

**MTS – 3599:  
STUDY ON MULBERRY SERICULTURE PRODUCTION  
IN WEST BENGAL: A STATISTICAL APPROACH**



*Investigators*

**Dr. G. R. Manjunatha, Mr. Shafi Afroz, Dr. S. Chanda,  
Dr. D. Pandit and Dr. T. Datta Biswas**

**Duration:** 18 Months (Nov. 2016 – April 2018)

**Budget:** 2 Lakhs



Central Sericultural Research & Training Institute  
Central Silk Board, Ministry of Textiles: Govt. of India  
Berhampore - 742 101, Murshidabad District  
West Bengal

**PROFORMA - I**  
(To be filled by applicant)

**PART - I: GENERAL INFORMATION**

Sl. No.	Items	Particulars
1.	Name of the Institute / University / Organization submitting the Project Proposal	Central Sericultural Research & Training Institute, Central Silk Board, Ministry of Textiles, (Govt. of India), Berhampore - 742 101, Murshidabad - Dist., West Bengal.
2.	Status of the Institute (s)	Not Applicable
3.	Name (s) and designation (s) of the Executive Authority of the Institute / University forwarding the application	Dr. Kanika Trivedy Director, CSR&TI, Central Silk Board, Berhampore - 742 101 (WB).
4.	Project Title	<b>Study on Mulberry Sericulture Production in West Bengal: A Statistical Approach</b>
5.	Category of the Project	Applied (Survey based)
6.	Specific Area	Applied Statistics and Economics
7.	Duration	18 months
8.	Total cost:	<b>2.00 Lakhs</b>
9.	Is the project single Institutional or multi-institutional	Single institutional
10.	If the project is multi-institutional please furnish the following	Not Applicable

## 11. Project Summary

In India, sericulture is one of the important sub-sectors of agriculture and plays a vital role in the farm economy. Compared to agricultural crops, sericulture provides more employment round the year and fetches higher income to the rural farm families (Roopa and Murthy, 2015). India is the 2<sup>nd</sup> largest producer of raw silk after China. India enjoys the distinction of being the only country in the world which produces all the five commercially exploited silk varieties namely Mulberry, Tropical Tasar, Temperate Tasar, Eri and Muga. Mulberry silk occupies the major chunk of silk production constituting 75 per cent of the total silk production. It is practiced in many regions of India but out of five traditional states West Bengal ranks third in mulberry silk production, though it was a premier state in Indian sericulture. Currently, West Bengal accounts for 14.5 per cent of the country's cocoon production in the vertex of the silk map. In the state, about 2000 villages are engaged in mulberry cultivation with plantation area of 37,883 acres (Anonymous, 2016). In the state, sericulture is highly concentrated in Malda, Murshidabad and Birbhum which are traditional sericultural districts contributing to 90 per cent of the total state's silk production. From the viewpoint of farmers, there is a need to find ways of obtaining higher net returns from the sericulture enterprise. Usually, farmers are facing the problem of effective allocation of farm resources and hence its repercussions on costs & returns will be assessed. In this direction, the study on mulberry sericulture production assumes utmost importance. For this, some of the statistical (and econometrics) approaches will be applied by collecting the representative data (both primary and secondary) of the state. The primary data from 240 respondents will be elicited (through pre tested questionnaires) regarding socio-economic aspects, cropping pattern etc., from the three traditional districts of West Bengal under multi-stage simple random sampling technique. Similarly, the secondary data of state regarding area under mulberry and production of cocoon will be collected from an authenticated source. Ultimately, the study helps to know the trend, optimal resource use pattern and cost & returns of mulberry sericulture production of the state.

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## PART II: PARTICULARS OF INVESTIGATORS

<b>12.</b>	<b>Name</b>	<b>Dr. G. R. Manjunatha</b>
	i) Year of birth	11.05.1988
	Sex	Male
	Principal Investigator or CI	<b>Principal Investigator,</b>
	Designation & Department	Scientist-B, PMCE Division,
	Institute / University : Address	CSR&TI., CSB., Berhampore - 742 101, (WB)
	ii) Name	<b>Mr. Shafi Afroz</b>
	Year of birth	20.12.1986
	Sex	Male
	Principal Investigator or CI	<b>CI-1</b>
	Designation & Department	Scientist-B, Extension and Publicity Division
	Institute / University : Address	CSR&TI., CSB., Berhampore - 742 101, (WB)
	iii) Name	<b>Dr. Subhra Chanda</b>
	Year of birth	28.04.1958
	Sex	Female
	Principal Investigator or CI	<b>CI-2</b>
	Designation & Department	Scientist-D, Extension and Publicity Division
	Institute / University : Address	CSR&TI., CSB., Berhampore - 742 101, (WB)
	iv) Name	<b>Dr. D. Pandit</b>
	Year of birth	16.12.1963
	Sex	Male
	Principal Investigator or CI	<b>CI-3</b>
	Designation & Department	Scientist-D, PMCE Division
	Institute / University : Address	CSR&TI., CSB., Berhampore - 742 101, (WB)
	v) Name	<b>Dr. Tapati Datta (Biswas)</b>
	Year of birth	10.04.1961
	Sex	Female
	Principal Investigator or CI	<b>CI-4</b>
	Designation & Department	Scientist-D, REC, Kamnagar
	Institute / University : Address	CSR&TI., CSB., Berhampore - 742 101, (WB)
<b>3.</b>	No of Projects/ Programmes being handled by each investigator at present:	
	Manjunatha G R	-
	Shafi Afroz	-
	S Chanda	01
	D. Pandit	02 (TOT)
	Tapati Datta Biswas	02
<b>14.</b>	Proposed Research Fellow	-

## 15. LIST OF FIVE EXPERTS IN INDIA IN THE PROPOSED SUBJECT AREA

Sl. No.	Name	Designation	Address
i.	Dr. Anurup Majumder,	Professor	Dept. of Agril. Statistics, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur - 741 252, West Bengal.
ii.	Dr. P. K. Sahu,	Professor and Head	Dept. of Agril. Statistics, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur - 741 252, West Bengal.
iii.	Dr. B. Chinnapa,	Professor and Head	Dept. of Agril. Economics, UAHS Shivamogga- 577204, Karnataka
iv.	Dr. A. R. S. Bhat,	Professor	Dept. of Agril. Statistics, UAS Dharwad- 580005, Karnataka
v.	Dr. K. V. Ashalatha,	Professor and Head	Dept. of Agril. Statistics, UAS Dharwad- 580005, Karnataka

