high yielding eri silkworm breed C2 with higher fecundity and shell weight has been evolved to increase productivity.
- Developed a Platform rearing technology of eri silkworm which consisting of 3 nos. of platforms (each of 1m x 2m size made up of bamboo strips) to accommodate 25-30 dfls.
- A bamboo strip type mountage (size 1 sq. m) has been developed for cocooning 500 mature worms of eri silkworm. The device is durable (5 years), requires less space to store and ensures better cocoon recovery (>90%).
- An 8-end multiend reeling machine has been developed.
- Process norms were evolved for silk reeling units.
- Sorting machine for grading of tasar cocoons was designed.
- A special brush for brushing tasar / muga cocoons before wet reeling was designed.
- An improved version of handloom (model II) (frame loom / pit loom) was developed.
- A parallel beat-up mechanism was designed for handlooms.
- A low cost electronic jacquard was designed for handlooms.
- A twin shuttle loom was designed specially for Nagaland weaving clusters.
- Nano carbon nitride was synthesized using silk fibroin and sericin by pyrolysis method.
- Developed a process to produce anti-crease finishing in silk fabrics
- Developed a process for improving dimensional stability in eri fabrics
- Developed techniques for block printing on muga and mulberry fabrics
- Developed technique for printing of silk fabrics with coloured mud as a pigment
- Developed dye extraction technique for neem and its application on silk textiles

11.5. Major achievements during XI Plan

During XI Plan, 303 Research projects were concluded, 34 technologies were assigned, 9 technologies were patented and 10 technologies were commercialized. The salient findings and a brief highlight of Research and Development activities are as follows:

A. Mulberry

A newly evolved mulberry variety 'SAHANA' recommended for mixed cropping in the existing coconut plantations. RC1 and RC2 varieties recommended for input resource constraint conditions in farmers mulberry garden.

Five new genotypes evolved for moisture stress and non-stress conditions were found to be significantly superior over the existing S13 and V1 varieties.

Mulberry genotype, Tr-23 was identified as suitable genotype for acidic soil of hills / foothills with an annual leaf yield of 24.5 MT.

Photosynthetically efficient mulberry genotypes T-36 and S-1572 were identified for crop improvement through conventional breeding.

Total 1136 Mulberry accessions were maintained under ex-situ conservation. Mulberry accessions were characterized for morphological, reproductive and leaf histological parameters.

Disease control package for nursery diseases, root rot and root knot has been developed. A herbal product Chetak was developed for the control of major foliar and root diseases of mulberry was developed.

Bivoltine silkworm hybrids suitable for rearing through out the year have been developed. CSR50 x CSR51 and (CSR52xCSR50) x (CSR51 x CSR53) have been selected for authorization.

A new multivoltine x bivoltine hybrid (L14 x CSR2) was developed to produce gradable silk.

Some potential hybrids viz. ND7 x CSR2 (Jayalakshmi), NDV6 x CSR2 were developed.

A total of 12 bivoltine silkworm genetic resources were introduced to gene bank raising the total number of silkworm genetic resources to 441.

Long-term seed preservation technology was developed for multi x bi (PM x CSR2) eggs up to 50 days without affecting hatching, cocoon yield and cocoon traits.

Several disinfectant viz. General disinfectants Asthra, Rakshak and Decol were developed to prevent secondary contamination in Silkworm crops.

A multiplex PCR-based technique was developed to detect infections of Nosema bombycis, Nuclear polyhedrosis virus (NPV) and Densonucleus virus (DNV) in silkworm.

Suitable methods for intercropping of medicinal and aromatic plants with mulberry were evolved

Disease tolerant variety of mulberry was evolved. IPM for control of white fly has been developed.

Developed low cost package for mass production of *Nesolynx thymus* and *Exorista phillipinensis* on housefly pupae and popularized biological control.

B.Vanya sector

Protocol has been developed for vegetative propagation of *Terminalia arjuna* and *T. tomentosa*, with rooting of about 75%. Post transplantation survival up to 90% has also been recorded.

