ANNUAL REPORT

2014-15

SIKKIM STATE COUNCIL OF SCIENCE & TECHNOLOGY

An autonomous organisation under

Department of Science & Technology and Climate Change

Government of Sikkim

Vigyan Bhawan, P.O. Deorali, Gangtok, East Sikkim - 737102

INTRODUCTION

Department of Science & Technology in the State has been created during 1996 mainly for Research and Development in various identified areas relevant to the state, generation of scientific awareness and also for transfer of appropriate technologies for economic upliftment of the weaker section of the society.

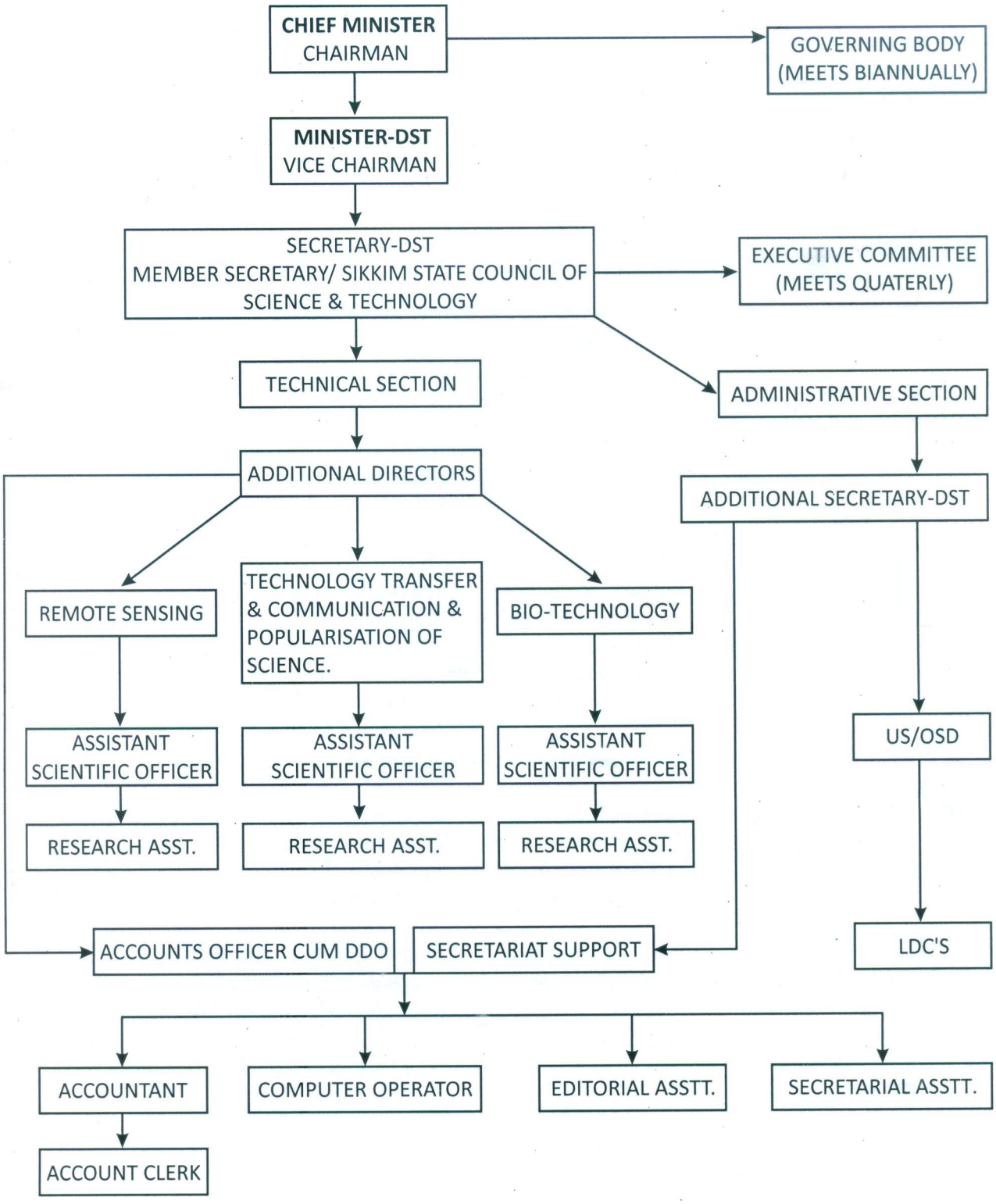
Further, Sikkim State Council of Science & Technology was also created keeping in view the importance of Science & Technology for overall development of the state and with a view to provide sufficient autonomy for implementation of various scientific programmes. The Council takes up various programmes funded by the State Government as well as projects funded by the Government of India agencies like the Department of Science & Technology, Ministry of Environment & Forests, Department of Bio-technology and Department of Space as well. The Sikkim State Council of Science & Technology is the functional arm of State Science & Technology Department for implementation of various scientific programmes in the State.