## PART III: TECHNICAL DETAILS OF PROJECT

16.1	<b>Definition of the Problem</b>	<p>This study will be an attempt to identify the important factors governing production of mulberry and silk worm in sericulturally important districts of West Bengal. In the process an attempt will be made to trace the path of production process over the years in the state. In addition profitability of sericulture enterprise, existing resource use pattern, resource use efficiency and factors responsible for the same will be assessed.</p>
16.2	<b>Origin and Introduction of the problem</b>	<p>In India, marginal and small land holders are predominant and lack alternative sources of income and employment for their sustainable livelihood. In this regard, Government of India is encouraging regular income and employment oriented farming approaches, one such potential farming enterprise is sericulture (Roopa and Murthy, 2015). India is the second largest producer of raw silk (28,708 MT) in the world. Its production has shown a notable progress during 2014-15 however its growth was 8.4 per cent which is on the lower side in comparison with leading silk producing country like China (Anonymous, 2015).</p>

Sericulture in India plays an important role in poverty alleviation. Compared to agricultural crops, sericulture provides year round employment and higher incomes to the rural farm families. It has generated employment for about 8.03 million farmers in 2014-15 as compared to 7.85 million in 2013-14 with a growth of 2.29%. Most of the beneficiaries are marginal farmers, women farmers and farmers belonging to the weaker section of the society (Anonymous, 2015). Micro level studies (Lakshmanan and Geetha Devi, 2000, 2005) indicated that mulberry sericulture practiced on an acre generated employment of 506.20 mandays from leaf to cocoon stage of production.

Sericulture, a rural-agro based cottage industry, occupies the major chunk of silk production, constitutes about 75% of the total silk production. In India, it is practiced mainly in five traditional states. Amongst five, West Bengal ranks third and fourth in terms of mulberry silk production and total silk production, respectively.

Sericulture has historical background in case of West Bengal. The authenticated history is available from the beginning of 18<sup>th</sup> century i.e from the time of East India Co. who had considerable trading interest in raw silk. Currently, West Bengal accounts for 14.5 per cent of the country's cocoon production in the vertex of the silk map (Anonymous, 2015). In the state, mulberry is cultivated in 2000 villages with plantation area of 37,883 acres (Anonymous, 2016). In the state, sericulture is highly concentrated in Malda, Murshidabad and Birbhum, traditional sericultural districts contributing to 90% of the total state's silk production. In this study, an attempt will be made to ascertain the trend in mulberry and silkworm production. In addition, existing production pattern, resource use pattern, cost structure, returns realized and profit materialized from sericulture enterprise will be assessed. In case if resource use, profits realized are found sub optimal, then ways and means to attain optimal level will also be addressed in the study. To assess trends, resource use pattern, use efficiency, identification of sub-optimality, statistical knowledge is pivotal.

<p><b>16.3 Expected outcome</b></p>	<p>The trend in production of mulberry and silk and causes for the trend will be determined. Existing resource use pattern, level of resource use efficiency, factors responsible for in/efficiency, ways towards optimality, major cost item in moriculture and sericulture and ways to minimize costs will be identified.</p>
<p><b>16.4 Objectives :</b></p>	<ul style="list-style-type: none"> <li>• To analyze the trends in mulberry cocoon production in West Bengal</li> <li>• To estimate costs and returns of mulberry cocoon production</li> <li>• To assess resource use pattern and resource use efficiency of sericulture farmers</li> </ul>

## 17. REVIEW OF STATUS OF RESEARCH AND DEVELOPMENT ON THE SUBJECT

The available literatures relevant to the objectives of the present study were reviewed. The literature directly related to the current study is rather limited. So, the studies related to other crops or technologies were reviewed and highlighted under the following headings.

### 17.1 Trends in mulberry area, production and productivity of silk cocoons

Raveendaran *et al.*, (1993) reported that silk production in India had registered a growth of 6.6 per cent in recent years as against the overall growth of 10 per cent. They concluded that silk worm rearing is one of the most profitable enterprises even for small farmers and therefore, efforts should be made by the Department of Sericulture to increase the area under mulberry, where irrigation is available. Increased production of mulberry cocoons would lead to an increased foreign earning potential.

Namasivayam and Richard Paul (2004) estimated trend in area, production and productivity of coconut in India for the period (1977-78 to 2001-02). The analysis was done in three phases; 1977-78 to 1986-87 as Phase-1, 1987-88 to 1996-97 as Phase-2 and 1997-98 to 2001-02 as Phase-3. The trend analysis indicated a positive growth in area, production and productivity in the first two phases, while, negative growth was noticed in the third phase for productivity.

Sharad and Shekhar (2008) assessed the status of silk production in India during 1980-81 to 2004-05. They observed an increasing rate of growth in area under mulberry at a significant rate of 0.25 per cent. The production and productivity of raw silk showed highly significant growth of 5.06 per cent and 4.80 per cent, respectively. The production of raw silk has increased mainly due to high yielding mulberry varieties and silk worm breeds.

Sharma and Kalita (2008) conducted a study on trends in area, production and productivity of major fruit crops in Jammu and Kashmir. Data pertaining to area, production and productivity of major fruit crops were collected from Horticulture Department of Jammu and Kashmir for 25 years from 1974-75 to 1999-2000. Linear, Quadratic and Exponential function were used for analysis of data. The results revealed a positive and significant growth rates in area, production and productivity for all the major fruit crops in the state.

Jose and Jayashekar (2009) conducted a study on growth trends in area, production and productivity of arecanut in India using time series data for 30 years. They employed exponential and linear model to analyze the data. The findings indicated that during last 15 years due to favorable price, area has increased by more than two times and production by three times.

Mote and Sananse (2014) conducted trend analysis of global area, production, growth rates of global export and import scenario of raw silk, employing compound growth rate and other statistical techniques. The growth rate analysis indicated that during 1997-98 to 2011-12, the rate of growth in total silk production of China and India was increasing at a significant rate of 6.90% and 2.60%, respectively.

Manjunath *et al.*, (2015) employed exponential growth model to know the scenario of mulberry and cocoon production in major silk producing States of India. Data on mulberry area, production, productivity, cocoon production and productivity from 1971-72 to 2008-09 was used for the analysis. The study period was divided into quarters with a time period of 10 years. They found that all the traditional sericulture states, exhibited significant positive growth in area, production and productivity of mulberry during Period II. Karnataka, Andhra Pradesh and West Bengal have exhibited positive and significant growth in Cocoon production and productivity during the study period. At national level, Cocoon production (4.08 %) and productivity (2.41 %) have shown significant positive trend during the study period.

### **17.2 Costs and returns of mulberry cultivation and cocoon production**

Sahabhalmik and Mukhopadhyay (1977) reported a cocoon yield of 1,440 per hectare per annum in West Bengal. A sericulture farmer incurs a total cost of Rs. 18,067.50 per ha for its production realizing a net return of Rs. 4,292.50.

Nanaiah (1981) reported that sericulture is a highly profitable enterprise in Karnataka providing returns throughout the year. The gross income realized per acre amounted to Rs. 15,450 from 1,313 dfls.

