

ASSESSMENT, DEVELOPMENT AND MANAGEMENT OF AREA UNDER MULBERRY IN MAJOR SERICULTURE DISTRICTS OF WEST BENGAL USING GEOSPATIAL TECHNIQUE

Collaborative Project **PPF 3532**



Central Sericultural Research and Training Institute
Berhampore - 742101, West Bengal

&



North-Eastern Space Applications Centre
Umiam-793 103, Meghalaya

PART I : GENERAL INFORMATION

1.	Name of the Institute / University / Organization submitting the Programme Proposal	:	Central Sericultural Research and Training Institute, Berhampore - 742101, West Bengal
2.	Status of the Institute(s)	:	R&D
3.	Name(s) and designation(s) of the Executive Authority of the Institute / University forwarding the application	:	Dr. S. Nirmal Kumar, Director
4.	Programme Title	:	ASSESSMENT, DEVELOPMENT AND MANAGEMENT OF AREA UNDER MULBERRY IN MAJOR SERICULTURE DISTRICTS OF WEST BENGAL USING GEOSPATIAL TECHNIQUE
5.	Category of the Programme	:	Applied
6.	Specific Area	:	GIS & MIS
7.	Duration	:	21 st March, 2015 to 20 th March , 2017)
8.	Total cost	:	Rs 20.00 lakh
9.	Is the Programme single institutional or multi-institutional	:	Bi- institutional
10.	If the Programme is multi-institutional, please furnish the following: Name, Designation and Address of the Project Coordinator.	:	Dr. S. Sudhakar, Director, North-Eastern Space Applications Centre, Dept. of Space, Govt. of India, Umiam, Meghalaya

11a. Project Summary: Commercial exploitation and overseas trading of natural silk- the Queen of Textiles have been thriving in India since 15th century AD. About 7.56 million people are engaged presently in our country along the value chain of sericulture –a labour intensive, low input but high output income generating agro-industry. Women constitute the 60% of the work force in the down stream activities of sericulture. Indian silks are also source of sizeable export earning. Apart from domestic consumption, total revenue of Rs.2303.53 crores was earned during 2012-13 through export of direct and diversified silk goods.

India is the second largest producer of silk among 20 silk producing countries in the world and has 15.49 % share in global raw silk production amounting to 23,679 MT in 2012-13 of which, contribution of mulberry raw silk was 79.04% (18,715 MT). Sericulture has been traditionally practiced in West Bengal and flourished under the patronage of local rulers under Mughal Empire. Cossimbazar, a river port situated off Berhampur, Murshidabad district had been a silk hub even during 17th century. Presently, Malda, Murshidabad, Birbhum and Nadia districts are the major contributors of mulberry cocoons and silk in West Bengal.

Mulberry (*Morus* sp.: Moraceae) thrives extensively in tropical and temperate countries and serves as a very important horticultural crop. But in at least 20 countries world over mulberry leaves are converted into silk by a unique bioreactor-the domesticated and indoor-reared silkworm -*Bombyx mori* L. Mulberry is perennial in nature and its leaves are harvested during various phenophases in commensuration with the age of silkworm for its dietary gratification. Farmers of major sericulture districts in West Bengal take up five rearings per year on an average and accordingly mulberry leaves are harvested twice a day to feed the silkworm for a period of 18-27 days depending on season and silkworm breeds, preceded by pruning of the plants for required foliage-flush at desirable height.

Traditional sericulture farmers uproot and replenish old plantation since the economic life of mulberry extends up to 20 years. Many a time farmers do uproot the existing plantation of less yielding varieties and adopt new high yielding improved variety. Sometimes new farmers take up sericulture and surviving mulberry plantation as per actual might not have been reported upon correctly. There have also been incidents where uprooted land patch is partly replenished or not at all replenished with mulberry. These situations warrant attention as successful cocoon crops throughout the year are to be planned and monitored much ahead with season specific availability of quality foliage and quantity of layings to be reared. Policy interventions and planning sometimes get set backs due to erratic weather. Temperature accumulations beyond thresholds of mulberry which impedes growth and depletes nutrition of the foliage also result in reduced cocoon harvest.

Moreover, mulberry withstands 5-6 prunings/ year at the completion of silkworm larva-stage which feeds voraciously on mulberry gross primary production coupled with the fact that senescence is hindered.

Hence, the use of Remote Sensing and geo-spatial technology in management of Mulberry growing areas including acreage, temporal dynamics, foliar nutrient

status, impact of short and long term climate anomaly and resilience / coping strategy are proposed to be assessed towards climate-resilient precision sericulture.

11b. Aims and Objective:

- To estimate the current spatial extent of mulberry cultivation in selected blocks of 4 major Mulberry growing districts of West Bengal using Remote Sensing, Geographic Information System and Global Positioning Systems
- Crop condition assessment of existing Mulberry plantation
- Correlate estimates of leaf moisture and chlorophyll contents using Hyperspectral Radiometric and NDVI data
- To develop block-specific MIS which can be integrated into SILKS portal for dynamic rendering.

PART II: PARTICULARS OF INVESTIGATORS

12.	Name, Designation and Address of the Project Coordinator	:	Dr. S. Sudhakar, Director, North-Eastern Space Applications Centre, Dept. of Space, Govt. of India, Umiam, Meghalaya
12a	Investigators		
i)	Name: Date of birth Sex Indicate whether Principal Investigator / Co-investigator Designation Department/Institute / University: Address	:	Dr. Monica Chaudhuri 05-12-1957 Female Principal Investigator Scientist – C C.S.R & T.I., Berhampore, W.B.
ii)	Name: Date of birth Sex Indicate whether Principal Investigator / Co-investigator Designation Department/Institute / University: Address	:	Dr Bijoy Krishna Handique 30.01.1975 Male Principal Investigator Scientist/Engineer-SE North-Eastern Space Applications Centre, Dept. of Space, Govt. of India, Umiam, Meghalaya

iii)	Name: Date of birth Sex Indicate whether Principal Investigator / Co-investigator Designation Department/Institute / University: Address	Mrs Jonali Goswami 30.04.1975 Female Co- Investigator Scientist/Engineer-SE North-Eastern Space Applications Centre, Dept. of Space, Govt. of India, Umiam, Meghalaya
iv)	Name: Date of birth Sex Indicate whether Principal Investigator / Co-investigator Designation Department/Institute / University: Address	Mrs Pratibha Thakuria Das 01.09.1973 Female Co- Investigator Scientist/Engineer-SD North-Eastern Space Applications Centre, Dept. of Space, Govt. of India, Umiam, Meghalaya
v)	Name: Date of birth Sex Indicate whether Principal Investigator / Co-investigator Designation Department/Institute / University: Address	Shri Chandan Goswami 11.01.1977 Male Co- Investigator Scientist/Engineer-SD North-Eastern Space Applications Centre, Dept. of Space, Govt. of India, Umiam, Meghalaya
13.	No of Projects Being Handled By Each Investigator At Present: 1. Dr. Monica Chaudhuri 2. Dr Bijoy Krishna Handique 3. Mrs Jonali Goswami 4. Mrs Pratibha Thakuria Das 5. Shri Chandan Goswami	: 4 as Principal Investigator 4 4 4 4
14.	Proposed Research Fellow	: Nil

PART III : TECHNICAL DETAILS OF PROJECT

15	Introduction	<p>India is the second largest producer of silk among 20 silk producing countries in the world and has 15.49 % share in global raw silk production amounting to 23,679 MT in 2012-13 of which, contribution of mulberry raw silk was 79.04% (18,715 MT). Sericulture has been traditionally practiced in West Bengal and flourished under the patronage of local rulers under Mughal Empire. Cossimbazar, a river port situated off Berhampur, Murshidabad district had been a silk hub even during 17th century. Presently, Malda, Mushidabad Birbhum and Nadia districts are the major contributors of silk in West Bengal. Due to uneven distribution and lack of scientific survey approach, the actual area under mulberry plantations and their spatial distribution are not available for these districts. Moreover planning and monitoring at Block and village level require detail information in geospatial domain.</p> <p>Geospatial techniques comprising of remote sensing, GIS and GPS have emerged as important tools for mapping and monitoring of silkworm host plants. Recent advances in hyperspectral remote sensing has added the advantage of assessing crop condition, which may also be used for deriving different biophysical parameters.</p> <p>Management Information System in the form of web enabled geoportal has the advantage of providing a single window platform for all the sericulture related information including the detailed maps, statistics etc.</p>
15.1	Definition of the Problem	<p>Due to uneven distribution and lack of scientific survey approach, the actual area under mulberry plantations and their spatial distribution are not available for any district in the country, which is a prerequisite for any sericulture planning and monitoring activity. Moreover planning and monitoring at Block and village level require detailed information in geospatial domain.</p> <p>Geospatial techniques comprising of remote sensing, GIS and GPS, which have emerged as important tools for mapping and monitoring of silkworm host plants can effectively be utilized for large scale mapping of mulberry plantations. Hyperspectral remote sensing and Normalized Vegetation Indices require to be used for mulberry crop condition assessment and also to derive different biophysical parameters such as leaf</p>