The Department of Science and Technology has taken up through the Sikkim State Council of Science & Technology various scientific programmes related to (i) Bio-Technology (Bioinformatics & Tissue Culture, Medicinal Plants, Scientific programme on Planting Stock Improvement; Establishment of Sikkim Biotechnology Research and Application Centre) (ii) Glaciers and Climate Studies (iii) Environmental Information System; (iv) Patent Information Centre; (v) Remote Sensing and GIS; and (vi) Technology Transfer and Scientific Awareness, Capacity Building and Skill Development programmes.

The broad objectives of the Sikkim State Council of Science & Technology are as under:

- To increase the Science & Technology infrastructure for meeting the challenging demands in basic research, technological development and scientific services.
- To identify the areas where Science & Technology intervention could significantly improve the existing socio-economic conditions.
- To identify areas of long term development of the State by ensuring application of science and technology developed so far.
- Pilot scale demonstration projects.
- Replication of success models and undertaking pilot scale demonstrations projects.
- Develop appropriate mechanisms for reducing the time lag between an invention and its commercialization.
- To supplement the efforts of the State Government in implementing various projects whenever and wherever called for.
- To popularize Technologies and initiate scientific attitude and temperament amongst the people of the State through awareness and training programmes.
- To facilitate the scientists and the entrepreneurs in promoting technology transfers, establishing a strong relationship among the academics, research institutes and industry, guidance for developing entrepreneurship.

ORGANISATIONAL STRUCTURE OF THE SIKKIM STATE COUNCIL OF SCIENCE & TECHNOLOGY



GOVERNMENT OF SIKKIM
HOME DEPARTMENT
GANGTOK

NOTIFICATION

No.1/Home/96 Dated: 22.01.1996

In exercise of the powers conferred by clause 3 of article 166 of the Constitution of India, the Governor of Sikkim is hereby pleased to make the following rules to amend the Government of Sikkim Allocation of Business Rules,1994 namely:-

1 These rules may be called the Government of Sikkim Allocation of Business amendment rules 1996.

2 In the government of Sikkim (allocation of business) rules, 1994 (herein after referred to as the said rules), in the first schedule, after serial number 36 the following shall be inserted namely:-"37.Science & Technology Department.

3 In the said rules, in the second schedule;

a After the heading XXX VI- Women and Child Welfare Department, the following headings and entries shall be inserted, namely:-

"XXXVII-Science & Technology Department".

i All matters connected with Science & Technology.

ii Advising the government in matters of selection, adoption and transfer to technology in all Science & Technology related field.

iii Regulation and development of Science & Technology specially for research, development and transfer of Technology.

iv Regulation and development of other scientific organizations, NGOs of Science.

v Co-ordinating and regulating science related activities in the rural areas.

vi Organizing Seminar etc. in collaboration with the Government of India departments, organizations and NGOs.

vii Coordinating and regulating scientific research, etc. on behalf of the state with the Government of India departments, organizations and other agencies.

viii Control and development of Sikkim State Remote Sensing Application Centre. Tissue Culture and Seed Technology, Environmental research.

b Under the heading XXVII-Planning and Development Department, entry no. 7 viz " all matters connected with Science & Technology" shall be deleted.

c Under the heading XII-forest department, entry no. 12 viz "Control and development of Sikkim State Remote Sensing Application Centre, Tissue Culture and Seed Technology, Environmental research "shall be deleted.

By order and in the name of the Governor.

K.A. VARADAN
CHIEF SECRETARY
(F.No.54 (182) Home/95)

GOVERNMENT OF SIKKIM
HOME DEPARTMENT

No.55/Home/2012 Date: 07/08/2012

NOTIFICATION

The Governor of Sikkim is pleased to re-constitute the Governing Body of the Sikkim State Council of Science & Technology with immediate effect.