Lakshmanan *et al.*, (1997) traced out the cost and returns profile per hectare of mulberry in Salem and Dharmapuri districts of Tamil Nadu. In their study on economies of scale in mulberry sericulture, they estimated that on an average Rs. 1.52, 1.28, 1.16 and 1.09 were incurred in producing one kg of mulberry leaf while, in the case of cocoon it worked out to be Rs. 79.46, 64.24, 63.73 and 54.31 for holding size Group-I (0.01-0.50 ha), II (0.51-1.00 ha), III (1.01-1.50 ha) and IV (>1.50 ha), respectively. The returns per rupee of investment indicated that farmers with large holdings (size IV) had the highest returns in comparison with other holding categories. They also suggested that specific development schemes like implementation of minimum support price for cocoon, coverage of crop insurance for silkworm rearing and diffusion of cost effective and eco-friendly new technologies at faster rate would help in enhancing production of quality cocoon in these regions.

Lakshmanan *et al.*, (2000) compared economic benefits over investment in rearing bivoltine and crossbred cocoons in K. R. Nagar taluk of Mysore district. The study indicated that bivoltine rearing earns higher net returns than crossbred rearings owing to climatic suitability, skilled manpower and technical guidance received from developmental agencies.



Kumaresan and Vijayaprakash (2001) compared the economics of sericulture with that of the major crops cultivated in Tamil Nadu. The revenue obtained from sericulture (Rs.21, 153.51/acre/year) was comparatively higher than that of all other major crops cultivated in the area namely, paddy, sugarcane, gingelly, groundnut and sorghum except turmeric.

Lakshmanan and Geetha (2007) demonstrated the employment generating capacity of sericulture in Tamil Nadu. The results indicated that the female labour participation was higher in particular and employment opportunities were even wider in sericulture in general in comparison with other crops. They showed that mulberry sericulture generated 532 man days in a year (of this, 319.20 man days were family labour and 212.80 man days were hired) which was comparatively higher than that of sugarcane (296.15 man days) and turmeric (133.50 man days). They also observed that the sex ratio in labour participation was the highest in sericulture i.e. 1:1.86 while it was 1:0.93 for sugarcane and 1:1.49 for turmeric.

Lakshmanan (2011) examined the cost and returns in silk cocoon production at the farm household level in Karnataka, Tamil Nadu and Andhra Pradesh. Their field investigation indicated that the per annum cost of cocoon production per acre worked out to Rs. 71635.83 in Karnataka, Rs. 67638.44 in Tamil Nadu and Rs. 49011.07 in Andhra Pradesh, respectively. The net return per acre/year was the highest in Tamil Nadu followed by Karnataka and Andhra Pradesh.

### **17.3 Allocative and use efficiency of resources in sericulture**

Marihonnaiah (1987) using a modified Cobb-Dougllass production function regressed mulberry acreage, labour (mandays), fertilizers (Rs.) and manure (cart loads) on mulberry leaf yield. Mulberry acreage had significant and positive coefficient across different farm size groups. Similarly, labour too had a positive and significant bearing on leaf yield. Layings (nos), percentage of successful crops, labour (mandays), fixed costs and leaf (kgs) were regressed on cocoon yield. Amongst five variables, leaf had a positive and significant coefficient in case of marginal and large farm size groups.

Das *et al.*, (1999) examined the resource use efficiency in sericulture at Mushidabad district with the help of inter group analysis. They revealed that comparative yield performance is always better for marginal farmers; they may be given sufficient help for boosting up the overall productivity.

Das *et al.*, (2000) studied the size and productivity relation in sericulture. They observed that net return is optimized at mulberry land holding of 0.5 acre in most of the districts of West Bengal.

Srinivas *et al.*, (2008) assessed resource use efficiency in sericulture at Chamarajanagar and Kolar districts of Karnataka. They indicated that the quantum of resources used was suboptimal in case of farmers of Chamarajanagar district compared with farmers of Kolar district.

Mane *et al.*, (2012) conducted study on resource productivity and resource use

efficiency in cocoon production (from sample of 60 producers) at Osmanabad district of Maharashtra. They revealed that the sum of production elasticities ( $\sum b_i$ ) was 0.876 which indicated decreasing return to scale.

Kainga *et al.*, (2013) determined the allocative efficiency in case of banana and plantain production in Bayelsa State of Nigeria. The data (of 180 sample households) were analyzed using production function models. Their study indicated that banana suckers were efficiently allocated, while plantain suckers were inefficiently allocated; family and hired labour were inefficiently allocated in case of both banana and plantain enterprises.

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**17a EXPERTISE AVAILABLE WITH PROPOSED INVESTIGATION GROUP/ INSTITUTION ON THE SUBJECT OF THE PROJECT**

Principle investigator is having expertise in Applied statistics as well as farming activities and Co-investigators are having expertise in Mulberry Cultivation and Rearing Technology of Silkworm.

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## **18.0. WORK PLAN (METHODOLOGY)**

The design of the study is an important component of research. To accomplish study, an appropriate methodology describing sampling design, data collection and tools of analysis is inevitable.

In the present study, including selection of study area, sampling design, nature and source of data, collection of data, data editing and statistical tools employed will be presented under the following heads.

- 18.1. Selection of study area
- 18.2. Nature and source of data
- 18.3. Sampling design
- 18.4. Collection of data
- 18.5. Data editing
- 18.6. Use of statistical tools

### **18.1. Selection of study area:**

The study area comprises traditional mulberry growing districts (viz. Malda, Murshidabad & Birbhum) of West Bengal. These traditional districts will be preferred because of their major contribution towards the growth of sericulture in the State. The study in these districts fairly represents the West Bengal sericulture scenario. Hence, these districts are purposively selected.

## 18.2. Nature and source of data:

The study will be based on both primary and secondary data. The primary data will be collected using pre tested schedule / questionnaire regarding socio economic status of family, cropping pattern, variety of crop and breed reared, inputs used, technology adopted, cost and returns etc. from the respondents.

The secondary data will also be collected from authenticated sources to assess the trends in area, production and productivity of mulberry cocoon in the region.

## 18.3 & 18.4. Sampling design and collection of data:

Multistage random sampling design will be adopted for the selection of district, blocks, villages and sericulture growers.

Three traditional districts (Malda, Murshidabad and Bhirbum) will be preferred based on their maximum contribution towards sericulture in the past decade. From each selected district, two blocks will be selected, from the selected blocks, 10 villages will be preferred. From each village, four mulberry cultivating farmers will be randomly selected. So that, from each district 80 farmers will be considered (40 no. from each block). Thus, the total sample size constituted to 240 farmers from the study area (Fig 18.1).

## 18.5. Data Editing:

To carry out statistical analysis, data on 240 farmers will be collected from selected districts of West Bengal as shown in Fig 18.1 & 18.2.

## 18.6 Use of statistical tools:

The tools employed for the statistical analysis are outlined below.