		<p>nutrient/chlorophyll content, moisture contents, stress on-setting etc.</p> <p>Management Information System in the form of web enabled geoportal is required for providing a single window platform for all the sericulture related information including the detail maps, statistics etc.</p>
15.2	Origin of the Proposal/ Rationale of the Study	<p>Central Silk Board (CSB), Ministry of Textiles, Government of India has been pursuing the application geospatial techniques comprising of remote sensing, GIS and GPS for sericulture development ever since the launch of the first operational remote sensing satellite, in 1988. Recent developments in the area of geoinformatics opened up new opportunities in assessment, development and management of mulberry at sub districts level.</p> <p>Specialized Organization like NESAC has come forward to support this applied endeavor in terms of satellite based acreage estimation of Mulberry, crop condition assessment, development MIS and integration of MIS into GIS, whereas CSRTI, Berhampore will support with field data collection, required laboratory analysis, and ground truth verification.</p>
15.3	Relevance to the Current Issues and Expected outcome	<p>Spectral and temporal characteristics of mulberry and associated cover types have a different spectral response in different regions of the electromagnetic spectrum. This forms the basis of identifying Mulberry crops along with other land use classes adopting digital classification approaches. Efficiency of satellite images having different resolutions need to be evaluated based on distribution of cropping patterns in a particular district. Acreage estimates derived from classified maps need to be verified in the field with GPS for accuracy assessment.</p> <p>An assessment of the mulberry crop condition will be made using temporal LISS IV and Cartosat-1 data, where hyper spectral data will also be utilized. Similarly an attempt will be made estimate leaf nutrient and leaf moisture content using NDVI and hyper spectral data, which will be supported by laboratory analysis of the study variables.</p> <p>Management Information System in the form of web enabled geoportal has the advantage of providing a single window platform for all the sericulture related information including the detailed maps, statistics etc. which will be linked to SILKS portal already developed.</p>

15.4	Objectives	<ul style="list-style-type: none"> • To estimate the current spatial extent of mulberry cultivation in selected blocks of 4 major Mulberry growing districts of West Bengal using Remote Sensing, Geographic Information System and Global Positioning Systems • Crop condition assessment of existing Mulberry plantation • Estimate leaf chlorophyll and moisture contents using hyperspectral radiometry and normalized vegetation indices with limited laboratory based analysis. • To develop block specific MIS which can be integrated with SILKS portal for dynamic visualization and decision making
16. Review of Status of Research and Development on the Subject		
16.1	National Status	<p>Central Silk Board (CSB) and Indian Space Research Organization (ISRO) in collaboration with the concerned States Sericulture/Textiles Departments applied the technology of remote sensing (RS) and geographical information system (GIS) for mulberry acreage estimation, garden condition assessment and for finding suitable areas for introducing sericulture in the non-traditional States. Two approaches for mulberry acreage estimation have been developed, viz., (i) complete enumeration and (ii) stratified random sampling. These two approaches were tried in many parts of the country and it was found out that the mulberry area estimates could be made within 8 percent error (i.e. 92% accuracy). ISRO and CSB had carried out another large area project, titled National Survey of Potential and Actual Area under Sericulture through Remote Sensing (SPAARS), in which large scale application of the RS and GIS technologies were tried. Satellite based estimates of area under mulberry and a comparison of these estimates with that of the State Sericulture Department, Karnataka showed drastic reduction in the acreage under mulberry in some districts like Mysore and Bangalore rural districts of Karnataka State. SPAARS also had carried out district wise assessment of area suitable for sericulture development <i>albeit</i> on 1:250,000-scale mapping. The database generated under this project is available at the five Regional Remote Sensing Service</p>

		<p>Centres (RRSSCs). SPAARS in some way served as a mechanism of evaluating the National Sericulture Project funded by World Bank.</p> <p>The technology of remote sensing has further improved with launch of RESOURCESAT-1 (October 17, 2003) and CARTOSAT –1 (May 05, 2005) and CARTOSAT-2 on January 10, 2007 with improved spatial and temporal resolutions. The project on Applications of RS and GIS in Sericulture development executed by North Eastern Space Applications Centre in collaboration with State Remote Sensing Centre, Directorates of Sericulture and CSB Research Institutes has made a phenomenal impact on using of geospatial techniques along with advanced ICT tools for integrated management of Sericulture activities. Sericulture Information Linkages and Knowledge System (SILKS) geoportal developed under the project has already shown tremendous potential in information dissemination at farmers’ level.</p>
16.2	International Status	<p>There have been numerous applications of geospatial techniques in mapping, monitoring and suitability analysis of various crops throughout the globe. Basing on the spectral variation the global land cover has been broadly classified into six biome types (Myneni et al., 1997) depending on their canopy structure and numerous approaches have been developed for studying various land cover types. Along with optical satellite data, microwave and hyper spectral data have shown tremendous potential in studying biophysical and biochemical properties of different crops.</p> <p>Along with vegetation, information on soil is critical considering wide physical, chemical and textural variations. The information on the spatial distribution and suitability of various types of soils to various types of crops is crucial for planners and agricultural scientists to initiate and encourage farmers to practice cropping systems based on soil potential to various crop categories. The utility of soil–land resource information for proper agricultural land use was proposed by Dumanski et al. (1987). The land evaluation system of FAO (1983) was based on land qualities as related to individual crops that was used to develop the crop requirements based on experiences in tropical areas.</p>

16.3	Importance of The Proposed Project In The Context Of Current Status	<p>Due to uneven distribution and lack of scientific survey approach, the actual area under mulberry plantations and their spatial distribution are not available for any district in the country, which is a prerequisite for any sericulture planning and monitoring activity. Moreover planning and monitoring at Block and village level require detailed information in geospatial domain.</p> <p>Geospatial techniques comprising of remote sensing, GIS and GPS, which have emerged as important tools for mapping and monitoring of silkworm host plants, which can effectively be utilized for large scale mapping of mulberry plantations. Hyperspectral remote sensing and NDVI estimates may be used for mulberry crop condition assessment and also to derive different biophysical parameters such as leaf protein content, moisture contents etc.</p> <p>Management Information System in the form of web enabled geoportal is required for providing a single window platform for all the sericulture related information including the detail maps, statistics etc.</p>
16.4.	Anticipated Products, Processes/ Technology Package Information or Other Outcome from the Project and Their Expected Utility	<p>The major project outcome will be the volume and spatial distribution of mulberry plantations in the selected blocks, which is expected to cover around 90% of the total mulberry acreage in the selected four districts. This information will help the user department in optimizing the distribution of farm inputs, scheduling package of practices, silkworm crop rearing, supply of silkworm seeds, marketing of cocoons etc. Results from hyperspectral data and NDVI analyses will confirm the possibility of using the data for leaf chlorophyll and moisture content indicating nutrient content. MIS will be a source of single window information for all Sericulture related information at block and village level, which will be part of SILKS portal.</p>
16.5.	Detailed justification with work sharing	<p>Central Silk Board (CSB), Ministry of Textiles, Government of India has been pursuing the application geospatial techniques comprising of remote sensing, GIS and GPS for sericulture development ever since the launch of the first operational remote sensing satellite, in 1988. Recent developments in the area of geoinformatics opened up a new vista in assessment, development and management of mulberry at sub districts level.</p>

Specialized Organization like NESAC will support the in terms of satellite based acreage estimation of Mulberry, crop condition assessment and development and integration of MIS, where CSRTI, Berhampore will support with field data collection and required laboratory analysis.

Central Silk Board will be the funding agency for carrying out the project. NESAC, Dept. of Space, Govt of India, Umium. is the nodal centre for executing the project. CSR&TI, Berhampore will provide the necessary ground information, logistic support for carrying out field visits and limited laboratory facilities for mulberry leaf quality assessment. Timely technical inputs and the logistic support will be provided by each participating centers for execution of the project. Responsibilities of each centre are listed below:

NESAC. Nodal Agency for implementation of the project. Development of methodology, procurement of relevant RS data, acquiring AWS data, ground truth, field verification, data processing & analysis, a mulberry Atlas for major mulberry areas up to block level,, integration of MIS contents into SILK portal and final deliverables such as

Digital database / maps on the following will be provided to the user

- Spatial extent and acreages of existing mulberry plantations at 1:10,000 scale
- Spatial distribution and acreage estimates of mulberry growing areas and related thematic maps
- Assessment of crop condition and related weather and climate
- A mulberry Atlas of major mulberry areas up to block level,
- Project completion report.

CSR&TI, Berhampore. Executive Agency. Shall provide attribute data on the farmers' holding and practice, ground truth, field verification, help in image analysis regarding boundaries.

Central Silk Board. Funding agency

16.6	Expertise Available With Proposed Investigation Group / Institution On The Subject Of The Project	CSR&TI, Berhampore has the expertise of handling spatio-temporal data, currently a program on spatio temporal validation of mulberry yield-weather model is under progress. NESAC has built up an exclusive group working in the area of geospatial applications in Sericulture development. This group comprises of the Scientists/Engineers from the areas of Agriculture, Soil Science, Agro-meteorology, Forestry and Computer Science.
------	---	---

17. WORK PLAN

17.1	Methodology	<p>Spectral and temporal characteristics of mulberry and associated cover types have a different spectral response in the visible (0.45 – 0.69µm), near infrared (0.76 – 0.96 µm), shortwave infrared (1.55 – 2.35 µm) regions of the electromagnetic spectrum. This forms the basis of identifying Mulberry crops along with other land use classes adopting digital classification approaches. Classified maps will be verified in the field with GPS for accuracy assessment using ground truth collection following standard methodology.</p> <p>An assessment of the mulberry crop condition will be made using temporal LISS IV and Cartosat-1 data, where hyper spectral and NDVI data will also be used to the extent possible. Similarly an attempt will be made to estimate leaf nutrient content using hyper spectral data, which will be supported by laboratory analysis of the study variables.</p> <p>For developing the Management Information System (MIS) at block level, open source GIS tools will be used as per methodology already developed by NESAC and will be integrated to SILKS portal.</p>
17.2	Organization Of Work Elements	<p>NESAC will be responsible for satellite data acquisitions and analysis of Mulberry crop acreage estimation. CSRTI will carry out the field surveys and ground truth collection in the selected locations provided by NESAC.</p> <p>Collection of hyperspectral and NDVI data will be done by CSRTI under the guidance of NESAC at periodic interval. Analysis of these data will be carried out by NESAC, while laboratory analysis of leaf protein</p>