Disease tolerant accessions of *Terminalia* species against leaf spot, black nodal girdling diseases have been screened.

Vaccine against virosis has been developed. Double vaccination either in I & II, II & III or once in each instar up to III significantly reduced virosis or improved the cocoon productivity from 62.3% to 71.70%.

Jeevan Dhara a botanical powder formulation has been developed to control the viral diseases in tasar silkworm. It reduces tasar silkworm virosis by 36.54% under outdoor rearing with improvement of cocoon yield by 10-12 cocoons/df.

RAPD analysis of eleven genotypes of *T. arjuna* and *T. tomentosa* indicated genetic variation in the genotypes.

Organic farming system of muga host plant has been developed. Som (*Persea bombycina* Kost.) showed highest leaf yield (11.14 T/Ha) under Dhaincha + FYM (5T/Ha) + vermicompost (1T/Ha) which was at par with recommended dose.

Intercropping of *Colocasia* in the effective interspaces som and kesseru plantation was successful without affecting the yield of main crops ie., Som and Kesseru.

Eight eco-races of *A. mylitta* (Daba BV, Daba TV, Sukinda, Sarihan, Modal, Modia, Raily, Laria) are maintained in the Germplasm Bank.

Indoor chawki rearing technique of *Antheraea mylitta* has been standardized and improved grainage, incubation and chawki rearing technologies were developed.

Conservation of eco races of *Antheraea mylitta* (Raily, Sukinda, Bhandara and Andhra local) in its native natural habitat was conducted.

Biodiversity among different ecoraces of Tasar silkworm was investigated using molecular markers

High yielding variety of Oak tasar silkworm *Antheraea proylei* have been developed.

Three species of oak fed silkworms viz., *A. proylei*, *A. pernyi*, *A. frithi* and ten breeds viz., PRP2, PRP3, PRP5, PRP12, RPP4, Blue, C27, B6, BY1 and Yellow were maintained in the GPB.

Towards improvement of Muga cocoon production five promising genotypes of Som were evolved in North eastern region. Micro-propagation technique for Muga host plant *Persea bombycina* was standardized.

Semi-synthetic diet for rearing of early stage muga silkworm larve has been developed. Feeding response to diet was recorded as 87.0% based on larval survivability in 1st instar after 48 hours of brushing.

Seven wild muga silkworm stocks viz. RMRS AS001, RMRS AS002, RMRS AS003, RMRS AS004, RMRS AS005, RMRS AS006 and RMRS AS009 collected from Assam and Meghalaya are being maintained under Ex-situ condition for characterization.

Thirty seven micro satellite loci developed from *Antheraea assamensis* were screened for polymorphism.

High yielding eri silkworm breeds with higher fecundity and shell weight were evolved on the basis of higher fecundity and higher shell weight.

Ten eco-races of eri silkworm were maintained. 41 genotypes of Castor germplasms, 11 varieties of Tapioca and four other secondary host plants of eri silkworms were maintained.

C. Post Cocoon Sector

Tasar silk reeling package was developed and fine-tuned for propagation at the field level.

Spun silk yarn from mulberry and non-mulberry wastes for the development of fancy yarns were produced.

Reeling process parameters were developed for the cocoons produced under unfavourable season. Bivoltine hybrid cocoons and multi-bivoltine cocoons were reeled employing combination of different stifling & cooking methods.

Low cost 8 ends / basin 10 basin multiend reeling machine has been developed for mulberry silk reeling.

Solar water heating system along with mini boiler for cooking and reeling for multiend reeling unit was developed.

Eight ends multiend reeling unit suitable for tasar and muga cocoon reeling with individual break stop motion has been developed which is capable of producing superior quality yarn with higher productivity.

A low cost solar operated hand spinning machine suitable for spinning all types of non-mulberry wastes and also mulberry waste has been developed for achieving better quality of yarn and higher productivity.