### 18.6.1 Parametric trend models:

To trace the path of production process, different parametric trend models will be used. Among the competitive trend models, the best models will be selected based on maximum  $R^2$  value, minimum RMSE (Root Mean Square Error) and significance of the parameters. Different trend models will be used are:

Polynomial Model	$Y_t = b_0 + b_1 t + b_2 t^2 + b_2 t^3 + \dots + b_k t^k$
Linear Model	$Y_t = b_0 + b_1 t$
Quadratic Model	$Y_t = b_0 + b_1 t + b_2 t^2$
Cubic Model	$Y_t = b_0 + b_1 t + b_2 t^2 + b_2 t^3$
Exponential Model	$Y_t = b_0 e^{(b_1 t)}$
Logarithmic Model	$Y_t = b_0 + b_1 \ln(t)$
Growth Model	$Y_t = e^{(b_0 + b_1 (t))}$

### 18.6.2 Tabular analysis:

The primary data elicited from 240 respondents will be subjected to simple tabular analysis. Tabular analysis includes computation of means, percentages etc for the desired variables. The cropping intensity will be calculated using following formula,

$$\text{Cropping intensity} = \frac{\text{Gross cropped area}}{\text{Net cropped area}} \times 100$$

The budgeting technique will be used to compute the costs and returns in mulberry cultivation.

### 18.6.2 Production function approach:

For evaluating marginal productivity of resources and allocative efficiency of resources, different forms of production functions will be used. The production functions will be estimated using OLS (Ordinary Least Square) technique. Variables (Inputs: organic manures, fertilizers, labours, age of the plantation, chemicals, feed, disinfectants, dfls reared, etc.) will be included in the production function (both mulberry and cocoon), and their inclusion will be decided based on their graphical relationship (scatter diagram) with output.

The production function establishes functional relation between input and output in the below form

$$Y = f(X_i)$$

Where,

Y = Output / product (cocoon or mulberry production or both)

X<sub>i</sub> = Input / factor (quantity of i<sup>th</sup> variable/fixed resource used); i = 1, 2, ..., n.

To evaluate the goodness of fit of the regression, the adjusted coefficients of multiple determination ( $\bar{R}^2$ ) will be calculated using the following formula

$$\bar{R}^2 = 1 - (1 - R^2) (n-1) / n-k$$

Where,

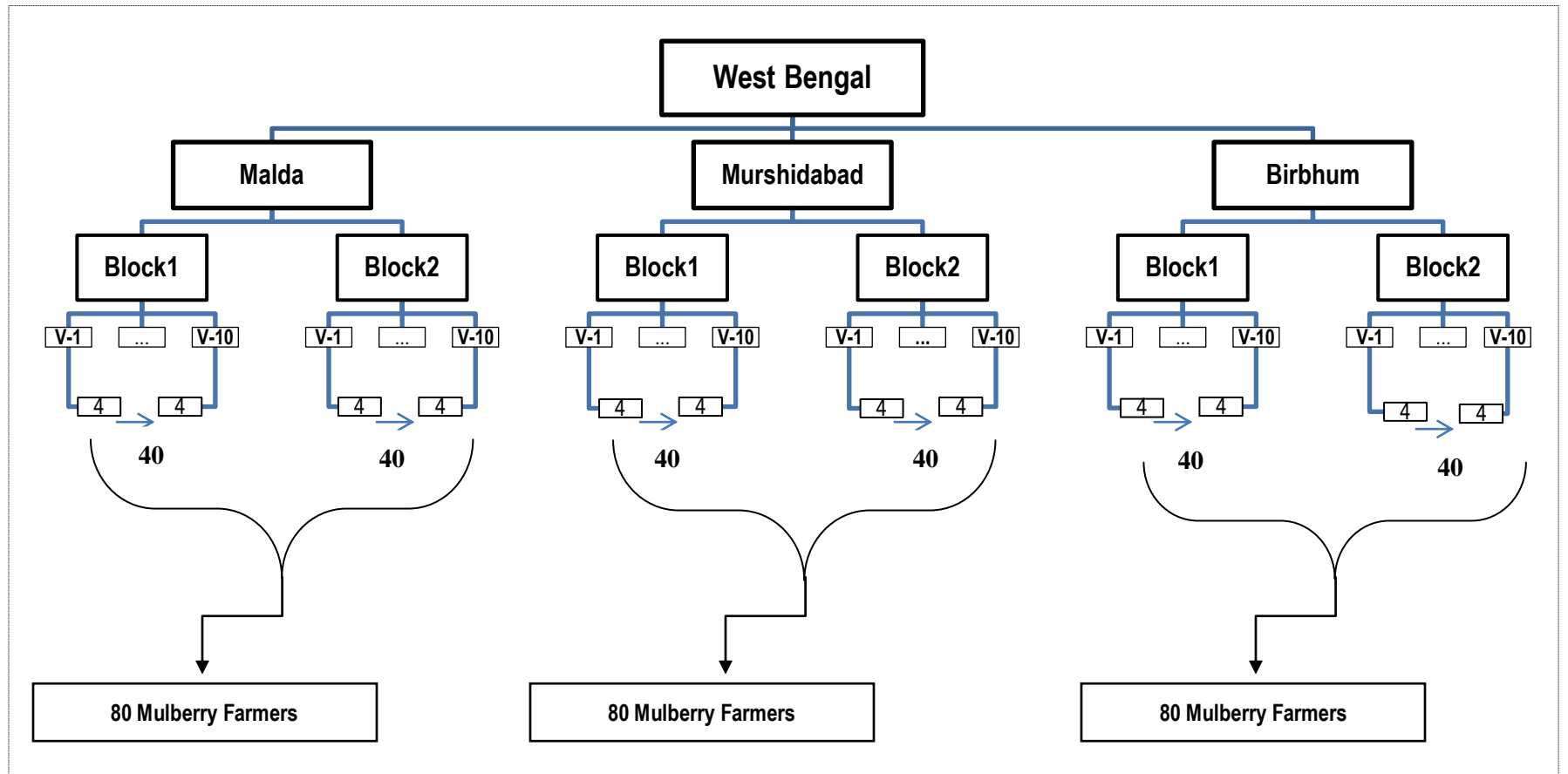
$\bar{R}^2$  = adjusted coefficient of multiple determination

$R^2$  = Coefficient of multiple determination

n = Number of observations

k = Number of parameters

Allocative efficiency is determined using marginal value product (MVP) and marginal input cost (MIC) approach. MVP is the value of marginal product. Marginal product is obtained by taking the first order derivative of production function with respective inputs. The obtained marginal product is then multiplied with the price of output prevailing in the market to arrive at marginal value product. The marginal input cost is the cost of additional input (or in simple words it is the price of input). Farmer is said to be allocatively efficient or price efficient if he/she follows marginal criteria ( $MVP = MIC$ ). MVP = MIC condition is determined for all the variable resources used in the production process. If  $MVP > MIC$ , then it can be concluded that resource under consideration is underused or used sub-optimally. Contrarily if  $MVP < MIC$  then it can be concluded that resource is over used. The extent of sub-optimality and factors responsible for the same can be determined. Using production function approach itself technical efficiency can also be assessed.