		<p>and leaf moisture content will be done by CSR&TI.</p> <p>Development of MIS will be the responsibility of NESAC, whereas CSR&TI will support the block and village level information. Required support will be taken from specialized organizations or companies for integration of the MIS contents in SILKS portal.</p>
17.3	Proprietary / Patented Items, If Any, Expected To Be Used For This Project	NOT APPLICABLE
17.4	Suggested Plan Of Action For Utilization Of The Expected Outcome From The Project	<p>The major project outcome will be the volume and spatial distribution of mulberry plantations in the selected blocks, which is expected to cover around 90% of the total mulberry acreage in the selected four districts. This information will help the user department in optimizing the distribution of farm inputs, supply of silkworm seeds, scheduling silkworm rearing, marketing of cocoons etc. Results from hyperspectral data and NDVI indices analyses will confirm the possibility of using these data for leaf Chlorophyll, nitrogen and moisture content towards harvesting quality cocoon crops. MIS will be a source of single window information for all Sericulture related information at block and village level, which will be part of SILKS portal.</p>

17.5. TIME SCHEDULE OF ACTIVITIES GIVING MILESTONES

Sl. No.	Milestone / Activity	Expected Date of		Expected Outcome / visible/ measurable indicator
		Starting	Completion	
1.	Satellite data acquisition	21.03.2015	20.04.2015	Acquisition of satellite imagery
2.	Satellite data analysis	21.04.2015	20.04.2016	Acreage estimates of Mulberry at block level
3.	Ground truth verification	21.04.2015	20.04.2016	Accuracy of digital classification results

4.	Hyperspectral data collection and analysis	21.04.2015	20.04.2016	Efficiency of hyperspectral data and NDVI indices in crop condition assessment and relating the parameters in turn related to nutritional quality of leaf for silkworm
5.	Development of MIS	21.04.2016	30.04.2017	Integration of MIS into SILKS portal
6.	Analysis of data, compilation and preparation of final report	01.05.17	30.09.17	Project Report

17.6. PROJECT IMPLEMENTING AGENCY/ AGENCIES

Name of the Agency	Address of the Agency	Proposed Research Aspects	Proposed Amount	Cost Sharing %
Central Sericultural Research and Training Institute,	CSR&TI, Berhampore - 742101, West Bengal	GIS & MIS (Applied)	Rs. 20.0 lakh	40 (Rs. 8.0 lakh)
North Eastern Space Applications Centre, Dept. of Space, Govt. of India,	NESAC, Umiam, Ri Bhoi 793103 Meghalaya			60 (Rs. 12.0 lakh)
Total :				100.0

PAYMENT SCHEDULE FOR NESAC BY CSB THROUGH CSR&TI, BERAHAMPORE

- 50% of the allocated project cost as an advance payment to start the work
- 30% of the project cost at the onset of 2nd yr
- Balance 20% of the cost of the study after completion of the work and submission of project report

CONSTRAINTS

- Non-availability of suitable satellite data during the required period of due to cloud cover or poor quality
- Small and fragmented crop areas not recognizable by satellite sensors

PART IV: BUDGET PARTICULARS: (Excluding salary of Scientists, Technical Staff and wages of Field workers/ Time scale field workers).

18. **Budget (in Lakh Rupees):** Rs. 20.0 lakhs

A. Non-Recurring (e.g. equipments, accessories, etc. required for CSR&TI, Berhampore)

Equipment	Specification	Approx. cost
Computer (Work Station)	As specified by NESAC for working out on GIS, GPS and RS	150,000.00
Dedicated Laptop	As specified by NESAC for working out on GIS, GPS and RS during ground truth/off- campus image and data management	49,770.00
Digital Camera with Geo-tagging facility	As specified by NESAC for ground truthing	35,000 .00
Handheld GPS	As specified by NESAC for recording GPS co ordinates in the field	38,000.00
Sub Total A		2,72,000.00

B. Recurring (expenditure in Rs. Lakh)

Particulars	1 st Yr		2 nd Yr		Total	
	CSR&TI	NESAC	CSR&TI	NESAC	CSR&TI	NESAC
1. Satellite Images	-	5.00	--	2.50	-	7.50
2. Processing Charges including software acquisition/ up gradation charge and Service Tax	-	2.00	-	2.50	-	4.50
3. Travel for ground truth and field verification	1.0	-	2.28	-	3.28	-
4. Other Costs (Consumable and stationary, AMC, chemicals, glass wares, Biochemical analyses, collection of GIS inputs etc)	0.50		1.50		2.00	
Sub total B (Recurring)	1.5	7.0	3.78	5.0	5.28	12.0
Sub total A (Non recurring)	2.72	-	-	-	2.72	-
Sub Total C	4.22	7.0	3.78	5.0	8.00	12.0
Grand total:					20,00,000.00	

PART V: EXISTING FACILITIES:

19 a. Available equipments and accessories to be utilized for the project at NESAC

Sl. No.	Name of the Equipment/Accessories	Make	Model	Funding Agency /Year of procurement
1.	Desktop computers	HP	ZR2440w	Dept of Space
2.	Image processing software (ERDAS)	Leica		Dept of Space
	GIS Softwares (ArcGIS)	ESRI		Dept of Space
3	Plotter	HP		Dept of Space
4.	GPS	Trimble	Juno 3B	Ministry of Agriculture
5.	NDVI meter	NDVI 300		Ministry of Agriculture
4	Printers	HP	Colourjet CP1215	Dept of Space

PART VI: REFERENCES

- CSB (1994) Manual of Satellite remote sensing applications for sericulture development, Central Silk Board, Bangalore.
- Dumanski, J., M. Phipps & E. Huffman. 1987. A study of relationships between soil survey data and agricultural land use using information theory. Canadian Journal of Soil Science. 67: 95-102.
- FAO (1976). A Framework for Land Evaluation. Soil Bulletin, 32. Food and Agriculture Organization. United Nations. Rome, Italy.
- Ghosh, R., Goel, R.K., Lole, B.S., Singh, T.P., Sastry, K.L.N., Patel, J., Vanikar, Y.V., Thakker, P.S. and Navalgund, R.R. (1993). District Level Planning- a case study for the Panchmahals district using remote sensing and GIS techniques. International Journal of Remote Sensing, 14, 3163-3168.
- Goovaerts, P. (1999). Performance comparison of geostatistical algorithms for incorporating elevation into the mapping of precipitation, .Geocomputation 99, pp.1-17.
- Gupta, A.K., Nageswara Rao, P.P., Ganesh Raj, K., Dutt, C.B.S. and Chandrashekhar, M.G. (1993). An integrated approach for resource

development using remote sensing- a case study specific to Hill areas. *Journal of Indian Society of Remote Sensing*, 21, 99-108.

- Nageswara Rao P.P., Ranganath, B.K. and Chandrashekhar, M.G. (1991) Remote sensing applications in sericulture, *Indian Silk*, 30, 7-15.
- Nageswara Rao P.P., Ravishankar, H M., Uday Raj and Nagajothi, K. (2004). Production estimation of horticultural crops using IRS 1D LISS III data. *Journal of Indian Society of Remote Sensing*. 32 (4), 393-398.
- Naidu, L. G .K., Rameshkumar, S. C., Nair, K.M., Srinivas, S., Padmavathi, M. and Krishan, P.(2003). Land suitability criteria for rapeseed and mustered, sunflower and castor crops. (In) National seminar on stress management in oil seeds for attaining self-reliance in vegetable oils.28-30th, Jan.2003. Indian Society of Oil Seeds Research, DOR, Hyderabad.
- Myneni, R.B. Nemani, R.R. and Running S.W., 1997, Estimation of global leaf area index and absorbed PAR using radiative transfer models, *IEEE Trans. GeoSc. and Rem. Sen.*, 35(6):1380-1393.
- Navalgund, R.R., Parihar, J.S., Ajai, Nageswara Rao, P.P., Crop Inventory using remotely sensed data, *Current Science*, 61,162-171.
- NRSA (2006) Manual- National Land Use Land Cover mapping using multi-temporal satellite data., Land Use Division, National Remote Sensing Agency, Hyderabad.
- Patel,N.R., Mandal,U.K. and Pande,L.M.(2000).Agro-ecological Zoning system. A Remote Sensing and GIS Perspective. *Journal of Agrometeorology*, 2(1):1-13.
- Rao, U.R. 1991, Remote Sensing for sustainable development, *Journal of Indian Society of Remote sensing*, 19,217-236.
- Shibayama, M. and Akiyama, T., 1989, Seasonal visible, near-infrared and mid-infrared spectra of rice canopies in relation to LAI and above ground dry phytomass, *Remote Sensing of Env.*, 27:119-127.
- Sys, C., Ranst, V., Debaveye, J. and Beernaert, F. (1993). Land Evaluation Part III, Crop requirements. Agricultural publication No. 7, ITC Ghent

9. Memberships/fellowship:

- Life member of Indian Society of Remote Sensing
- Life member of Indian Society of Geomatics.