A twin shuttle loom has been designed and developed specifically for the requirement of North Eastern states to weave two narrow width fabrics simultaneously,

Apart from the regular R&D programmes, during XI plan, 12 special R&D initiatives were also taken up. Some of those programmes will be continued to XII plan as the set progress could not be completed due to various reasons. These components are; establishment of a Regional Silk Technology Research Station in Assam, establishment of Regional Eri Research Station for the Non-traditional States, strengthening of CTR&TI, Ranchi, strengthening of CMER&TI, Lahdoigarh, establishment of Soil Science & Agro Chemistry facility, disease Forecasting and Forewarning, Remote Sensing, Training Initiatives, Transfer of Technology, and IT Initiatives.

The progress of the training programme imparted by R&D units during the plan was quiet appreciable and achievements always outpaced the targets set for the XI Five Year Plan.

CSB has also collaborated with IGNOU for a course on certificate in sericulture under distant education mode with compulsory practical training in the Research Institutes of CSB.

The progress on IT development in CSB are; upgraded networking and server with high speed internet connectivity, started with centralized application on MIS, web based Email facility to entire CSB units & staff, developed a data centre in CSB with 24x7 operational capabilities and hosted CSB website and other applications in CSB itself, strengthened IT infrastructure by replacing old and out-dated computers across CSB, networking of research Institutes completed at Ranchi & Ladoigarh, developed information kiosk on sericulture in different regional languages and installed at different states, and IVRS installed at CSR&TI, Mysore to assist sericulture farmers for immediate information on sericulture practices.

11.6. RECOMMENDATIONS

Research and development (R&D) has potential to offer long-term solutions to the problems of sericulture sector. The concerted efforts by R&D Institutes have helped in developing a number of new technologies and provided options to derive higher benefits at lower cost per unit of output. Advancement in post cocoon technologies facilitated reduction in losses and helped in value addition. Although the technology alone is not sufficient to provide complete solution to the ailments of the sector, it is capable of offering better solutions. Hence, the role of R&D is critical in managing and boosting the silk production. Development of technologies and increased awareness about them among farmers has resulted in adoption of improved practices

and technologies. Some of the suggested recommendations for making the scheme more effective during XII Plan are listed below:

- A multi-disciplinary approach is required i.e., on the lines of ICAR's All India Coordinated Crop Improvement Programme (AICRP).
- All R&D projects need to be managed on a Project Management mode.
- All extension activities to be taken on Mission Mode Approach
- Cluster Development Approach in sericulture growing areas need to be propagated.
- Schemes having applied value and with scope for both horizontal and vertical growth need to be incorporated.
- Majority of the scientists are in the age group of 50+, therefore recruitment of young scientists needs to be taken up on priority.
- Quality and creativity comes from employee satisfaction, therefore promotional avenues and career progression need to be streamlined under HRD.
- Survey and exploration of mulberry and silkworm genetic resources should be undertaken in unexplored areas within the country.
- Mulberry and silkworm genetic resources of exotic origin should be introduced through international channels.
- Backup centers for conservation of mulberry and silkworm genetic resources may be established in different agro climatic zones.
- Long term conservation of mulberry and silkworm genetic resources may be taken up through cryopreservation technology.
- The reeling Technology needs to be improved. The presently popularized technology has been developed 15 years ago. To make this technology more acceptable to the reelers, improvements need to be undertaken.
- Reeling of silk uses a good amount of water. The efforts may be made to recycle the waters by using simple technologies
- For the reeling process, alternate sources of energy such as solar energy may be tapped to reduce the dependence on wood. Also the whole process may be made more energy efficient.
- Non mulberry silk may be reeled by using wet reeling machines. CSTRl developed machine may be modified as per the requirement of reelers of Vanya silk
- New machineries need to be developed for Vanya silk / twisting and soaking. Methods need to be standardized for efficient reeling
- Objective gradation method of tasar silk is not available. This needs to be developed, which will help the reelers and wavers in sorting out price disputes and it will help in improving the quality of tasar silk.
- Tasar, Eri and Muga silk needs more attention in product development, standardization of processes etc. Focused research may be conducted in these areas.