**Fig 18.1: Schematic representation of sampling design**

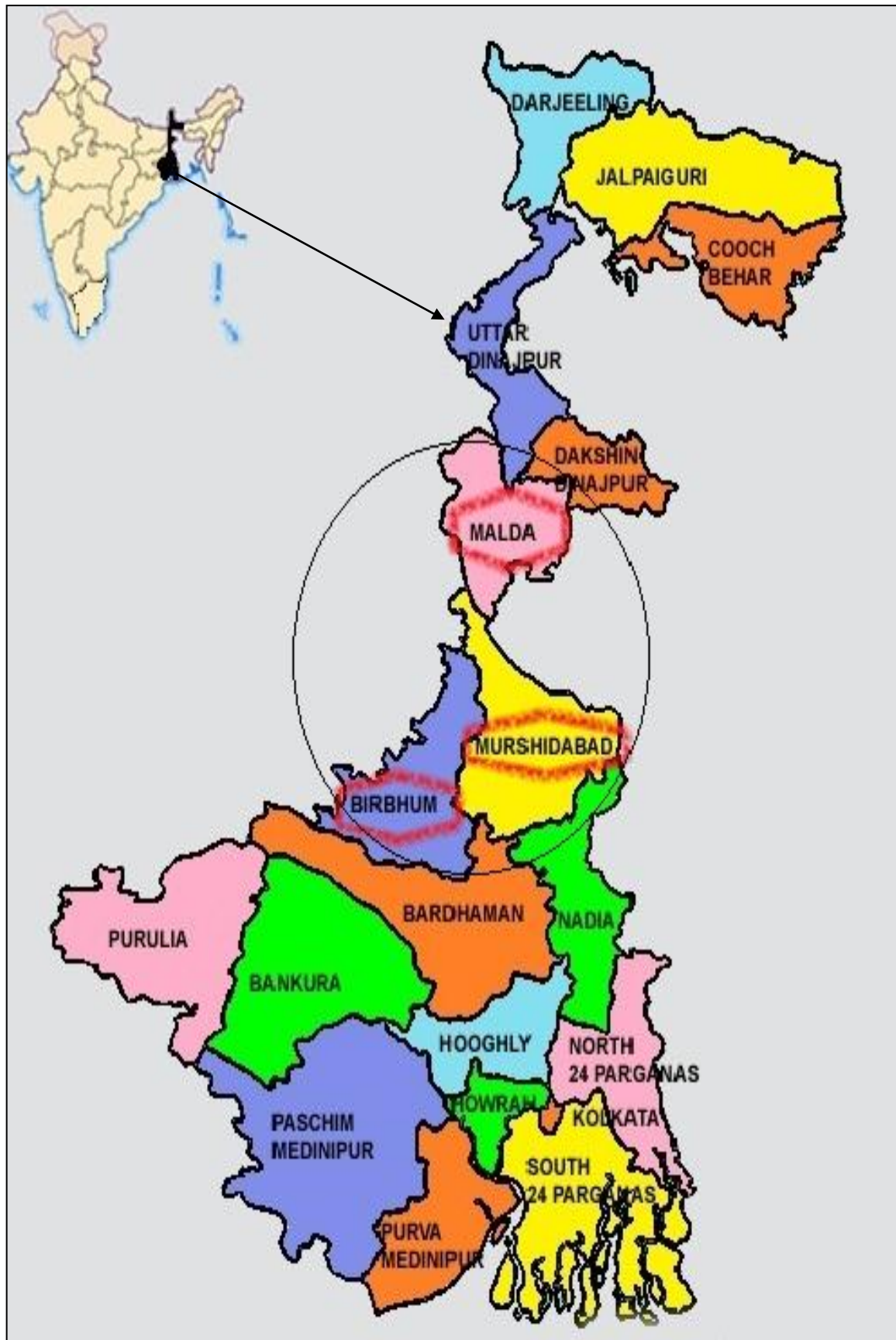


Fig 18.2 Map Showing study area

### 18.6a Organization of Work Elements

Name of Scientist	Designation	Time Allocation	Organization of work elements
1. Dr. G. R. Manjunatha	PI	60%	Project formulation, literature review, planning, co-ordination and execution of study, data collection, sorting, analysis and interpretation of results and submission of final reports.
2. Mr. Shafi Afroz	CI	10%	Associate coordination in collection of data (primary & secondary) of the study region in the approved format for finalization of the project reports with statistical analysis for valid inference.
3. Dr. Subhra Chanda	CI	10%	Monitoring of progress & guidelines and association in proposal of the project and finalization of reports.
4. Dr. D. Pandit	CI	10%	Associate coordination in collection of data (primary & secondary) of the study region in the approved format for finalization of the project reports with statistical analysis for valid inference.
5. Dr. Tapati Datta (Biswas)	CI	10%	Associate coordination in collection of primary data of the region under their jurisdiction in the approved questionnaire and timely onward transmission of data to PI for finalization of the project reports with statistical analysis for valid inference.



### 18.7 Time Schedule of Activities Giving Milestones

#	Activity / Milestone	Estimated date of	
		Starting	Ending
1	<p><b><u>Prerequisite Survey:</u></b></p> <ul style="list-style-type: none"> <li>➤ Documentation of area-wise sampling frame (list of farmers) as sampling design mentioned in the study.</li> <li>➤ Preparation of structured questionnaire to meet the objectives of the study.</li> <li>➤ Testing of structured questionnaire</li> <li>➤ Re-tuning of structured questionnaire</li> <li>➤ Orientation training on how to collect data</li> </ul>	Nov.16	Dec. 16
2	<p><b><u>Secondary data collection:</u></b></p> <ul style="list-style-type: none"> <li>➤ Collection of secondary data (area &amp; production mulberry, raw silk production etc) from the authenticated source</li> <li>➤ Pooling, sorting and computation of collected data</li> <li>➤ Time series analysis (Parametric trend modeling)</li> <li>➤ Interpretation of results</li> </ul>	Jan. 17	March 17
3	<p><b><u>Primary data collection:</u></b></p> <ul style="list-style-type: none"> <li>➤ Collection of primary data from the study region (to meet 2<sup>nd</sup> and 3<sup>rd</sup> objectives of the study) by using pre-tested questionnaires under the sampling design as depicted in the methodology of the study.</li> <li>➤ Pooling of collected data</li> </ul>	April 17	Jan. 18
4	<p><b><u>Analysis, interpretation and submission of report:</u></b></p> <ul style="list-style-type: none"> <li>➤ Sorting of pooled data</li> <li>➤ Computation of pooled data</li> <li>➤ Analysis and interpretation of the data</li> <li>➤ Submission of final report</li> </ul>	Feb. 18	April 18