10. **Patents:** (Not required for in-house personnel)

11. **Publications** (Number only):

- ✓ **Books:**
- ✓ **Research Papers / Reports:**
- ✓ **General articles:**

12. List of important publications whose contents can be used in the proposed area of work:

1. Handique, B. K. and **Sudhakar S.** (2014) Timber volume estimation by double sampling using high resolution satellite data, ***Indian Forester***, 140 (2) : 154-161
2. **Chutia D**, Bhattacharyya DK, **Sudhakar S** (2012) Effective feature extraction approach for fused images of Cartosat-I and Landsat ETM+ satellite sensors. ***Applied Geomatics, Springer*** 4 (3):217-224
3. **Chutia, D**, Singh, PS, Goswami, C, Goswami, J, Das, R, Rocky, P and **Sudhakar, S** (2012): A novel Geospatial Framework for providing effective Planning and Developmental inputs for District Resources Plan. ***NNRMS (B)-36***, 74-80.
4. **Borgohain A, S S Kundu and S Sudhakar** , Spatial, temporal and spectral variations of Aerosol Optical Depth along the Brahmaputra Valley: Northeastern Indi, *Journal of Earth System Science* (Under review process), ***JESS-D-12-00341***, 2012.
5. Goswami, J, Chutia, D and **Sudhakar, S** (2012): Climatic zone specific effective Horticultural Planning in East Khasi Hills District of Meghalaya state, India- a Geospatial approach, *J. of Geographic Information System*, 4(3), 267-272.
6. Chutia, D, Singh, PS, Goswami, C, Goswami, J, Das, R, Rocky, P and **Sudhakar, S** (2012): A novel Geospatial Framework for providing effective Planning and Developmental inputs for District Resources Plan. ***NNRMS (B)-36***, 74-80
7. Chutia, D, Bhattacharyya, DK and **Sudhakar, S** (2012): Effective feature extraction approach for fused images of Cartosat-I and Landsat ETM+ satellite sensors. DOI: 10.1007/s12518-012-0088-y, *Applied Geomatics*, Springer
8. Singh, PS, Chutia, D and **Sudhakar, S** (2012): Development of a Web Based GIS Application for Spatial Natural Resources Information System Using Effective Open Source Software and Standards, *Journal of Geographic Information System*, DOI: 10.4236/jgis.2012.43031, 4(3), pp 261-266.
9. Goswami. J, Roy, S and **Sudhakar, S** (2013): A novel approach in identification of urban hot spot using geospatial technology: a case study in kamrup district of Assam. *International journal of geosciences*, 4, 898-903.

10. Forest fragmentation in India (2013) (**Co author**) CURRENT SCIENCE,VOL:105.PP 1-7.

Accepted and under consideration:

1. Chutia, D, Bhattacharyya, Kalita, Ranjan, **Sudhakar, S** (2013): A model on achieving high performance in the classification of hyperspectral satellite data:- a case study on Hyperion data, *Journal of Applied Geomatics*, Springer (Communicated)
2. Chutia, D, Bhattacharyya, Kalita, Ranjan, **Sudhakar, S** (2013): Hyperspectral Remote Sensing classification: Approached, Methods and Tools, *Intl J of Remote Sensing* (Communicated)
3. Binita Pathak, Arup Borgohain, Pradeep Bhuyan, Shyam Sundar Kundu, **S Sudhakar**, Mukunda M Gogoi, Toshihiko Takemura, Spatial heterogeneity in near surface aerosol characteristics across the Brahmaputra Valley., *Journal of Earth System Science*, Submitted on 5thAug 2013 .
4. Sudhakar Singuluri (2013) Remote sensing and GIS approach for Wetland ecosystem studies with special reference to Sunderbans of West Bengal. *International Journal of Scientific and Engineering Research (IJSER)*
5. Singuluri Sudhakar (2013) Modern Pollen analysis and Ecological adaptations in parts of Jagdalpur Forest Division, Chattisgarh- an approach through RS & GIS techniques. . *International Journal of Scientific and Engineering Research (IJSER)*
6. Borgohain A, S S Kundu, K Nongbri and **S Sudhakar**, Black carbon aerosol characteristics over high altitude, hilly and semi-urban location in Shillong (Umiam), North East India from Jan - Dec 2008: fist time result *Under final review with Indian Journal of Radio and Space Physics.*
7. Binita Pathak, Arup Borgohain, Pradeep Bhuian, S S Kundu, **S Sudhakar**, Mukunda M Gogoi, Toshihiko Takemura, Spatial heterogeneity in near surface aerosol characteristics across the Brahmaputra valley, Under review with *Journal of Earth System Science.*

Worshops/Symposium:

1. Chutia D, Goswami C, Rocky P, Goswami J, Singh PS, Das R and **Sudhakar S** (2012): Preparation of action plan inputs for developmental activities: a case study for afforestation planning using geospatial approach. In proceedings of *National Seminar on Geospatial Solutions for Resource Conservation and Management*, Karnataka State Remote Sensing Applications Centre, Bangalore, pp. 184-188.
2. A Borgohain, S S Kundu and **S Sudhakar**, "Characteristics of columnar and near surface aerosol over a high altitude station Umiam (Shillong): Northeastern India", *Proceeding of 39th Scientific Assembly of the Committee on Space Research*, Page-192, 2012.
3. S S Kundu, A Borgohain, **S Sudhakar**, "Aerosol Characterization over Brahamaputra valley of Assam", *Proceedings of the Project review meeting-ISRO Geosphere Biosphere Program*, Page 78-80, 2012.
4. Goswami. J, Roy, S and **Sudhakar, S** (2012): Agriculture Drought like Scenario in Manipur- Remote Sensing Observation. In proceedings of *National Symposium Frontiers of Mountain Meteorology with special*

emphasis on Himalayas (TROPMET 2012), November 20-22 ,2012 at Dehradun .

5. Borgohain A, S S Kundu, K Nongbri and **S Sudhakar**, Spatial, Temporal, and Spectral variation of aerosol optical depth along the Brahmaputra valley: North eastern India, *NSSS – 2012, Tirupati*
6. Borgohain A, S S Kundu, **S Sudhakar**, Characteristics of columnar and near surface aerosol over a high altitude station Umiam (Shillong): Northeastern India. *COSPAR-2012, Mysore*
7. Borgohain A, S S Kundu, A J Kalita, A Chhari and **S Sudhakar**., Regional characterization of air pollution over North Easter Region of India: its impact on seasonal precipitations., *Asian Summer Monsoon (ACAM), held at International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, 2013.*
8. A Borgohain, S S Kundu, A J Kalita, A Chhari and **S Sudhakar**., Regional characterization of air pollution over North Easter Region of India: its impact on seasonal precipitations., *Asian Summer Monsoon (ACAM), held at International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, 2013.*
9. Chutia D, Singh PS and **Sudhakar S.** Space Based Information KIOSK (SBIK) for effective planning and monitoring of developmental projects and schemes in North Eastern Region (NER), accepted for oral presentation in *India Geospatial Forum 2013.*
10. Handique, B. K., Khan, S. A., Mahanta J. and **Sudhakar S.**, (2013) Forecasting Japanese Encephalitis incidence from historical morbidity patterns: statistical analysis with 27 years of observation in Assam, India, *Proceedings of the 5th International Conference on Health GIS held in Bangkok Aug 21-23, 2013.*
11. **Sudhakar S** (2013) Temporal Biomass studies in North India. Presented during workshop on "Forest cover changes and carbon estimates' during 22-27th Sept. 2013

RECOGNITIONS

- (1) FLEWS project has been recognised as one of the best innovative practices in governance sector by the Department of Administrative Reforms, Ministry of Public Grievances & Pensions, Govt. of India and has been funded for its professional documentation (based on its success till 2011).
- (2) The project has also been shortlisted for Prime Minister's award for innovation in Public Administration for 2012 and has already been scrutinised by a team of experts on 9th November, 2012 at ASDMA, Guwahati.
- (3) North East Award 2012 under e-governance and Public Service Delivery by North East Development Foundation.

Major activities and achievements

1. Director, NESAC

The major responsibility is to give overall direction and Management of North East Space Applications Centre in executing various applications projects pertaining to the fields of Remote Sensing and GIS, Satellite

Communication, Atmospheric Space. Have been working closely with various State Remote Sensing Centres in all eight states in NE Region in executing user, DOS sponsored projects and on job training & capacity building.

As Director NESAC, continued development and up keeping the Centre, increased user base and technical activities. Following activities are carried out: -

- Interaction and coordination with the all Heads of State Remote Sensing Centres and User Agencies in the region.
- Discussion, Formulation, Estimation, Planning and Execution of the various Projects.
- Deployment of Scientific and Technical manpower as per the requirement.
- Technical guidance for the execution of the thematic and software projects.
- Organizing training programmes on advance techniques of Image Processing, GIS and customized courses for the user departments.
- Attending meeting of the user departments and presentation of the results of the projects.
- Delivering lectures at user departments in Potential of Remote Sensing Technology, Application studies in North Eastern Region and on GIS Technology.
- Demonstration and discussion with Visitors.
- Coordination with the State Centres for DOS projects, projects of regional importance and mutual interest.
- General administration and up-keeping of the Centre.
- Accounts, purchase and execution of headquarters directions.
- As Member Secretary NESAC Society, Organized regular Governing Council and Society meeting for the periods of 2009-10, 2010-11, 2011-12, 2012-13
- Assisted in realizing New ISTRAC-IRNSS Ground Station Complex at NESAC and also DWR at Cherrapunji

2. Remote Sensing Application Scientist

Formulating and providing scientific and technical guidance / inputs for User projects, National Mission projects, EOAM projects, societal projects, Projects of regional importance and Students research projects. Also assess current technical activities in the centre, review of different projects and commitments with the users, preparation of project reports, document having project wise workload and work plan for execution with monthly / quarterly targets. Specialization wise involvement and work allotment to scientists major user projects, arrangements for establishing working lab and hosting of various application oriented information system from NESAC server.