The Governing body of the Council shall comprise of the following members, namely:-

1. Chief Minister - Chairman
2. Minister, Science & Technology & Climate Change - Vice Chairman
3. Chief Secretary - Member
4. Principal Secretary-cum-Development Commissioner, Development,Planning, Economic Reforms and NEC Affairs - Member
5. Secretary, Finance Revenue and Expenditure Department - Member
6. Secretary, Food Security & Agriculture Development Dept./ Horticulture & Cash Crops Development Department. - Member
7. Secretary, Animal Husbandry,Livestock, Fisheries & Veterinary Service Department - Member
8. Secretary, Horticulture & Cash Crop Development Dept. - Member
9. PCCF-cum Secretary, Forest, Envn. & Wildlife Management Dept. - Member
10. PCE-cum- Secretary, Irrigation - Member
11. PCE-cum-Secretary, Public Health Engineering - Member
12. Secretary, Rural Management & Development Dept. - Member
13. Secretary, Human Resource Development Dept. - Member
14. Secretary, Health care, Human Service & Family Welfare Dept. - Member
15. Representative of Planning Commission, GOI - Member
16. Representative of Department of Science & Technology, GOI - Member
17. Representative of Department of Space, GOI - Member
18. Representative of Department of Bio-Technology, GOI - Member
19. Representative of All India Council of Technical Education, GOI - Member
20. Representative of Council of Scientific & Industrial Research (CSIR), GOI - Member
21. Representative of Department of Non-Conventional Source of Energy, GOI - Member
22. Representative of Indian Agricultural Research Institute, New Delhi - Member
23. Director, Geological Survey of India, Sikkim Circle - Member
24. Secretary, Science & Technology & Climate Change, Government of Sikkim. - Member Secretary

1. The function of the State Council shall be as under:-

(i) To identify the areas in which Science & Technology can be utilized for the achievement of the Socio-Economic development of the State and in particular tackling the problems of the backward and under-privileged section of the society with the aim for poverty alleviation thereby reducing the regional imbalances:

(ii) Advice on the policies and measures necessary to promote Science & Technology and its utilization for achievement of Socio-Economic objectives in the field of Agriculture, Animal Husbandry, Horticulture, Environment, Health, Power, Industries, Energy, Irrigation, Public Health Engineering, Building, Roads and in any other related fields;

ONE DEPARTMEN

Contd from page 1

(iii) Advice on policies and measures related to the infrastructure of Science and Technology manpower, their utilization and generation of resources;

(iv) To identify priority areas of long term development of the State by ensuring application of Science and Technology developed so far to solve real problems and encountered in plan-implementation through assigning Pilot Projects etc.

(v) To initiate, support promote and co-ordinate network of Research and Development, design of the projects and programmes and demonstrate the relevant specific objectives, survey and optimum utilization of the natural resources of the State by involving the State based technical institutions and organizations;

(vi) Promote the popularization of the technologies and initiate of the scientific attitude and temperament amongst the people of the State;

(vii) To supplement the achievement of the on-going technical projects/efforts of the State Government;

(viii)To prepare and approve the Science & Technology Plan and Schemes for the State;

(ix)To interact with other States, National and International bodies having similar or related objectives;

(x) To take initiative for any other matters relevant to the application of Science and Technology to solve the problems of the State of Sikkim.

(xi) Registration of voluntary agencies, education research and development institutions, non-governmental organization and individuals involved in doing Science & Technology related work for the purpose of development of the State;

(xii) To maintain a fund into which shall be credited all funds provided to the Council by the Central Government or the State Government , all fees and other charges, all fund received by way of grant, gifts, donations, transfer etc or in any other manner or from any other source. To prepare and maintain accounts and other relevant records in respect of the fund in such a form and manners as may be prescribed by the State Government;

2. The Chairman of the State Council may co-opt any other person as a member of the Council or invite any person to its meeting as deemed necessary.
3. The State Council shall be serviced by the Department of Science and Technology.
4. The State Council shall meet as often deemed necessary and at least twice in a year.

BY ORDER IN THE NAME OF THE GOVERNOR.

Karma Gyatso, IAS
CHIEF SECRETARY
File no.DST/58/1996

SIKKIM STATE COUNCIL OF SCIENCE & TECHNOLOGY
Development Area, Gangtok, Sikkim. PIN 737101
Ph. 03592 204104 Fax: 03592 208764

No. /6 /SSCS&T/ 2013 Date. 22/7 /2013

NOTIFICATION

In supersession of the notification number 596/SSCS&T/07 dated 31/03/2007, the State Government is hereby pleased to constitute the Executive Committee of the Sikkim State Council of Science and Technology consisting of the following members,

1.	Member Secretary, State Council of Science and Technology	Chairman
2.	Chief Conservator of Forest, Forest, Environment and Wildlife Department	Member
3.	Chief Engineer (Electrical)Energy and Power Department	Member
4.	Director, Food Security and Agriculture Development Department	Member
5.	Director, Geological Survey of India	Member
6.	Director, Mines, Minerals and Geology Department	Member
7.	Joint Director, Indian Council of Agriculture Research	Member
8.	Additional Director (Remote Sensing), State Council of Science and Technology	Convener

The Chairman of the Executive Committee may co-opt any other members from the Sikkim State Council of Science and Technology and from Government of India to its meetings as and when deemed necessary.