### 18.8. Project Implementing Agency / Agencies:

Name of the Agency	Address of the Agency	Proposed Research Aspects	Proposed Amount (lakhs)	Cost Sharing %
Central Silk Board	CSB Complex, BTM layout, Madivala, Banagalore – 560 068.	Survey on mulberry sericulture (Statistical aspects)	2.00	Full
<b>Total</b>			<b>2.00</b>	

## PART IV: BUDGET PARTICULARS

### 19.1 Budget for non-recurring

Sl. No.	Items	12 months	6 months	Total (in Rs)
1	Mini laptop (note book) / Stat. software & Camera (high resolutioned)	65,000	-	65,000
<b>Total</b>		<b>65,000</b>	<b>-</b>	<b>65,000</b>

### 19.2 Budget for Consumable Materials

Sl. No.	Items	12 months	6 months	Total (in Rs)
1	Office Stationary	9,000	3,000	12,000
2	Computer stationary/ Others	3,000	-	3,000
<b>Total</b>		<b>12,000</b>	<b>3,000</b>	<b>15,000</b>

### 19.3 Budget for Travel

Sl. No.	Particulars	Budget (in Rupees)		
		12 months	6 months	Total
1	Travel (Project officers)	70,000	35,000	1,05,000
<b>Total</b>		<b>70,000</b>	<b>35,000</b>	<b>1,05,000</b>

### 19.4 Budget for Other Costs

Sl. No.	Particulars	Budget (in Rupees)		
		12 months	6 months	Total
1	Reports/Publications/Conference/others	10,000	5,000	15,000
<b>Total</b>		<b>10,000</b>	<b>5,000</b>	<b>15,000</b>

### 19.5 Year wise budget (Summary)

Sl. No.	Items	Budget (in Rupees)		Total (in Rupees)
		12 months	6 months	
1	Non-recurring	65,000	-	65,000
2	Consumables	12,000	3,000	15,000
3	Travel	70,000	35,000	1,05,000
4	Other costs	10,000	5,000	15,000
<b>Grand total</b>		<b>1,57,000</b>	<b>43,000</b>	<b>2,00,000</b>

## PART V: REFERENCES

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## PART VI: BIODATA OF INVESTIGATORS

### PRINCIPAL INVESTIGATOR

<b>Name</b>	<b>Dr. G. R. Manjunatha</b> Scientist-B BV cell & PMCE Central Sericultural Research & Training Institute Berhampore-742101 E-mail: mgr.dvg@gmail.com
<b>Date of Birth</b>	11 <sup>th</sup> May 1988
<b>Nationality</b>	Indian
<b>Sex</b>	Male

#### Educational Qualification

Sl. No	Institute Place	Degree Awarded	Year	Award/Prize/Certificate
1	University of Agricultural Sciences Dharwad, Karnataka	M.Sc (Agri) in Agril. Statistics	2011	<b>1<sup>st</sup> Rank</b> <b>Dissertation topic:</b> Use of statistical tools in organic farming practices in northern zones of Karnataka
2	Bhidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal	Ph. D (Agri) in Agril. Statistics	2016	<b>Thesis topic:</b> Combinatorial aspects & optimality properties of generalized neighbour designs in circular blocks <b>Supervisor:</b> Prof. A. Majumder, Dept. of Agril. Statistics, BCKV, Mohanpur

#### Academic Accolades

- ✓ I received, University of Agricultural Sciences **Gold Medal** for having secured the highest grade point average among the M.Sc (Agri) in Agril. Statistics graduates during 2010-11.
- ✓ I received, Dr. G. K. Veeresh, Former Vice-Chancellor, UAS, Bangalore **Gold Medal** for having obtained First Rank among the M.Sc (Agri) graduates who have worked on Organic Farming related problems during the year 2010-11.
- ✓ Qualified for **ICAR-NET 2013**
- ✓ Awarded '**INSPIRE Fellowship**', Department of Science & Technology, Government of India for pursuing of full time Ph.D degree
- ✓ Qualified for '**ICAR-SRF 2014**', from ICAR, Government of India.
- ✓ Successfully upgraded for '**INSPIRE Fellowship from JRF to SRF**' assessed by Prof. Rahul Mukherjee, IIM, Kolkata.

#### Work Experience

- Research Associate, RKVY project, UAS Bangalore (26<sup>th</sup> Sep 2011 to 31<sup>st</sup> March 2012)

#### Awards related to publications

- ❖ **DR. ANAMITRA SAHA PRIZE AWARD** for one of the **Best Article** published in *Indian Journal of Agricultural Economics* during the year **2013**.
- ❖ **DR. G. R. SETH MEMORIAL YOUNG SCIENTIST AWARD 2014** for the paper entitled "Generalized Efficiency Balanced Designs in Circular Blocks with Correlated observations" authored by S. G. Patil, A. Majumder and **G. R. Manjunatha** at ICAR-IASRI, New Delhi during **68<sup>th</sup> annual conference of Indian Society of Agricultural Statistics**.
- ❖ **DR. G. R. SETH MEMORIAL YOUNG SCIENTIST APPRECIATION CERTIFICATE 2015** for the paper entitled "Generalised Neighbour Designs in Circular Blocks with Group-Divisible Association Scheme for Correlated Observations" authored by **G. R. Manjunatha**, A. Majumder and S. G. Patil at University of Kota, Rajasthan during **69<sup>th</sup> annual conference of Indian Society of Agricultural Statistics**.

#### Membership of professional Societies

- 1) Life Member of Indian Society of Probability and Statistics (**ISPS**)
- 2) Life Member of Society for Application of Statistics in Agriculture and Allied Sciences (**SASAA**)
- 3) Life Member of Crop and Weed Science Society (**CWSS**)

- 4) Life Member of Indian Society of Agricultural Statistics (**ISAS**)

**Publications** (numbers only): Research papers: **18**; Abstracts: **10**; Popular article in Hindi: **01**

**Professional training/ Workshops /seminar attended/undergone:**

- 1) Workshop on “Statistical Data Analysis”, Applied Statistics Unit, Indian Statistical Institute (ISI), Kolkata, 21-25 January, 2013 [**5 Days**].
- 2) One-day Seminar on “Optimum Covariates Designs and Their Applications”, Dept. of Statistics, University of Kalyani, West Bengal, 28<sup>th</sup> February, 2014 [**1 Day**].
- 3) Workshop on “Innovation Management and IPR in Agriculture/ Horticulture”, Dept. of Agril. Economics, UAHS, Shimoga, Karnataka, 28<sup>th</sup> October 2014. [**1 Day**]
- 4) National Workshop cum Training Programme on “Statistical Tools for Research Data Analysis”, Dept. of Agril. Statistics, B.C.K.V, West Bengal, 16-20 March, 2015 [**7 Days**].