- The chemical processing of silk yarn/ fabric needs a lot of intervention. The colour fastness of silk fabrics needs to be improved by standardizing machines, dyestuff, process parameters, chemicals, etc.
- Dimensional stability is a major concern for any silk fabrics. Finishing processes needs to be developed to solve the instability problem.

Based on the field survey findings, it is recommended that the “Central Sector Scheme - Research & Development, Transfer of Technology, Training and IT Initiatives,” needs to be continued during XII Five Year Plan as well. It may also be noted that since CSB - R&D institutions are the sole agencies serving the technical and transfer of technology requirements of the sericulture sector in the country, there is an urgent need to augment the manpower and strengthen the infrastructure of these R&D centres with further funding to the tune of Rs.250 crores during the XII Plan for the survival and sustenance of the sericulture sector in the country and also to make the Indian sericulture industry internationally competitive.

===XXX===

ANNEXURE 1.1

SURVEY QUESTIONNAIRE: R&D / TRAINING/ IT INITIATIVE (Research & Development Institute/IT initiative)

National Productivity Council, an autonomous organization under Ministry of Commerce & Industry, Government of India, is carrying out a study on “ Evaluation of R&D/Training/IT initiatives scheme during XI Plan”, sponsored by Central Silk Board, Ministry of Textiles, Government of India. The objective of this field study is to find out the effectiveness of Research & Development/ Training/ IT initiatives scheme implementation during XI Plan. Findings of the study will be utilized by CSB to modify and improve the scheme during XII five year Plan.

(Please fill as per instructions given with each question
Write codes/ values in the box provided at the right hand side)

1.0	General Information	
1.1	Region (1=North Western Himalayan Region, 2=North Eastern India, 3=Northern and Central India, 4=Eastern region, 5=Southern India)	
1.2	State (1=Andhra Pradesh, 2=Jammu & Kashmir, 3=Karnataka, 4=Tamil Nadu, 5=West Bengal, 6=Assam, 7=Chhattisgarh, 8=Himachal Pradesh, 9=Jharkhand, 10=Maharashtra, 11=Manipur, 12=Meghalaya, 13=Uttar Pradesh, 14=Uttarakhand 15= Orissa)	
1.3	Name of the Institute:	
1.4	Silk variety on which institute is working? (1= Mulberry 2= Eri 3= Tasar 4= Muga)	
1.5	Specialization of the Institute. (1= Seed Sector 2= Seed Cocoon 3= Commercial Cocoon 4= Post cocoon 5= others)	
1.6	Key Contact Person: Address: _____ City/Town/Village: _____ District: _____ Pin: _____ Phone/Mobile No: _____ E-mail, if any _____	
1.7	Year of establishment of Institute	
1.8	Please explain the basic objectives or goals of the Institute.	
1.9	Total Employees in the Institute (Nos)	
	Permanent:	Temporary:
1.10	Number of Scientists in the institute (including nested Regional Sericulture Research Stations and Regional Extension Centres.	

2.0 Details regarding R&D Projects during XI Five Year Plan						
2.1	Number of Projects undertaken by the Research Institute during XI Five year Plan					
	Year	Number of Projects	Status of project			
			Completed	Work in Progress	Technology Transferred (Lab to Land initiative)	
	2007-08					
	2008-09					
	2009-10					
2010-11						
2011-12						
2.2	Area in which Research & Development projects have been taken up in the institute as well as in its nested units during XI five Year Plan?					
	Area of Research	Name of the Projects taken up	Amount sanctioned in area of research (Rs Lakhs)	Status of the Project (e.g. Ongoing, just completed, implemented on field)	Impact of the project on productivity & Quality vis a vis proposed objective	No. of farmers benefitted from the project
	Development of high yielding silkworm breeds and their food plants (Mulberry & Vanya silk host plants)					
	Development of clonal propagation techniques					
	Improvement in soil health and fertility					
	Cultivation practices					
	Water conservation techniques					