3. Project Director, SILKS (Sericulture Information and Linkages & Knowledge) project

Application of remote sensing and GIS for sericulture development, funded by the Central Silk Board, has been completed in all the selected 108 districts covering 24 states in the country. Sericulture Information Linkages and Knowledge System (SILKS) developed under the project is ready for hosting.

As Project Director, directing a team of more than 50 Scientists / Engineers from 24 State Remote Sensing Centres in the country and NESAC to generate database (on potential spatial areas for Mulberry, Eri, Muga, Tusar and best practices) and host web enabled SILKS information in the country on 1: 50,000 scales. The SILKS portal will be launched by the Hon'ble union minister of Textiles on 13th Sept. 2013 in New Delhi.

6. Member, Project Execution Committee

As Member, -in SISDP, DMSP involved in policy decisions for EO applications in decentralized planning and disaster management programmes being executed in NE Region.

7. State coordinator for Telemedicine, Edusat and AWS programmes

A satellite based VSAT connectivity for Telemedicine at 35 nodes – 7 District Hospitals, 4 Medical Colleges, 30 Divisional Headquarters; 7 hubs, 351 SIT nodes and 120 AWS in NE Region. Involved in Coordinating with all involved state agencies, DECU and ISRO Hqs.

8. Member, State Remote Sensing Centre Governing Boards

Representing ISRO in State Remote Sensing Centre Governing boards of NE Region and providing inputs for annual plans and user interface in the states.

9. Roles in State Governments and Academic Institutions

- Member, NSDI, IBDLP
- Selection Board Member, Dept of Geography, NEHU University, Shillong
- Member in various review committees under Integrated Basin development missions.

10. Facilitator for identification of NGOs and establishment of VRCs and Expert

Centers in the region and their capacity building:

- 40 VRCs and 3 Expert Centers

11. Facilitator - provided assistance / technical guidance in establishing Remote Sensing and GIS facilities for Govt. departments and Educational institutes in the region.

- State Forest Departments in Meghalaya, Mizoram
- Support to State Geospatial database generation and establishment
- Support to NERIWALAM for NSDI organization

12. Facilitator- development support to NGOs and Entrepreneurs for capacity building in the region for Land use Planning and watershed development programs.

- Extended support towards development and capacity building for IBDLP, Meghalaya, NEHU faculty and Researcher, Representatives from State Remote Sensing Centres in all the 7 states, Aranyak, NGO, Guwahati etc

13. Coordinator- NRC project (1:50,000 scale)

- Coordinated NRC 1:50,000 scale mapping for the all the 8 states in NE Region for the projects of Landuse and Land cover at 1:50 k 1st and 2nd cycles, wasteland change, NUIS, geomorphology, ground water potential maps under RGNDWM.

14. Regional Project Executive – SISDP Project – QAS (1:50,000 scale)

- Responsibility of Orthrectification of all states excluding Assam, Arunachal Pradesh, generation of DEM for the states of four and merging have been taken and completed the task in time.

15. Promoter of Technology in the Region

- Promotion of Remote Sensing and GIS Technologies, delivered several lectures in the Universities, Colleges, conduction exhibitions and distributed handouts in several occasions during the assessment period.

16. International Collaboration

- Being workout collaborations with Colombian University, US under Flood Early Warning project, ICMOD, Nepal for Forestry applications, AIT, Bangkok and NIT, Netherlands for disasters.

2. PRINCIPAL INVESTIGATOR 1

1. **Full Name** (in Block letters) : Dr. MONICA CHAUDHURI (nee MUKHOPADHYAY)
2. **Designation** : Scientist-C
3. **Department/Institute/University** : Central Sericultural Research & Training Institute
Address for communication : Agronomy, Central Sericultural Research & Training Institute, Institute, Berhampore – 742 101, Dist. Murshidabad, West Bengal.
4. **Date of birth** : 05.12.1957
5. **Sex** : Female

12. Education (Post Graduation onwards & Professional Career):

Name of the University	Degree Passed	Year of Passing	Subject taken with specialization	Class/ Division
Calcutta University	M.Sc(Ag)	1980	Agriculture (Genetics & Plant Breeding)	1 st
Gauhati University	PhD	2003	Genetic study of some life cycle traits of certain phenotypes of muga silkworm reared on different host plants.	

13. Awards (Not required for in-house personnel): NA

Year	Award	Agency	Purpose	Nature

14. Positions Held / Research Experiences in various institutions (Not required for in-house personnel):

Employer	Designation of the post held	Date of joining	Date of leaving

15. Memberships/fellowship: Indian science Congress Association, Knowledge Management for Development

16. Patents: (Not required for in-house personnel)

17. Publications (Number only):

- ✓ **Books:** A chapter

- ✓ **Research Papers / Reports:** 15 full papers, 16 abstracted
- ✓ **General articles:** 6

12. List of important publications whose contents can be used in the proposed area of work:

- ▶ Chaudhuri, M.Singh S.S. Das, B. Dhar N.J. Basumatary, B. Goswami, D. Das, K. Barah, A. Sahu, M. Kakoty, L.N. Chatterjee, S.N. (1999). Climatic variability in nine locations of north east India and their effect on cocoon productivity of muga silkworm (*Antheraea assama* ww). *Sericologia* 39(4):577-591.
- ▶ Chaudhuri Monica [nee Mukhopadhyay] (2003). Studies on the relationship between silk yield, yield components and rearing environment of muga silkworm (*Antheraea assama* Ww), *Sericologia* 43(3):349-354
- ▶ Chaudhuri Monica [nee Mukhopadhyay] (2004). Quantification of impact of weather on cocoon shell weight of muga silkworm (*Antheraea assama* ww). *Proc. Nat. Workshop on Potential and Strategies for Sustainable Development of Vanya Silks in the Himalayan States:* 316-319.
- ▶ Chaudhuri Monica [nee Mukhopadhyay] (2008). Evaluation of impact of weather on cocoon shell weight of muga silkworm (*Antheraea assama* ww). *Sericologia*. 48(3): 315-322
- ▶ Chaudhuri Monica [nee Mukhopadhyay], Jalaja, S.K. Roychowdhury S. and Bindroo B.B (2012). Retrospective analysis of weather variables and mulberry foliage yield. *Nat. Sem. on plant genetic research in Eastern and North-Eastern India. Organized by Indian Society of Genetics and Plant Breeding held at ICAR Complex, Meghalaya, on May 11-12, 2012. Abstract P II (8):* 76.
- ▶ Monica Chaudhuri (nee Mukhopadhyay) and Elfrida Kyriem (2012). Assessment of heat use efficiency of mulberry (*Morus* sp.) for foliage yield. *Indian Biologist*. 44(2): 51-54. ISSN 0302-7554..NAAS Rating Impact factor: 2.2
- ▶ Elfrida Kyriem and Monica Chaudhuri (neeMukhopadhyay) (2012). Use of phenology in ascertaining the thermal requirement of mulberry (*Morus* sp.). yield. *Indian Biologist*. 44(2): 51-54.
- ▶ Monica Chaudhuri(nee Mukhopadhyay), Supen Subba, G.K. Chattopadhyay and S. Nirmal Kumar (2013). Preliminary Estimation of Thermal Time Requirement for Growth of Silkworm Breeds. *Indian Biologist*. 46 (1) :19-22
- ▶ Monica Chaudhuri(nee Mukhopadhyay) and S. Nirmal Kumar (2013). Evaluation of Impact of Weather On Mulberry Leaf Yield. *Indian Biologist*. 46 (1) :23-29
- ▶ Monica Chaudhuri(nee Mukhopadhyay) and S. Nirmal Kumar (2013). Geospatial Thinking Initiative In Sericulture : Assessment of Real Time Photothermal Impact on Growth and Yield of Mulberry. *Indian Cartographer*, Vol. XXXIII, 2013: 72-77

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

Sl. No.	Title of the Project	Funding Agency	Duration	No. of Scientists/ Associates working under the project	Total approved cost of the Project*
1.	Study and maintenance of Castor and Eri Silkworm germplasm, Identification of Perennial castor genotypes suitable for Ericulture in West Bengal	CSB	2009-2011	4	2.15 lakh
2.	Decision Support System Initiative through Impact Assessment of Agroclimate on Foliage Yield of Mulberry (Morus sp.) for Climate Resilient Sericulture in Eastern India	CSB	2012-2013	2	0.33 lakh
3	Real time spatio temporal validation trial for mulberry yield-weather model PPF3487	CSB	2014-2016	5	0.63
4	Evolving Growing Degree Day based Integrated Sericulture Crop Calendar	CSB	2014-2015	3	0.40 lakh
5	Optimum resource utilization through vermiculture for generating on farm value added compost	CSB	2014-2016	2	0.50
6	Screening of mulberry seedlings for phenotypic plasticity of thermo tolerance	CSB	2014-2016	2	0.10

* Excluding the salary of Scientists, Technical Assistants, Technicians and Skilled Farm Workers

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

- Maintained Castor elite lines and eri silkworm germplasm suiting local condition
- Short listed perennial castor genotypes with higher foliage yield suitable for ericulture in West Bengal condition where ericulture is progressing in steady stride
- Developed a synthetic yield weather model for mulberry foliage for which led validation of the model in different agro-eco zones as climate resilient sericulture initiative
- Preparation of a GDD based silkworm and mulberry crop calendar is under progress taking crop phenology and thermal impact on them into consideration
- Generation of vermicompost using farm and seri-waste towards resource management while conserving the local ecology