**Selected peer-reviewed publications (in chronological order)**

**I. Theoretical Aspects:**

- 1) **Manjunatha, G. R.**, Majumder, A., Manoj, K., Patil, S. G. and Das, H., 2016, Triangular Generalised Neighbour PBIB Designs in Circular Blocks for Correlated Observations. *Rashi*,1(1) 61-66.
- 2) Majumder, A., **Manjunatha, G. R.** and Patil, S. G. 2015. Efficient Circular Neighbour Balanced BIB Designs with minimum number of blocks for Correlated observations. *International Journal of Agril. and Statistical Science*, 11(2), 449-458.
- 3) Majumder, A., Patil, S. G. and **Manjunatha, G. R.** 2013. General efficiency balanced (GEB) block designs with correlated observations for even number of treatments. *Calcutta Statistical Association Bulletin*, 65,257-260.

**II. Applied Aspects:**

- 1) Manoj, K., Majumder, A., **Manjunatha, G. R.** and Sanjeev, K. 2015. Flower production index using principal component analysis. *Journal of Crop and Weed*, 11 (1), 54-57. [NAAS Rating (NR) -**3.59**]
- 2) Patil, K. K. R., **Manjunatha, G. R.** and Vishwajith, K. P. 2015. Growth dimensions of Karnataka economy in post liberalization period. *Journal of Crop and Weed*, 11 (SI), 19-27. [NR-**3.59**]
- 3) **Manjunatha, G.R.**, Ashalatha, K.V., Kiran Kumar, R. P. and Bhat, A.R.S. 2014. Application of Correspondence Analysis for organic farming practices in Northern Zones of Karnataka. *International Journal of Agricultural and Statistical Science*, 10(1), 115-119. [NR-**6.00**]
- 4) Kiran Kumar, R. P., Patil, B.L., **Manjunatha, G.R.** and Aditya, K. S. 2014. Remunerativeness led acreage response of arecanut in Karnataka state. *Journal of Plantation Crops*, 42(1), 54-61. [NR-**3.06**]
- 5) **Manjunatha, G. R.**, Kiran Kumar, R. P. and Chandrakanth, M. G. 2014. Optimal Stocking Pattern of Chemical Fertilizers: An Application of Waiting Time Model. *Indian Journal of Marketing*, 44(10), 34-40. [NR-**3.89**]
- 6) **Manjunatha, G. R.**, Asha Latha, K. V., Patil, K. R. and Shripad, K. 2014. Effect of Organic farming practices on crop productivity in Northern Zones of Karnataka. *Bioinfolet*, 11(1), 94-96. [NR-**3.75**]
- 7) **Manjunatha, G. R.**, Ashalatha, K. V., Bhat, A. R. S. and Patil, K. R. 2013. Organic Farming a Way to Sustainable Agriculture Development: A Case Study of Karnataka, India. *Environment & Ecology*, 31(2), 1043—1046. [NAAS Rating (NR) -**4.09**]
- 8) Kiran Kumar, R. P., **Manjunatha, G.R.** and Chandrakanth, M.G. 2013. Economic Impact of Institutions on the Consumption of Forest Products in India. *Indian Journal of Agricultural Economics*, 68(2), 155-168. [NAAS Rating (NR) -**5.04**]
- 9) **Manjunatha, G. R.**, Ashalatha, K.V., Patil, K. R. and Vishwajith, K. P. 2013. Effect of organic farming on organic carbon and NPK status of soil in Northern Karnataka, India. *Journal of Crop and Weed*, 9 (1), 79-82. [NR -**3.59**]
- 10) Kiran Kumar, R. P., Aditya, K.S., **Manjunatha, G. R.** and Chinnappa, B. 2013. Market integration of arecanut in Karnataka state: an error correction model approach. *Journal of Plantation Crops*, 41(3), 404-410. [NR-3.06]
- 11) Patil, K. R., **Manjunatha, G. R.** and Aditya, K. S. 2013. Structural transition in Karnataka Agriculture during post liberalization era. *Journal of Crop and Weed*, 9 (2), 65-71. [NR-3.59]

### CO INVESTIGATOR - 1

1. Full Name (in Block Letters) : **Mr. SHAFI AFROZ**
2. Designation : Scientist - B
3. Department /Institute /University : Extension & Publicity Division
4. Address for communication : CSR&TI, Berhampore,  
shafiafroz31@gmail.com
5. Date of birth : 20/12/1986
6. Sex : Male
7. Education onwards & (Post Graduation onwards & Professional Career)

Name of the university	Degree passed	Year of Passing	Subjects taken with Specialization	Class/ Divn.
IARI, New Delhi	M. Sc. (Ag)	2013	Agricultural Extension	I

8. Awards: [Not required for house personnel]:
  - Awarded National Talent Scholarship (NTS) in UG (2007-11), ICAR-JRF (2011-13) in PG, IARI PhD Fellowship
  - Awarded Maulana Azad national Fellowship (MANF) for PhD in 2014-15
  - Qualified UGC NET Exam, Qualified ASRB-NET Exam
  - Awarded ICAR's AICE-SRF(PGS)-2014 in Agricultural Extension
9. Position Held / Research Experience in various institutions:  
[Not required for in-house personnel]
10. Memberships/Fellowships: [Not required for in-house personnel]:
11. Patents: [Not required for in-house personnel]:
12. Publications (Number only):  
Book Chapter: 02; Research Papers: 02
13. Project(s) submitted / being pursued / carried out by Investigator:

Sl.No.	Title of the Project	Funding agency	Duration From and To	No of Scientists /Associates working under the project	Total approved cost of the project ( Rs. in lakh)
Nil					

14. Highlights of outcome / progress of the project (s) handled during the past 10 years their outcome and utilization (in 200 words). **Nil**

## CO INVESTIGATOR - 2

1. Full Name (in Block Letters) : **DR. SUBHRA CHANDA**
2. Designation : Scientist - D
3. Department /Institute /University : CSR&TI, Berhampore
4. Address for communication : Extn. & Publicity Division, CSR&TI,  
Berhampore
5. Date of birth : 28/04/1958
6. Sex : Female
7. Education onwards & (Post Graduation onwards & Professional Career)

Name of the university	Degree passed	Year of Passing	Subjects taken with Specialization	Class/ Divn.
University of Burdwan	M. Sc.	1979	Entomology	I
University of Burdwan	Ph.D.	1987	Insect physiology	Awarded

8. Awards: [Not required for house personnel]:

Year	Award	Agency	Purpose	Nature
NIL				

9. Position Held / Research Experience in various institutions:

[Not required for in –house personnel]

10. Memberships/Fellowships: [Not required for in-house personnel]:

11. Patents: [Not required for in-house personnel]:

12. Publications (Number only):

Books: - Research Papers, Reports: **20** General articles: **03**

13. Project(s) submitted / being pursued / carried out by Investigator:

Sl.No.	Title of the Project	Funding agency	Duration From and To	No of Scientists /Associates working under the project	Total approved cost of the project ( Rs. in lakh)
1	IVLP (Phase _III)	CSB	2010-13	04	23.25

14. Highlights of outcome / progress of the project (s) handled during the past 10 years their outcome and utilization (in 200 words).