By order

-Sd-
T.B Gurung
Member Secretary

Copy for information to:

1. All above members
2. Chief Secretary, Government of Sikkim
3. Commissioner-cum-Secretary to HE, the Governor, Raj Bhawan
4. All Secretaries/HOD's, Government of Sikkim
5. Principal Secretary to HCM, Chief Minister's Office, Government of Sikkim
6. Home Department, Gazzette Section-for publication in the Sikkim Government
7. File and Guard File

19/07/2013
Member Secretary
State Council of Science & Technology

CORE MANPOWER OF SIKKIM STATE COUNCIL OF SCIENCE & TECHNOLOGY.

Sl.No	NAME	DESIGNATION
1	Dr. Anil Mainra. IFS	Member Secretary
Supported by DST,GOI Grants-in-Aid		
2	Dr. B.C. Basistha	Additional Director
3	Shri D.G. Shrestha	Additional Director
4	Shri D.T. Bhutia	Additional Director
5	Shri K.B.Subba	Asst Scientific Officer
6	Shri Narpati Sharma	Asst. Scientific Officer
7	Shri Suman Thapa	Asst. Scientific Officer
8	Shri Rinzing Namgyal Lepcha	Asst. Scientific Officer
9	Shri Nabeen Sharma	Computer Operator
10	Ms. Eden Bhutia	Secretarial Assistant
11	Smt. Sonam Ongmu Bhutia	Editorial Assistant
12	Smt. Neeta Maya Rai	Librarian
13	Shri Dadul Lepcha	Accounts Clerk
14	Shri Tika Ram Sharma	Peon
Supported by State Grants-in-Aid		
15	Shri Tashi Bhutia	Peon(Consolidated)
16	Shri Tenzing Bhutia	Peon(Consolidated)
17	Shri Karma Bhutia	Peon(Consolidated)
18	Smt. Anita Basnett	Lower Divisional Clerk(MR)
19	Shri Dadul Bhutia	Craftsman(Consolidated)
20	Shri Hari Psd. Sharma	Peon(MR)
21	Smt. Nar Maya Gurung	Peon(MR)
22	Smt. Premika Gurung	Peon(MR)
23	Km. Ganga Limboo	Peon(MR)
24	Smt. Ran Maya Karki	Safaikarmachari (MR)
25	Mr. Arpan Lepcha	Safaikarmachari (MR)
26	Smt. Karma Doma Lepcha	Peon(MR)
27	Mrs. Nisha Gururg	Office Helper(MR)
28	Shri Rohit Chettri	Night Guard(MR)
29	Shri Bijay Pradhan	Driver(MR)
30	Shri Am Bdr. Manger	Driver(MR)
31	Shri Lakpa Tshering Lepcha	Driver(MR)
32	Shri Sonam Bhutia	Driver(MR)
33	Prem Kumar Chettri	Driver(MR)

LIST OF OFFICERS & STAFF
DEPARTMENT OF SCIENCE & TECHNOLOGY & CLIMATE CHANGE

Sl.No	NAME	DESIGNATION
01.	Dr. Anil Mainra IFS	Secretary
02.	Mr. T.W.Khangsarpa	Special Secretary
03.	Ms.Tshering Donka	Dy. Director
04.	Dr. Sonam Rinchen Lepcha	Dy. Director
05.	Km. Rina Brahma	Assistant Director
06.	Shri D.K.Pradhan	Senior PS to Secretary
07.	Dr.Shiva Kr.Sharma	ASO (Ad hoc)
08.	Shri Tseten Pradhan	APO (Contract)
09.	Km. Januka Tamang	OS
10.	Shri Mohan Kr.Rai	Accountant
11.	Smt.Binita Shrestha	R.A. (Ad hoc)
12.	Shri Benoy Kr.Pradhan	Research Asst.
13.	Ms.Geeta Cintury	H.A.
14.	Smt. Sashi Kala Pradhan	UDC
15.	Smt. Sushila Pradhan	UDC
16.	Smt. Nisha Gurung	Steno II
17	Smt. Prem Kumari Luitel	LDC
18.	Smt. Poonam Pradhan	LDC
19.	Ms. Tshering Youden Bhutia	Lab. Attendant
20.	Smt. Saroj Lepcha	Lab. Attendant
21	Smt. Dawa G.Bhtuia	Lab. Attendant
22	Shri Hem Raj Chettri	Chowkidar
23	Shri Suresh Rai	Peon
24	Shri Raju Rai	Peon
25	Smt. Sancha Kri. Rai	Peon
26	Shri Sarad Pradhan	Driver
27	Shri Ram Bdr. Gurung	Driver
28	Shri Ongden Lepcha	Driver
29	Shri Bikash Pradhan	Driver
30	Shri Sonam Bhutia	Driver
31	Shri Kewal Sharma	Driver
32	Shri Gyampa Sherpa	Driver
33	Ms. Neeru Sunar	Safaikarmachari