3. PRINCIPAL-INVESTIGATOR- 2

1. **Full Name** (in Block letters) : DR BIJOY KRISHNA HANDIQUE
2. **Designation** : Scientist/Engineer 'SE'
3. **Department/Institute** : North Eastern Space Applications Centre
Address for communication : Dept. of Space, Govt. of India, Ri-Bhoi dist, Umiam, Mrghalaya
4. **Date of birth** : 30.01.1975
5. **Sex** : Male

18. Education (Post Graduation onwards & Professional Career):

Name of the University	Degree Passed	Year of Passing	Subject taken with specialization	Class/ Division
Assam Agricultural University	M.Sc (Agri)	2000	Agricultural Statistics	1 st
North Eastern Hill University	Ph.D.	2012	Statistics	

19. Awards (Not required for in-house personnel):

Year	Award	Agency	Purpose	Nature
2005	ISRS-SPECK Award	Indian Society of Remote Sensing	Best research Paper presented in ISRS Symposium 2005	
2008	ISRO Young Scientist Merit Award	ISRO	Significant achievement in innovative research and applications	

20. **Positions Held / Research Experiences in various institutions** (Not required for in-house personnel):

Employer	Designation of the post held	Date of joining	Date of leaving
Director, NESAC, Umiam	JRF	30.12.2001	30.06.2003
Director, NESAC, Umiam	Scientist	01.07.2003	Till date

21. **Memberships/fellowship:**

- Life member of Indian Society of Remote Sensing
- Life member of Indian Society of Agricultural Statistics
- Life member of Indian Society of Geomatics.

22. **Patents:** Nil

23. **Publications** (Number only): 22 excluding project reports

- ✓ **Books:** 2 chapter
- ✓ **Research Papers / Reports:** 22 research papers in journals and in proceedings of National Seminar/Conference/annual convention.

18. **List of important publications whose contents can be used in the proposed area of work:**

- i) **Handique, B.K.** (2012) A class of regression-cum-ratio estimators in two-phase sampling for utilizing information from high resolution satellite data, ***ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences***, I-4, pp 71-76.
- ii) **Handique, B.K.** and Das, G. (2011) Spatial statistical analysis for delineating timber species diversity hotspots at compartment level, ***International Journal of Geomatics and GeoSciences*** Vol 2(2), 655-668
- iii) **Handique, B.K.**, Khan S.A., Chakraborty K., Goswami, J. and Sarma, K.K. (2011) Spatial statistical analysis of JE occurrence and identification disease hotspots-case studies in a JE endemic district in north east India, ***International Journal of Geoinformatics***, 7(1), 7-14.
- iv) **Handique, B.K.**, Das, G. (2010) Classification of spatial attributes with GIS and spatial statistics analysis- *Proceedings of the National Seminar on Statistics and Informatics for Massive datasets*, Dec 3-4, 2010, Kalyani West Bengal.
- v) Sarma, K.K., **Handique, B.K.**, Chakraborty K., Devi, H. Suchitra and Rao, P.P.N. (2009), Remote Sensing and GIS based forest working plan inputs for Hills Circle, North Cachar Hills District, Assam, ***NNRMS Bulletin*** **33**, 71-78.

- vi) **Handique, B.K.**, Chakraborty K., Goswami, J. and Sarma, K.K. (2009) Spatial statistics analysis of JE occurrence and identification disease hotspots, *Proceedings of the 3rd International Conference on Health GIS* July 24-26, 2009, Hyderabad.
- vii) **Handique, B.K.**, Rao, P.P. N., (2009) Remote Sensing based acreage estimation of multiple crops in NE Hilly region-scope and challenges, *Proceedings of the National Seminar on Potato in North East*, May 8-9, 2009, Shillong.
- viii) **Handique, B.K.**, Chakraborty K., Goswami, J. and Sarma, K.K. (2009) Geo-spatial analysis of environmental and social determinants of JE outbreak and risk assessment, *Proceedings of Geomatics-2009* Feb 2-4, 2009, Dehradun
- ix) **Handique, B.K.**, Das, G. (2007) Prioritisation of timber species richness hot spots for optimal harvesting and conservation planning – a spatial statistics approach, *Journal of Geomatics*, 1(2)107-112.
- x) Sahoo, P.M., Rai, A., Singh, R., **Handique, B.K.** and Rao, C.S. (2005). Integrated approach based on Remote Sensing and GIS for estimation of area under paddy crop in North Eastern Hilly Region, *Journal of the Indian Society of Agricultural Statistics*, 59 (3).
- xi) **Handique B.K.**, Khan S.A., Goswami, J., Chakraborty K., Bora R., Sarma, K.K. (2005) Characterization of JE prone areas of Dibrugarh District of Assam using Remote Sensing and GIS, *Proceeding of the 25th ISRS Annual Convention and National Symposium*, 6-9 Dec, 2005, Ranchi, Jharkhand

19. **Project (s) submitted/being pursued/carried out by Investigators:**

Sl. No.	Title of the Project	Funding Agency	Duration	No. of Scientists/ Associates working under the project	Total approved cost of the Project *
1	Applications of Remote Sensing and GIS in Sericulture Development (CSB Funded)	CSB	5 years	6	298 Lakhs
2	Developing Remote Sensing based methodology for collecting crop statistics in NER	Ministry of Agriculture, Govt. of India	5 years	3	45 Lakhs

3	Applications of Rs and GIS for development of Agriculture in Assam	Dept of Agriculture, Govt. of Assam	2years	4	35 Lakhs
2	Acreage estimation of rice crop for NE states (Under FASAL project)	Ministry of Agriculture, Govt. of India	2 Years	3	29 Lakhs
3	GIS mapping of vector borne diseases in NER	Dept. of Space	3 year	3	30 Lakhs
4	Comparative studies on selected forest sampling techniques with remote sensing inputs.	Dept. of Space	2 years	2	7 Lakhs
5	RS and GIS based inputs for preparation of Forest Working Plan in NER	Forest Department, NER states	4 years	5	150 Lakhs

20. Highlight of the outcome/ progress of the project (s) handled during the past 10 years, their outcome and utilization (in 200 words):

The output of the project is helping in adopting better sampling designs in preparation of Forest Working Plan inputs for NE states

1. Development of Early warning system for Japanese Encephalitis disease with integrating remote sensing, GIS and Epidemiological studies in Assam. Every year in the month of March/ April early warning is made and bulletin with list of JE prone villages sent to Health Department of Assam via Regional medical Research Centre, Dibrugarh. These are found to be quite helpful by the Health department in taking timely intervention measures. The project has been selected as Translational Research Project by ICMR, New Delhi. A detailed mapping done for the six selected vector borne diseases in NER is expected to immensely help the health authorities to take appropriate intervention measures.
2. Developed the methodology for collecting crop statistics for selected crops for NE hilly region. The project report along with the crop acreage estimates has been found to be quite useful by user departments. Directorate of Economics and Statistics, Govt. of Meghalaya has reconciled their acreage estimates for few of the districts based on the RS based estimates. Government of Meghalaya has nominated Director, NESAC as the member of State Crop Report Committee.
3. Methodology developed for district level acreage estimation of Rice crop for the state of Assam using optical and SAR data with intensive field survey approach.
4. Optimal sampling designs have been suggested for relatively plain and in steep hills having different forest compositions for generating forest working

plan inputs in north eastern region. New estimators have been suggested to increase the efficiency of different forest attributes under given conditions. The outcome of the project is helping in adopting suitable sampling designs for preparation of Working Plan inputs in NER.

5. Coordinating the nationwide project on Applications of Remote Sensing and GIS in Sericulture Development, funded by Central Silk Board. Potential area mapping has been done for 108 districts covering 24 states in collaboration with State Remote Sensing Application Centre of the respective state. Appraisal surveys have been completed for selected blocks/Talukas for acreage estimation of Mulberry host plants for two time periods. Geoportal developed under the project has been hosted under the domain name <http://silks.csb.gov.in>. Outcome of this project is expected to immensely help planners, decision makers and sericulturists in expanding sericulture activities.

3. CO-INVESTIGATOR-1

1. **Full Name** (in Block letters) : SMT. JONALI GOSWAMI
2. **Designation** : Scientist/Engineer 'SE'
3. **Department/Institute** : North Eastern Space Applications Centre
- Address for communication** : Dept. of Space, Govt. of India, Ri-Bhoi dist, Umiam, Mrghalaya
4. **Date of birth** : 30.04.1975
5. **Sex** : Female

24. Education (Post Graduation onwards & Professional Career):

Name of the University	Degree Passed	Year of Passing	Subject taken with specialization	Class/ Division
Assam Agricultural University	M.Sc (Agri)	2000	Agricultural Meteorology	1 st

25. Awards (Not required for in-house personnel):

26. Positions Held / Research Experiences in various institutions (Not required for in-house personnel):

Employer	Designation of the post held	Date of joining	Date of leaving
Director, NESAC, Umiam	JRF	9.01.2002	30.06.2003
Director, NESAC, Umiam	Scientist	01.07.2003	Till date

27. Memberships/fellowship:

- Life member of Indian Society of Remote Sensing
- Life member of Indian Society of Geomatics.

28. Patents: Nil

29. Publications (Number only): 16 excluding project reports

- ✓ **Research Papers / Reports:** 16 research papers in journals and in proceedings of National Seminar/Conference/annual convention.