- The success of the programme is bound to have a wider implication, as the farmers in and adjoining the areas, where the program was implemented, were enthused with the high level of success both at the field and rearing level.
- The Achievement of the programme lies in the fact that scientific sericulture could prosper in Eastern and North Eastern states if India.



### CO INVESTIGATOR - 3

1. Full Name (in Block Letters) : **Dr. DIPESH PANDIT**
2. Designation : Scientist - D
3. Department /Institute /University : CSR&TI, Berhampore
4. Address for communication : PMCE, CSR&TI, Berhampore
5. Date of birth : 16/12/1963
6. Sex : Male
7. Education onwards & (Post Graduation onwards & Professional Career)

Name of the university	Degree passed	Year of Passing	Subjects taken with Specialization	Class/ Divn.
BCKV	M. Sc. (Ag)	1988	Agricultural Extension	I
BCKV	Ph.D. (Ag)	1996*	Agricultural Extension	Awarded

\* Awarded in 1996. Completed work (except writing) before joining in CSB on 05.02.1992. Submitted the write up after joining in CSB with due permission.

8. Awards: [Not required for house personnel]:

Year	Award	Agency	Purpose	Nature
NIL				

9. Position Held / Research Experience in various institutions:

[Not required for in –house personnel]

10. Memberships/Fellowships: [Not required for in-house personnel]:

11. Patents: [Not required for in-house personnel]:

12. Publications (Number only):

Research Papers: 20; Repots: 49; Seminar/Symposium: 14 & General articles: 08

13. Project(s) submitted / being pursued / carried out by Investigator:

Sl.No.	Title of the Project	Funding agency	Duration From and To	No of Scientists /Associates working under the project	Total approved cost of the project (Rs. in lakh)
1	MOE-3195	CSB	2001-03	3	-
2	MOE-3244	CSB	2002-04	3	-
3	MOE-3363	CSB	2006-07	3	-
4	MOE-3361	CSB	2006-08	3	-
5	MOE-3396	CSB	2007-10	5 + REC (15) + RSRS in charges(4)	-

14. Highlights of outcome / progress of the project (s) handled during the past 10 years their outcome and utilization (in 200 words).

- Determined Socio-economic and psychological characteristics of sericultural farmers and also determined adoption level of few sericultural technologies at farmers' level cause of high/low adoption and probable remedial measure etc.
- Determined yield gap at farmers' level w.r.t. research institute and demonstration plots and factors responsible for such gap along with percentage contribution of different factors.
- Determined Knowledge and perception level of sericulture farmers of WB w.r.t four different aspects like 'Mulberry garden management', 'Silkworm rearing management', 'Marketing management' and 'Miscellaneous aspects of mulberry sericulture management'.
- Determined constraints of client system in adopting and change agent system in disseminating sericultural technologies / practices.

## CO INVESTIGATOR - 4

1. Full Name (In Block Letters) : **DR. TAPATI DATTA (BISWAS)**  
 2. Designation : Scientist - D  
 3. Department/ Institute/university : REC, Kamnagar, Murshidabad, WB  
 4. Address of communication : CSR&TI, Berhampur -742101  
*tdattabiswas@rediffmail.com*  
 5. Date of Birth : 10/04/1961  
 6. Sex : Female  
 7. Education (Post Graduation onwards & professional career)

Name of the university / institute	Degree Passed	Year of Passing	Subjects taken With Specialisation	Class/Divn
The University of Burdwan	M.SC	1984	Zoology , Entomology	1 <sup>st</sup> ( 2 <sup>nd</sup> position)
The University of Burdwan	Ph.D.	1991	Dipteran Taxonomy	N.A.

### 8. Awards:

[Not required for in- house personnel]

Year	Award	Agency	Purpose	Nature

### 9. Positions Held/Research Experience in various institutions:

[Not required for in –house personnel]

10. **Memberships/Fellowships:** [Not required for in-house personnel]

11. **Patents:** [Not required for in-house personnel]

12. **Publications** (Numbers only): Books: One, Booklet: 4, Research Papers: Twenty (International: 7; National: 13), General articles: Four

13. **Project(s) submitted/ being pursued/carried out by investigator:** Nil

### 14. Highlights of outcome/progress of the project(s) handled during the past 10 years, their outcome and utilization (in 200 words)

- Importance of environmental factors on P1 seed crop rearing, subsequent commercial grainage as well as commercial rearing has been studied under the project APS 3497.
- Suitable package of practices for chawki garden has been formulated based on the finding of the project PPA 3366.
- Season specific rearing technology has been developed for agro-climatic condition of West Bengal based on the finding of the project APR 3250.
- Chemical capable of inducing trimoulting in bivoltine silkworm has been identified under the project APS 3238.
- Improvement of both leaf yield and cocoon yield through the application modern technologies has been studied under the project MOE 3196.

## **PART V: DECLARATION / CERTIFICATION**

### **It is certified that**

- a. The research work proposed in the project does not in any way duplicate the work already done or being carried out elsewhere on the subject.
- b. The same project has not been submitted to any other agencies for financial support.
- c. The emoluments for the manpower proposed are those admissible to persons of corresponding status employed in the institute / university or as per the Ministry of science & technology guidelines.
- d. Necessary provision for the project will be made in the Institute in anticipation of the sanction of the scheme.
- e. If the project involves the utilization of genetically engineered organism, it is agreed that we will ensure that an application will be submitted through our institutional bio-safety committee and we will declare that while conducting experiments, the bio-safety committee we will declare that while conducting experiments, the bio-safety guidelines of the Department of Biotechnology would be followed *in toto*.
- f. If the project involves field trials / experiments / exchange of specimens etc. we will ensure that ethical clearances would be taken from the concerned ethical committees / competent authorities and the same would be conveyed to the Department of Biotechnology before implementing the project.
- g. It is agreed by us that any research outcome or intellectual property right(s) on the invention (s) arising out of the Project shall be taken in accordance with the instructions issued with the approval of the Ministry of Finance. Department of Expenditure, as contained in annex. - V.
- h. We agree to accept the terms and conditions as enclosed in Annexure - IV. The same is signed and enclosed.
- i. The Institute agrees that the equipment, the basic facilities and such other administrative facilities as per terms and conditions of the grant will be extended to investigators throughout the duration of the project.
- j. The Institute assumes to undertake the financial and other management responsibilities of the project.

1. Signature of Executive Authority of Institute with Seal

2. Signature of Principal Investigator

3. Signature of CI-1

4. Signature of CI-2

5. Signature of CI-3

6. Signature of CI-4