	Development of disease management, disease forecast, forewarning system						
	Economic farming models & practices						
	Mechanization of sericulture farming						
	Mechanization of Silkworm rearing						
	Product development diversification						
	Any other region specific technologies						
	Improved reeling, weaving & processing devices						
	IT initiative						

	Any other (Please specify)							
	Total							
Please use this format for filling up the information								
2.3	Sl. No.	Source of Grants/Funds/Sponsors	Approximate Annual Funding (In Lakhs)					
			2007-08	2008-09	2009-10	2010-11	2011-12	
	a)	State Government						
	b)	CSB (under the R&D scheme)						
	c)	Industries						
	d)	International Bodies						
	e)	Others (Specify)						
	Total:							
2.4	Annual Expenditure (Total) of the Institute :							
	Year	Expenditure (in Lakhs)						
	2007-08							
	2008-09							
	2009-10							
	2010-11							
2011-12								
2.5	Please comment on the institute's achievements in terms of utilizable information/ product development/ process/transfer of technology/productivity/quality as a result of R&D projects taken up under the scheme during XI five Year Plan.							
3.0 Status of R &D Projects/ Training/ IT Initiatives								
3.1	Details Regarding the Projects undertaken during XI Five Year Plan							
	Year	Name of the Project	Proposed Duration of Project (months)	Actual Project completion duration (months)	Time Over run (Col 4- Col3)	Estimated project cost (Rs. Lakhs)	Final project cost (Rs Lakhs)	Cost Overrun (Col.7-col.6)
	1	2	3	4	5	6	7	8
	2007-08							
	2008-09							
	2009-10							
	2010-11							
	2011-12							
Use additional sheets for each year, if required.								

3.2	Number of Patents applied and awarded during XI Five Year Plan			
	Year	No. of Patents Applied (Nos)	No. of Patents Awarded (Nos)	
	2007-08			
	2008-09			
	2009-10			
	2010-11			
3.3	Number of Research papers published during XI Five Year Plan			
	Year	No. of Research Papers published (Nos)		
	2007-08			
	2008-09			
	2009-10			
	2010-11			
3.4	Number of training Programmes conducted during XI Five Year Plan			
	Year	No. of Training Programme	Total no. of Participants	
	2007-08			
	2008-09			
	2009-10			
	2010-11			
3.5	Details of IT Initiative undertaken to propagate new technologies developed by the R &D institute during XI Five Year Plan			
	Sl. No	New Technology Developed	IT Initiative details	Whether successful (1=yes 2=No)
4.0	Suggestions and recommendations			
4.1	Whether the present resources (manpower, finance, physical infrastructure etc., are adequate to meet the objectives of the institute? (1=Yes, 2=No)			
4.1.1	If No, please specify			

4.2	Do you feel that certain modifications of the R&D scheme will yield better result? (1=Yes , 2=No)			
4.2.1	If yes, please specify			

4.3	What is the overall level of acceptability of new technology among the End Users?		
4.4	Initiatives Planned for the XII Five year Plan		
	Sr. No.	Name of the Initiative	Objectives/Targeted stake holders Provisional Fund Requirements
4.4	Any Comment/Suggestion for improving the scheme during the XII Five Year Plan?		

Thank you

Name of the Official/Investigator : _____

Signature : _____

Place of Survey : _____ Date: _____

ANNEXURE 1.2

**SURVEY QUESTIONNAIRE:R&D / TRAINING/ IT INITIATIVE
(Project Leaders/ Researchers from R&D Institute/Regional Sericulture
Research Station/Silk Conditioning & Testing House)**

National Productivity Council, an autonomous organization under Ministry of Commerce & Industry, Government of India, is carrying out a study on “ **Evaluation of R&D/Training/IT initiatives scheme during XI Plan**”, sponsored by Central Silk Board, Ministry of Textiles, Government of India. The objective of this field study is to find out the effectiveness of Research & Development/ Training/ IT initiatives scheme implementation during XI Plan. Findings of the study will be utilized by CSB to modify and improve the scheme during XII five year Plan.