PROJECT MANPOWER 2015-16			
Sl.No	**NAME OF STAFF**	**DESIGNATION**	**PROJECT NAME**
1	Shri Rajdeep Gurung	Scientist 'B'-	PIC
2	Shri Laydong Lepcha	Information Officer	BIOINFORMATICS CENTRE
3	Dr. Sushan Pradhan	Research Assistant	BIOTECH HUB
4	Ms. Neelam Gurung	Jr. Research Fellow	BIOTECH HUB
5	Ms. Prerna Pradhan	Jr. Research Fellow	BIOTECH HUB
6	Shri Navin Kr. Chamlagain	Lab. Attendant	BIOTECH HUB
7	Shri Inchung Lepcha	Lab. Attendant	BIOTECH HUB
8	Shri Tika Psd. Sharma	Lab. Attendant	BIOTECH HUB
9	Ms. Ongkit Lepcha	Data Entry Operator	BIOTECHNOLOGY
10	Shri Kishore Psd. Sharma	Data Entry Operator	BIOTECHNOLOGY
11	Ms. Pratima Ghimiray	Jr. Research Fellow	BIOTECHNOLOGY
12	Shri Sherap N. Bhutia	Computer Scientist	ENVIS CENTRE
13	Shri Prabhakar Gurung	Research Assistant	ENVIS CENTRE
14	Ms. Kalzang Eden Bhutia	Data Entry Operator	ENVIS CENTRE
15	Ms. Chunkila Bhutia	Project Assistant	WATER PROJECT
16	Shri Radha Krishna Sharma	Scientist 'B'	CLIMATE CHANGE
17	Shri Pranay Pradhan	Scientist 'B'	CLIMATE CHANGE
18	Shri Nirmal Ghimiray	Sr. Project Officer	REMOTE SENSING
19	Shri Bandan Gazmer	JRF	REMOTE SENSING
20	Shri Bhaichung Lepcha	JRF	REMOTE SENSING
21	Shri Dilli Ram Dahal	JRF	REMOTE SENSING
22	Shri Sandeep Chettri	RA	REMOTE SENSING
23	Ms. Dipa Rupa Sharma	Project Assistance	REMOTE SENSING
24	Shri. Suman Kumar Sharma	JRF	BIO-TECHNOLOGY
25	Dr. Sabitri Shrestha	Project Scientist	PIC

Sikkim State Remote Sensing Applications Centre

The Sikkim State Remote Sensing Applications Centre (SSRSAC) was started with the Department of Science and Technology in the year 1997. The SSRSAC has well trained manpower in the field of Remote Sensing and GIS. The Centre provides training to the Educated unemployed in the field of Geo-informatics. Centre also provides short term training to Student of different colleges in the field of RS and GIS application. It has been undertaking various project funded by Central Government as well as State Government and also provides the necessary data to the user department for various developmental activities in the state. Sikkim State Remote Sensing Centre is also coordinating the Climate Change Programmes with various department of State, Central and other international agencies like GIZ UNDP etc.

1. Ongoing Projects

➢ Establishment of Sikkim State Climate Change Cell

Recently State Climate Change Cell is established in State Council of Science and Technology. The Cell is established under National Mission on sustaining the Himalayan Ecosystem (NMSHE), which is one of the missions of National Action Plan on Climate Change. The project is funded by Department of Science and Technology, Government of India. Fulfilling the objectives of NMSHE in Sikkim is one of the important objectives of the Centre. The NMSHE primarily focuses on:

- Himalayan Glaciers and the associated hydrological consequences
- Bio diversity conservation and Protection
- Wild life conservation and protection
- Traditional Knowledge societies and their livelihood and
- Planning for sustaining of the Himalayan Ecosystem

Based on above objectives, the State Climate Change Cell will work on the sensitive areas of Climate Change in Sikkim identified in State Action Plan on Climate Change (SAPCC).