18. List of important publications whose contents can be used in the proposed area of work:

- xii) **Goswami. J,** Roy, S and Sudhakar, S (2013): A novel approach in identification of urban hot spot using geospatial technology: a case study in kamrup district of Assam. ***International journal of geosciences***, 4, 898-903
- xiii) **Goswami, J,** Chutia, D and Sudhakar, S (2012): Climatic zone specific effective Horticultural Planning in East Khasi Hills District of Meghalaya state, India- a Geospatial approach, ***J. of Geographic Information System***, 4(3), 267-272
- xiv) **Goswami. J,** Roy, S and Sudhakar, S (2012): Agriculture Drought like Scenario in Manipur- Remote Sensing Observation. In proceedings of ***National Symposium Frontiers of Mountain Meteorology with special emphasis on Himalayas (TROPMET 2012)***, November 20-22 ,2012 at Dehradun
- xv) **Goswami.J.,** L.Tajo, Sarma.K.K (2010) Bamboo resources mapping using satellite technology, ***Current Science***, 99 (5), 650-653.
- xvi) **Goswami.J** (2008) Geomatics based Agroclimatic Characterization of Meghalaya, ***Journal of Agrometeorology***, Vol. 10, pp. 164-168.
- xvii) **Goswami.J.** and Goswami.C (2010) Weather advisories for Agricultural Planning in Assam- a novel dissemination approach in the proceeding of ***Tropmet -advances in weather and climate services***, Kolkata, India.
- xviii) Chutia, D, Singh, PS, Goswami, C, **Goswami, J,** Das, R, Rocky, P and Sudhakar, S (2012): A novel Geospatial Framework for providing effective Planning and Developmental inputs for District Resources Plan. ***NNRMS (B)***-36, 74-80
- xix) Chutia D, Goswami C, Rocky P, **Goswami J,** Singh PS, Das R and Sudhakar S (2012): Preparation of action plan inputs for developmental activities: a case study for afforestation planning using geospatial approach. In proceedings of ***National Seminar on Geospatial Solutions for Resource Conservation and Management***, Karnataka State Remote Sensing Applications Centre, Bangalore, pp. 184-188.
- xx) Handique, B.K., Khan S.A., Chakraborty K., **Goswami, J.** and Sarma, K.K. (2011) Spatial statistical analysis of JE occurrence and identification disease hotspots-case studies in a JE endemic district in

north east India, *International Journal of Geoinformatics*, 7(1), 7-14.

- xxi) Chutia, D., Goswami, C., **Goswami, J.**, Singh, P.S., Das, R., and Sudhakar, S. (2011): Preparation of action plan inputs for developmental activities: a case study for afforestation planning using Geospatial approach. Accepted in the proceeding of **National Seminar on Geospatial Solutions for Resource Conservation and Management**.
- xxii) Kundu.S.S. and **Goswami.J** (2010) Assimilation of multiplatform data for rainfall forecasting to simulate river run-off in the proceeding of **Tropmet -advances in weather and climate services**, Kolkata, India.
- xxiii) Barman.D.,**Goswami.J.**,Bhusan.K.2006. "RS and GIS Based Land Use Planning in "Sater Mianar Hour" Wetland Ecosystem" in the proceeding of ISPRS International Symposium on "**Geospatial databases for Sustainable Development**" Goa,India.
- xxiv) Chutia.D.,**Goswami.J.**,Nongkynryh.J.M.,Das.P.T.,L.Tajo. 2006. "Agricultural Planning Information Bank for East Khasi Hills District of Meghalaya" in the proceeding of ISPRS International Symposium on "**Geospatial databases for Sustainable Development**" Goa,India.
- xxv) Handique, B.K., Chakraborty K., Goswami, J. and Sarma, K.K. (2009) Spatial statistics analysis of JE occurrence and identification disease hotspots, *Proceedings of the 3rd International Conference on Health GIS* July 24-26, 2009, Hyderabad.
- xxvi) Handique, B.K., Chakraborty K., Goswami, J. and Sarma, K.K. (2009) Geo-spatial analysis of environmental and social determinants of JE outbreak and risk assessment, *Proceedings of Geomatics-2009* Feb 2-4, 2009, Dehradun
- xxvii) **Handique B.K.**, Khan S.A., Goswami, J., Chakraborty K., Bora R., Sarma, K.K. (2005) Characterization of JE prone areas of Dibrugarh District of Assam using Remote Sensing and GIS, *Proceeding of the 25th ISRS Annual Convention and National Symposium*,6-9 Dec, 2005, Ranchi, Jharkhand

19. Project (s) submitted/being pursued/carried out by Investigators:

Sl. No.	Title of the Project	Funding Agency	Duration	No. of Scientists/ Associates working under the project	Total approved cost of the Project *
1	Applications of Remote Sensing and GIS in Sericulture Development (CSB Funded)	CSB	5 years	6	298 Lakhs
2	Applications of Rs and GIS for development of Agriculture in Assam	Dept of Agriculture , Govt. of Assam	2years	4	35 Lakhs
3	Acreage estimation of rice crop for NE states (Under FASAL project)	Ministry of Agriculture , Govt. of India	2 Years	3	29 Lakhs
4	North East District Resource Planning (NEDRP) for Meghalaya	Dept. of Space	4 years	7	140.00
5	NRC LULC 50K 2nd Cycle	Dept. of Space	2 years	7	
7	North East Database Management and Analysis (NEDMA)	Dept. of Space	2 years	7	5 lakhs

20. Highlight of the outcome/ progress of the project (s) handled during the past 10 years, their outcome and utilization (in 200 words):

- i.** Applications of Remote Sensing and GIS in Sericulture Development project I was responsible for development of methodology to evaluate the site suitability based on climatic parameters for sericulture development.
- ii.** Developed an approach in monitoring flood and drought affected rice crop and to determine current state of recovery.
- iii.** The prime objective of NEDRP is to provide reliable, relevant, up-to-date and affordable information to the district administration and the concerned line departments for planning various kinds of developmental activities in their district in an user friendly environment.
- iv.** Coordinating the nationwide project for NER region and Completed mapping for the state of Meghalaya.

- v. North East Database Management and Analysis (NEDMA) is unique in nature which has main objective to integrate all layers of natural resources along with socio-economic data in a layer format coupled with climatic inputs in a 10km x 10 km grid which would lead to "Decision Supports Tool" (DST) for understanding the climatic adoptability and resilience.

4. CO-INVESTIGATOR-2

1. **Full Name** (in Block letters) : PRATIBHA THAKURIA DAS
 2. **Designation** : Sci/Engr.'SD'
 3. : North Eastern Space Applications Centre
Department/Institute/University : Dept. of Space, Govt. of India, Ri=Bhoi dist, Umiam Mrghalaya
Address for communication
 4. **Date of birth** : 01.09.1973
 5. **Sex** : Female

30. Education (Post Graduation onwards & Professional Career):

Name of the University	Degree Passed	Year of Passing	Subject taken with specialization	Class/ Division
Assam Agricultural University	M.Sc (Agri)	1999	Soil Science	1 st
Assam Agricultural University	Ph.D.	Pursuing	Soil Science	

31. Awards (Not required for in-house personnel): Nil

Year	Award	Agency	Purpose	Nature

32. Positions Held / Research Experiences in various institutions (Not required for in-house personnel):

Employer	Designation of the post held	Date of joining	Date of leaving
Director, ICAR, Barapani	SRF	01.02.2001	

			30.12.2001
Director, NESAC, Umiam	JRF	31.12.2001	30.06.2003
Director, NESAC, Umiam	Scientist	01.07.2003	Till date

33. Memberships/fellowship:

- Life member of Indian Society of Remote Sensing
- Life member of Indian Association of Hill farming
- Life member of Indian Association of Soil and water conservationists
- Life member of Indian Society of Geomatics.

34. Patents: Nil

35. Publications (Number only): 21 excluding project reports

- ✓ **Books:** 2 chapter
- ✓ **Research Papers / Reports:** 19 research papers in journals and in proceedings of National Seminar/Conference/annual convention.

18. List of important publications whose contents can be used in the proposed area of work:

- Nongkynrih, J.M. , **Das Pratibha T.** and Das Ranjit. 2005. Urban Sprawl and Urban-Built-Up Site Suitability Analysis of Aizawl City. ***In the proceedings of 25th ISRS 2005 annual convention and national symposium*** held in Ranchi.
- Chutia, D., Goswami, J., Nongkynrih, J.M., **Das Pratibha T.**, Tajo, L., and Nageswara Rao, P.P 2006. Agricultural Planning and Information Bank for East Khasi Hills District of Meghalaya. ***in the proceedings of ISPRS international symposium*** on "Geospatial Databases for Sustainable Development "held in Goa, India on 27-30th September, 2006.
- **Pratibha T. Das**, Ranjit Das and J. J.M.Nongkynrih. (2007). "Land use/land cover changes in Tinsukia town and it's surrounding using remote sensing and GIS" in the book of national workshop on "Land characterization in different Ecosystem of North Eastern India" held at NERIWALM, Tezpur during 24th-25th September, 2007.
- **Das, Pratibha T.**, Tajo Liagi and Goswami Jonali. 2009. Mapping of potential citrus decline areas of Umling block of Ri-bhoi district using RS and GIS technique. *Journal of Indian Society of Remote Sensing*.37(2):317-324.
- **Das, Pratibha T.** 2009. A Physical Evaluation of Soil Site Suitability for Mandarin Orange: A Methodological Study using GIS. *In the proceedings of Geomatics-2009 on "Geomatics and impact of climate change on Mountain Ecosystem"* held at Dehradun during 2nd to 4th February, 2009.
- **Das, Pratibha T.** & Das, Ranjit. 2009. Assessing the vulnerability to soil erosion of watersheds of Meghalaya using Remote Sensing and GIS. *In the proceedings of Geomatics-2009 on "Geomatics and impact of climate change on Mountain Ecosystem"* held at Dehradun during 2nd to 4th February, 2009.
- Das, Ranjit & **Das, Pratibha T.** 2009. Prioritization of Sub-Watersheds in the state of Meghalaya using RS & GIS. *In the proceedings of ISRS annual convention and National Symposium* held at Nagpur, 2009.
- Chakravarty,K., Devi, H.S., **Das, Pratibha T.** and Sarma, K.K. 2009. Application of Remote Sensing and GIS as a Tool in Wetland Management and Conservation in Deepor