(Please fill as per instructions given with each question)

Write codes/ values in the box provided at the right hand side)

1.0	General Information	
1.1	Region: (1=North Western Himalaya Region, 2=North Eastern India, 3=Northern & Central India, 4=Eastern Region, 5=Southern India)	
1.2	States: (1=Andhra Pradesh, 2=Jammu & Kashmir, 3=Karnataka, 4=Tamil Nadu, 5=West Bengal, 6=Assam, 7=Chhattisgarh, 8=Himachal Pradesh, 9=Jharkhand, 10=Maharashtra, 11=Manipur, 12=Meghalaya, 13=Uttar Pradesh, 14=Uttarakhand 15= Orissa)	
1.3	Name of the Institute/Regional Sericulture Research Station	
1.3.1	Silk variety to which the Research station is linked? (1= Mulberry 2= Eri 3= Tasar 4= Muga)	
1.4	Name of the Project Leader/ Researcher : Designation Address: _____ _____ City/Town/Village: _____ District: _____ _____ Pin: _____ Phone/Mobile No: _____ E-mail, if any : _____	
1.5	Highest Academic Qualification	
1.6	Years of experience with the Institute	
1.7	Total Work Experience in the Field (Years)	
2.0	R&D Projects / Sources of Grants/Funds/Sponsors	

2.1	Project wise details								
	Year	Name of the Project	Status (1=Completed, 2= Work in progress)	Proposed Duration of Project (months)	Actual Project completion (months)	Time Over run (Col 5- Col 4)	Estimated project cost (Rs. Lakhs)	Final project cost (Rs.Lakhs)	Cost Overrun Rs.Lakhs (Col.8-col.7)
	1	2	3	4	5	6	7	8	9
	2007-08								
	2008-09								
	2009-10								
	2010-11								
	2011-12								
Use additional sheets for each year, if required. Please use the same format while filling up									
2.2	Reasons for Cost and Time overrun, if any								
2.3	Status of Technology Transfer and Impact of the R&D project								
	Year	Name of the Project (All projects mentioned in Table 2.1)	No. of Researchers involved	Status of Technology transfer from Lab to Field and initiatives taken up	Outcome of the project vis a vis proposed objective	Approx No. of farmers Benefitted from the project throughout the country			
	1	2	3	4	5	6			
	2007-08								
	2008-09								
	2009-10								
	2010-11								
	2011-12								
Please provide the document containing actual cost benefit analysis carried out after implementation of the project on field for each of the project mentioned above.									
2.4	Number of Patents applied and awarded to you during XI Five Year Plan								
	Year	No. of Patents Applied	No. of Patents Awarded	No. of Research papers published in reputed journals					
	2007-08								
	2008-09								
	2009-10								
	2010-11								
2011-12									
3.0	Availability of facilities to Researchers								
3.1	Are the funds allocated for the research works are sufficient? 1=yes 2=No								

3.1.1	If No, please specify	
3.2	Whether the allocated funds received in time? 1=Yes 2=No	
3.2.1	If No, please specify the reasons?	
3.3	Is there any problem due to non availability of resources/infrastructure? (1= Yes 2= No)	
3.3.1	If yes, please provide the details and reasons	
4.0	Suggestions and Recommendations	
4.1	Whether the present resources (manpower, finance, physical infrastructure etc., are adequate to meet the objectives of the institute? (1=Yes, 2=No)	
4.1.1	If No, please explain:	
4.2	Do you feel that certain modifications of the R&D scheme will yield better result? (1=Yes , 2=No)	
4.2.1	If yes, please specify	
4.3	What is the overall level of acceptability of new technology among the End Users?	
4.4	Any comment/suggestion for improving the scheme during the XII Five Year Plan?	

Thank you

Name of the Official/Investigator :-

Signature :

Place of Survey : _____ Date:

ANNEXURE 1.3

**SURVEY QUESTIONNAIRE: R&D / TRAINING/ IT INITIATIVE
(Research Extension Center/Regional Sericulture Training
Center/Demonstration cum Technical Service Center)**

National Productivity Council, an autonomous organization under Ministry of Commerce & Industry, Government of India, is carrying out a study on “ Evaluation of R&D/Training/IT initiatives scheme during XI Plan”, sponsored by Central Silk Board, Ministry of Textiles, Government of India. The objective of this field study is to find out the effectiveness of Research & Development/ Training/ IT initiatives scheme implementation during XI Plan. Findings of the study will be utilized by CSB to modify and improve the scheme during XII five year Plan.