- Water
- Agriculture, horticulture and livestock
- Biodiversity, Forest, wildlife and eco tourism
- Promotion of energy efficiency
- Urban and rural habitats

The Centre will also focus on Glaciological studies as well as various studies on Climate Change. Under this program two Automated Weather Station will be installed in East Rathong Glacier in West Sikkim and Changme Khangpu glacier in North Sikkim. Vulnerability mapping of key areas in terms of climate change is one of the important objectives of the Centre. Apart from that the Centre will also work on awareness programme on the climate change. The Cell will work in close coordination with various stake holders based on the state in order to fulfill the goal of climate change adaptation programme.

So far, A devoted Officer and space for Cell is provided. We have participated and presented the Status of Sikkim State Climate Change Cell in DST-SDC Workshop on Adaptation, Planning and Implementation in Indian Himalayan Region: Technical support for State Climate Change Cells at Gurgoan, Haryana on 28-30 Jan 2015.

Glimpses of DST-SDC Workshop on Adaptation, Planning and Implementation in Indian Himalayan Region: Technical support for State Climate Change Cells

Manpower recruitment is almost completed. The equipment procurement is in process. Two GPUs are identified for the sample study of vulnerability mapping.

➢ **Study on South Lhonak Glacial Lake of Sikkim in terms of GLOF**

Sikkim State Remote Sensing Applications Centre under Sikkim State Council of Science and Technology has been monitoring the South Lhonak glacial lake from the past few years. South Lhonak glacial lake, located in the extreme North-western parts of Sikkim, is one of the fastest growing lakes in Sikkim. The lake formed right at the snout of the glacier is located in the geographical coordinates of N 27^0 54' 56.7" and E 088^0 12' 33.7" at an altitude of 5201m. The analysis of satellite imagery revealed that the lake is growing at alarming rate. The lake is dammed by loose moraines debris brought down by the glacier. The lake was a small glacial lake in 1960s, which grows to more than 2.10 km in length and 0.6 km in width at present. With this figure, the lake became one of the longest and largest lake within the territory of Sikkim. This enormous growth of lake on the loose moraines debris of the glacier, within a short period of time makes it one of the vulnerable lakes in Sikkim in terms of glacial hazard, in the form of glacial lake outburst flood (GLOF). The lake has increased from 18 ha in 1976 to 109 ha in 2011.

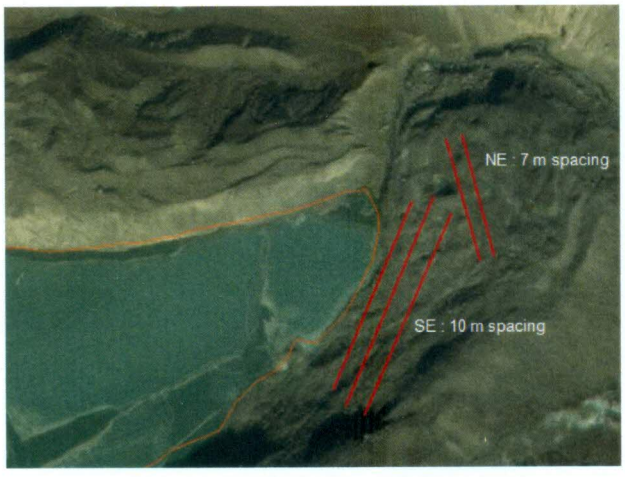
Keeping the threat in mind, Department of Science and Technology, Sikkim has already taken an initiative to study this particular lake. A working group committee has been formed in order to carry out the effective scientific studies of the lake. Based on the suggestions made by the working group committee, a field study of the lake was carried out in the end of August 2014. Following studies was conducted during this field visit:

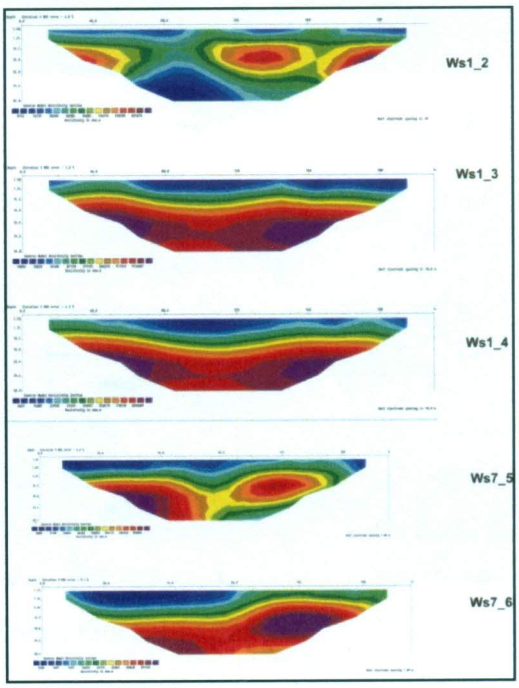
Electrical Resistivity Survey of Moraine Damming the South Lhonak Lake