Beel- A case Study. *In the Abstracts of National Seminar of MoEF on "Exploration, utilization and strategy action plan for sustainable management of plant resources" held at Guwahati.*

- **Das, Pratibha T. 2010.** Study of the soils of Deepor beel catchment in relation to soil forming factors using Remote Sensing and GIS. *Indian J. of Soil Cons.* , 38(2):94-100.
- Choudhury, B.U., **Das, P.T.**, and Das, Anup. 2011. Land use systems and Soil Organic Carbon stocks-Status in Northeastern Region of India. In the book on Soil Carbon Sequestration for climate change mitigation and food security. Pp.31-45.
- **Das, Pratibha T. 2010.** Mapping of potential sites for Pineapple using Gis technique. *Indian Journal of Hill Farming.*
- **Das, Pratibha T. 2010.** and Das, Ranjit. 2010. Remote sensing and GIS based approach in soil erosion risk assessment and prioritization of mini watersheds. *Indian J. of Soil Cons.* (Communicated)
- **Das, Pratibha T. & Das Ranjit. 2012.** Alternate land use planning for efficient use of natural resources in a village cluster using Geospatial technique. In: National Symposium on Space Technology for Food & Environmental Security, New Delhi, December 5-7, 2012.
- Das, Ranjit & **Das Pratibha T.** 2012. Study on utilization of the irrigation potential created under Bordikorai irrigation scheme using RS & GIS. In: National Symposium on Space Technology for Food & Environmental Security, New Delhi, December 5-7, 2012.
- Choudhury, B.U., Mohapatra K.P., Das Anup, **Das Pratibha T.**, Nongkhaw L., Fiyaz R. Abdul, Ngachan S.V., Hazarika S., Rajkhowa D.J. and Munda G.C. 2013. Spatial variability in distribution of organic carbon stocks in the soils of North East India. *Current Science.* 104(5):604-614.
- Choudhury, B.U., Nongkhaw L., **Das Pratibha T.**, Das Anup and Ngachan S.V. 2012. Linking land use – land cover change to soil health and socio economy in South Garo Hills District of Meghalaya, Northeast India: A remote sensing and GIS approach. In: National Symposium on Space Technology for Food & Environmental Security, New Delhi, December 5-7, 2012. Pp.212.
- Choudhury, B.U., Singh A.K., Ngachan S.V., **Das Pratibha T.**, Nongkhaw L., Das Anup, Verma B.C., Mohapatra K.P., Rajkhowa D.J. and Munda G.C. 2012. Soil organic carbon mapping of northeastern region of India: A geographic information system approach. In: Carbon Management in Agriculture for mitigating greenhouse effect (Eds. Singh et al., 2012). Pp. 83-95.
- **Das, Pratibha T.**, Das Ranjit & Sudhakar S. 2013. Land use diversification plan for a cluster of village using Geospatial Technology: A case study in Tinsukia district of Assam. *International Journal of Advancement in Remote Sensing, GIS and Geography.* 1(2):26-33.
- **Das, Pratibha T., Devi H. Suchitra., Sudhakar S. & Rently Mammi. 2014.** Characterization and Evaluation of Natural Resources for land use diversification planning: a case study in a block of Meghalaya using RS & GIS technique. *International Journal of Geosciences.* 5: 170-177.
- **Das, Pratibha T. & Sudhakar S. 2014.** Land Suitability Analysis for Orange & Pineapple: A Multi Criteria Decision Making Approach Using Geo Spatial Technology. *Journal of Geographic Information System.* 6: 40-44.

19. Project (s) submitted/being pursued/carried out by Investigators:

Sl. No.	Title of the Project	Funding Agency	Duration	No. of Scientists/ Associates working under the project	Total approved cost of the Project *
1	NRC-Soil Resource Mapping (SRM) on 1:50K (7 districts of Assam)	SLUSI	3 years	2	23.09 Lakhs
2	Soil and Land Capability Mapping for agricultural districts of NER at 1: 50K	NEC	5 Years	3	47.7 Lkhs
3	Soil Nutrient Management Plan for a micro watershed of Ri-Bhoi District of Meghalaya	DOS	1 year	2	4.2 Lakhs
4	Mission on study on Shifting cultivation and its sustainable development in selected districts of NER	In house project	6 months	2	1.5 Lakhs

20. Highlight of the outcome/ progress of the project (s) handled during the past 10 years, their outcome and utilization (in 200 words):

- Prepared soil map for 17 districts at 1:50K and maps are used for land use planning.
- Prepared soil map at 1:25 K for 5 study area and maps are used for watershed studies.
- Prepared soil fertility map for 7 study area and maps are used for soil health assessment and crop and fertilizer recommendations.
- Mapped potential areas for orange plantation in NE Region.
- Prepared potential area map for mulberry and non mulberry food plants in 107 districts of India.
- Prepared map of chemically degraded areas of NER.
- Prepared shifting cultivation change map of 20 districts of NER.

CO INVESTIGATOR-3

1. **Full Name** (in Block letters) : CHANDAN GOSWAMI
2. **Designation** : Sci/Engr -SD
3. : North Eastern Space Applications Centre
Department/Institute/University : Department of Space, Govt. of India
Umiam- 793 103 (Meghalaya)
Address for communication
4. **Date of birth** : 11.01.1977
5. **Sex** : Male

36. **Education** (Post Graduation onwards & Professional Career):

Name of the University	Degree Passed	Year of Passing	Subject taken with specialization	Class/ Division
Assam Agricultural University	M.Sc. (Agri)	2001	Soil Science	1 st

37. **Awards** (Not required for in-house personnel): NA

Year	Award	Agency	Purpose	Nature

38. **Positions Held / Research Experiences in various institutions** (Not required for in-house personnel):

Employer	Designation of the post held	Date of joining	Date of leaving
Director of Research (Agri) Assam Agricultural University Jorhat- 785 013	Junior Research Fellow	07-12-01	31-07-02
Director of Research (Agri) Assam Agricultural University Jorhat- 785 013	Research Associate	10-10-02	30-06-04
Director of Agriculture Govt. of Arunachal Pradesh Naharlagun- 791 110	Subject Matter Specialist (Soil Science)	23-11-05	08-03-09

39. **Memberships/fellowship:** Life member of Indian Society of Remote Sensing

40. **Patents:** Nil

41. **Publications** (Number only):

Research Papers: 6
Conference Paper: 5
Book Chapter: 2
Conference Abstracts: 8
Extension Bulletin: 9

42. List of important publications whose contents can be used in the proposed area of work:

- Chutia D, Singh PS, **Goswami C**, Goswami J, Das R, Rocky P and Sudhakar S (2012). A novel geospatial framework for providing effective planning and developmental inputs for districts resources plan. *NNRMS Bulletin (B)*-36, 74-80.
- Das R, **Goswami C**, Das PT and Sudhakar S (2014). Assessment of soil erosion and prioritization of sub-watersheds of Kopili catchment area using geo-spatial approach. In Souvenir of Scientific Research and Developemnts by SC/ST Sietists of DOS. ISRO Satellite Centre (ISAC), Bangalore, pp. 41-47.
- Chutia D, **Goswami C**, Rocky P, Goswami J, Singh PS, Das R and Sudhakar S (2012). Preparation of action plan inputs for developmental activities: a case study for afforestation planning using geospatial approach. In proceedings of National Seminar on Geospatial Solutions for Resource Conservation and Management (DK Prabhuraj, RS Reddy, TR ShreedharaMurthy, S Vadivelu, K Ashoka Reddy, BP Lakhmikantha, AS Rajasekhar, SS Bakre, K Prathima eds.). Karnataka State Remote Sensing Applications Centre, Bangalore, pp. 184-188.

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

Sl. No.	Title of the Project	Funding Agency	Duration	No. of Scientists/ Associates working under the project	Total approved cost of the Project* (Rs in Lakh)
1.	Application of Remote Sensing & GIS in Sericulture Development	Central Silk Board	2009-2014	7	298.00
2	Soil Resource Mapping on 1:50000 scale for Selected Districts of Assam	Soil & Land Use Survey of India	2009-2014	2	23.08
3	Soil and Land Capability Mapping of Agriculturally Important Districts of North Easter Region	North Eastern Council	2009-2015	2	45.00
4	North Eastern District Resources Plan	North Eastern Council	2011-15	7	140.00

* Excluding the salary of Scientists, Technical Assistants, Technicians and Skilled Farm Workers

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

- Identification of potential sites for mulberry, eri, muga and tasar in 108 districts under 24 states of India using remote sensing and GIS
- Development of Sericultural Information Linkages and Knowledge System for 108 districts under 24 states of India containing spatial as well as non spatial information in English and local languages of the respective states
- Generation of soil resource map on 1:50,000 scale for 7 districts of Assam using remote sensing and GIS (in progress)
- Generation of soil and land capability map on 1:50,000 scale for 14 agriculturally important districts covering the state of Assam and Meghalaya using remote sensing and GIS (in progress)
- Identification of potential sites for horticulture and afforestation for all the states of North Eastern Region using geo-spatial techniques