(Please fill as per instructions given with each question)

Write codes/ values in the box provided at the right hand side)

1.0	General Information	
1.1	Region: (1=North Western Himalaya Region, 2=North Eastern India, 3=Northern & Central India, 4=Eastern Region, 5=Southern India)	
1.2	State (1=Andhra Pradesh, 2=Jammu & Kashmir, 3=Karnataka, 4=Tamil Nadu, 5=West Bengal, 6=Assam, 7=Chhattisgarh, 8=Himachal Pradesh, 9=Jharkhand, 10=Maharashtra, 11=Manipur, 12=Meghalaya, 13=Uttar Pradesh, 14=Uttarakhand 15= Orissa)	
1.3	Category of the Extension Center (1= Research Extension Center 2= Regional Sericulture Training Institute 3= Demonstration cum Technical Service Centre)	
1.3.1	Name of the Research Extension Center/Regional Sericulture Training Center/Silk Conditioning & Testing House/Demonstration cum Technical Service Center)	
1.3.2	Silk variety in which Extension services are being provided (1= Mulberry 2= Eri 3= Tasar 4= Muga)	
1.4	Owned & Established by (1= CSB 2= DOS 3= NGO 4= Any other)	
1.5	Name of the Research Institute/Regional Sericulture Research Station to which REC is attached	
1.6	Name of the R&D project for which this Research Extension Center/Regional Sericulture Training Center/Silk Conditioning & Testing House/Demonstration cum Technical Service Center is to be evaluated?	
1.7	Name of the Respondent Designation Contact Address:	

	<p>City/Town/Village: _____ District: _____</p> <p>Pin: _____</p> <p>Phone/Mobile No: _____ E-mail, if any _____</p>					
2.0	Technology Transfer from Lab to Field					
2.1	Please mention the important new technologies or R&D initiatives disseminated in the field during XI Five Year Plan (2007- 2011).					
	Name of Technology/Process / R&D Project	Method of Technology Transfer (I.e. On field Demonstration, Training etc.	Approx No. of farmers benefitted till date	Comment on overall acceptability of these technologies by the beneficiaries	Impact of the technology on Productivity & Quality	
	Please provide the document containing actual cost benefit analysis carried out after implementation of the project on field for each of the project mentioned above.					
2.2	Training programs undertaken during XI Five Year Plan					
	Year	Total Trainings/Demonstra	Total	SC participants	ST participants	Female

	tion Conducted (Nos.)	Participants (Nos.)	(Nos.)	(Nos.)	Participants (Nos.)
	2007-08				
	2008-09				
	2009-10				
	2010-11				
	2011-12				
2.3	Overall impact of the training provided				
2.3	What are the IT initiatives undertaken during XI Five Year Plan. Please Specify				
3.4	Whether the end users of the new technology are satisfied with the inputs provided in the training programmes				
	(1=yes, 2=No).				
3.4.1	If No, please specify the reasons?				
3.5	Does the support provided by CSB is sufficient				
	(1= yes , 2=No)				
3.5.1	If No , Specify				
3.6	Please provide your suggestion or observations to make the scheme (R&D/ Training/ It Initiatives) more				

	<p>effective during the XII Five year plan</p> <hr/> <hr/> <hr/> <hr/>
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(If the space provided is insufficient, kindly use additional sheets)

Thank you

Name of the Official/Investigator : _____

Signature : _____

Place of Survey : _____ **Date:** _____

ANNEXURE 1.4

SURVEY QUESTIONNAIRE: R&D/TRAINING/IT INITIATIVES

Sericulture Beneficiaries (Graineurs/Cocoon Farmers/Post Cocoon processors)