Electrical resistivity survey was carried out on the eastern direction in the moraines which are sensitive by visual interpretation. During the study, 2D Electrical Resistivity survey was performed in the moraines to get resistivity characteristics against GLOFs. The survey covering *5 longitudinal profiles* of the moraines were carried out during the survey. Among them, three profiles were drawn along the SW to NE directions with electrode spacing of 10 meters each

covering the distance of 240 meters and two profiles were drawn from SE to NW directions with electrode spacing of 7 meters covering the distance of 168 meters. The distance between each profile was fixed around 50 to 60 feet.

Electrical Resistivity Survey of Moraines damming South Lhonak Lake

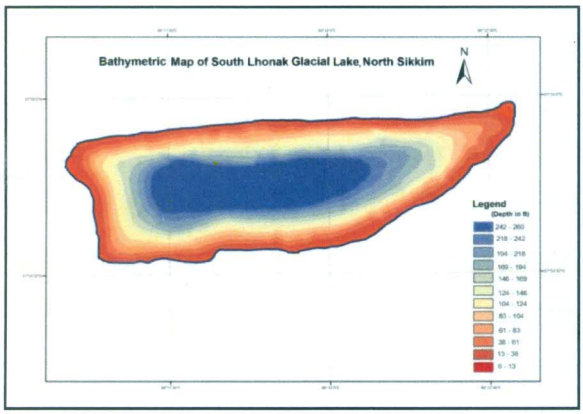


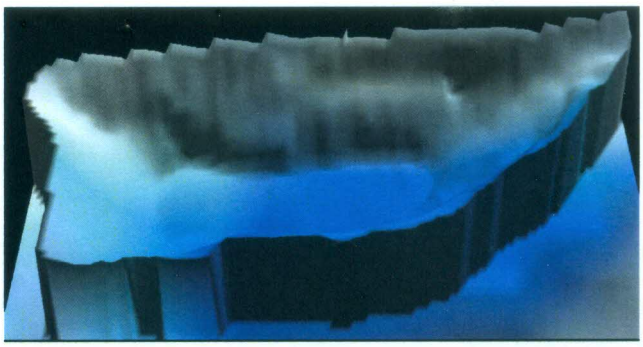


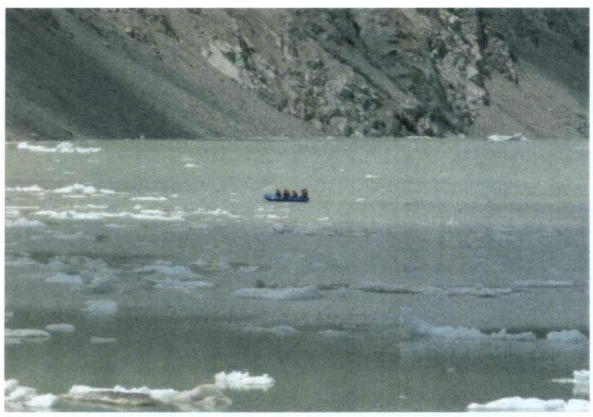
Location of Electrical resistivity survey site (5 longitudinal profiles)

Bathymetric Survey of South Lhonak Lake

Bathymetry is the study of underwater depth of lake or ocean floors. In other words, bathymetry is the underwater equivalent to hypsometry or topography. It is a crucial exercise for sustainable management of lake waters. Bathymetric data helps in evaluating the storage volume of lake, which is used to generate different potential reach models in GLOFs studies. The bathymetric study carried out in September 2014 in South Lhonak Glacier showed that the lake area is 126 hectare with a maximum depth of **260 feet**. The storage volume of the lake is 5, 36,38,863.54 m^3 (say **53 million m^3** = 536 billion litres of stored water) corresponding to the maximum depth of 260 feet.