National Productivity Council, an autonomous organization under Ministry of Commerce & Industry, Government of India, is carrying out a study on “Evaluation of R&D/Training/IT initiatives”, sponsored by Central Silk Board, Ministry of Textiles, Government of India. The objective of this field survey is to find out the effectiveness of the Seed Organization & HRD scheme implementation during XI Five Year Plan. Findings of this study will be utilized by CSB to modify and improve the scheme implementation during XII Five Year Plan

Please fill as per instructions given. Write codes/ values in the box provided at the right hand side)

1.0 General Information							
1.1	Region	(1=North Western Himalayan Region, 2=North Eastern India, 3=Northern and Central India, 4=Eastern region, 5=Southern India)					
1.2	State	(1= Himachal Pradesh , 2 Uttarakhand, 3=Jammu & Kashmir,4= Uttar Pradesh, 5 =Andhra Pradesh, 6= Maharashtra 7= West Bengal ,8= Chhattisgarh ,9= Jharkhand, 10=Manipur ,11= Assam, 12= Meghalaya ,13=Karnataka, 14=Tamil Nadu 15= Orissa)					
1.3	District:						
1.4	Name of the Cluster:						
1.5	Name of the Beneficiary: _____ Address: _____ _____ City/Town/Village: _____ Tehsil: _____ Pin: _____ Phone/Mobile No.: _____ E-mail, if any _____						
1.5.1	Name of the R&D Institute/Regional Sericulture Research Station/Research Extension Center/Silk Conditioning & Testing Center to which the beneficiary is attached?						
1.5.2	Name of the R&D Project for which the beneficiary is to be interviewed?						
1.6	Age of the respondent (in yrs):						
1.7	Gender	(1=Male, 2=Female)					
1.8	Caste	(1=SC, 2=ST, 3= Others)					
1.10	Educational Level	(1=Illiterate, 2=Primary, 3=Secondary, 4=Graduate & above)					
1.11	Experience in sericulture (in yrs):						
1.12	Type of Sericulture practiced	(1= Graineurs (Seed) 2= Chawkie Rearing Center 3= Seed Cocoon, 4=Commercial Cocoon 5= Reeling 6= Twisting 7= Weaving 8= Dyeing 9= Automatic Reeling Unit 10= CATD 11= Fabric Processing 12= Disinfection unit, 13= Others (Pls specify)					
1.13	Sericulture Activity	(1=Mulberry, 2=Tasar, 3=Eri, 4=Muga)					
1.14	Sources of family income						
	Sl. No.	Source of Income	Approximate Annual Income (Rs. In Thousands)				
			2007-08	2008-09	2009-10	2010-11	2011-12
	a)	Sericulture					
	b)	Income from Other activities					
		Total:					

2.0	New Technologies adopted					
2.1	Provide details regarding the new Sericulture R&D technologies adopted during last five years?					
	Year	Name of Technology/Process/Product/Best Sericulture Practice adopted	Implemented by CSB/DOS/NGO/Others	Whether Beneficial (1= Yes 2= No)	Impact on sericulture yield/productivity/ Quality or other benefits	Remarks
	2007-08					
	2008-09					
	2009-10					
	2010-11					
	2011-12					
(Please use additional sheets if required)						
2.2	Have you received any extension support/training for using the new technology developed through R&D project? (1= Yes 2= No)					
2.2.1	Please provide your views on the support received from the Research Centre, Researchers or Extension staff					
3.0 Suggestions						
3.7	Suggestions for improvement of the scheme during the XII Five Year Plan?					
<hr/> <hr/> <hr/> <hr/>						

Thank you

Name of the Official/Investigator : _____
 Signature : _____
 Place of Survey : _____ Date: _____

STUDY TEAM

Project Advisor	Dr. S K.Chakravorty Deputy Director General
Team Leader	Dr.K.P.Sunny Group Head (ES & SS)
Study Team	Shri Rajesh Sund Deputy Director (ES)
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	Smt. Sweta Kumari Assistant Director (ES)
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