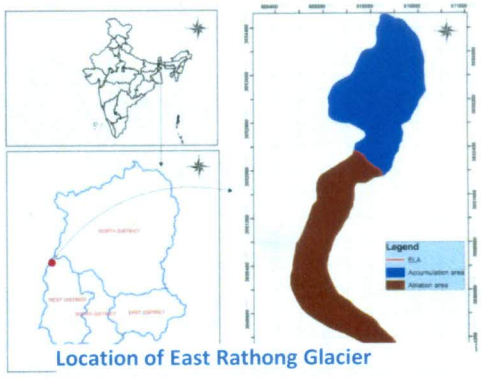




Field Photographs of Bathymetry survey in South Lhonak Glacial Lake

➢ **Study of Glacier Dynamic of East Rathong Glacier of Sikkim Himalayas**

Glacial Dynamics of East Rathong Glacier



Location of East Rathong Glacier

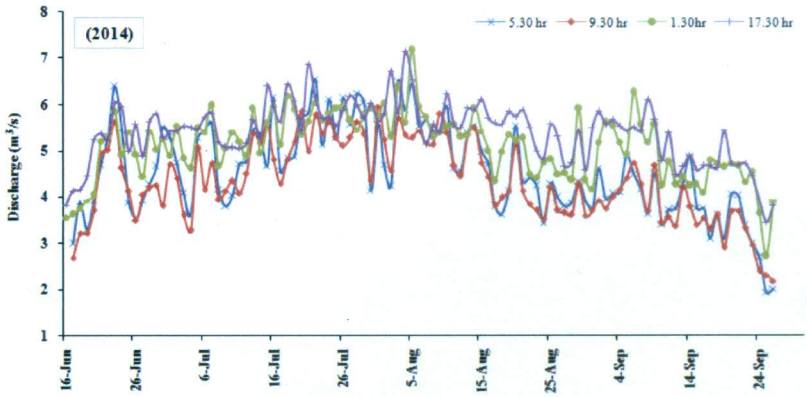
Study of Glacier Dynamic of East Rathong Glacier is project funded by Department of Science and Technology, Government of India. East Rathong glacier located in West District of Sikkim is selected as the benchmark glacier in Sikkim Himalaya for the study of glacial dynamics in order to know the health of glacier in this region. East Rathong Glacier is a valley type, debris cum clean, South- East facing glacier about 7 km with an average width of about 800 m. The flow of the trunk glacier (main body) is from North to South-East. It originates at an elevation between 4600- 6700m asl. From head of the glacier, it descends with a steep gradient and at ablation area, the gradient is moderately gentle. The glacier lies within a U-shaped valley. Around snout region is an Ice cave, on top of which is moraine materials lies. Two lateral moraines are well developed along the sides of the glacier.

Following are the major studies undertaken:

Snout Mapping and monitoring: Snout monitoring is one of the important parts of glaciology. Snout demarks the frontal part of glacier in the lower ablation area. In other words, snout is the particular area in the glacier from where the melt water starts flowing in the form of stream. From 2013, the snout has been monitored with the help of *Topcon DGPS*. The frontal faces of snout showed continuously changing on account of excessive melting in the ablation season of 2013 and 2014. The snout has retreated lengthwise at an average of 4.85 m in one year between September 2013- September 2014.

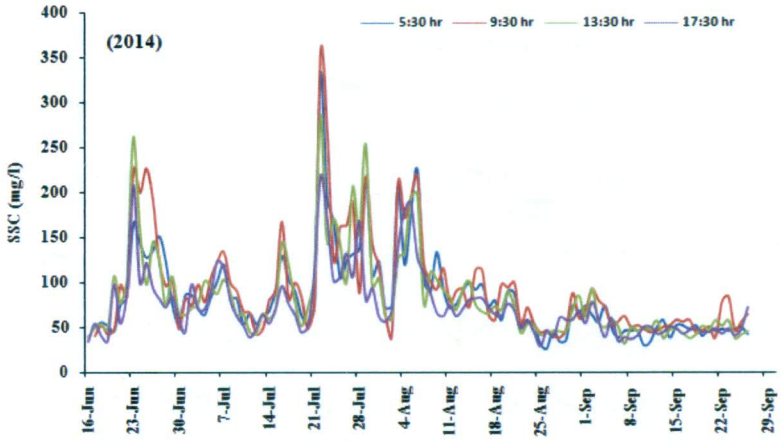
Glacier Hydrology covering Discharge measurement and suspended sediment load studies. Hydrological study is one of the important parts of glaciology, for which Rathong Chu was selected. The hydrological station was established below 1.5 km downstream of the glacier's snout. The average daily discharge in the year 2013 in East Rathong melt water stream was 5.07 m^3s^{-1}, which is comparatively higher than the average discharge of 2014 (4.84 m^3s^{-1}). Generally the maximum and minimum discharges were observed in 5:30 pm and 9:30 am for the year 2013-2014

respectively. Sometimes peak discharges were also observed at the end of the August at 13.30 hrs for both the years due to increased precipitation at that time.



Daily variation of discharge collected for ablation season (2014) at East Rathong Chu from morning to evening.

Average daily sediment concentration in East Rathong glacier stream is 106.3 mg/l and 84.20 mg/l for the year 2013 and 2014 respectively. Average Sediment Load carried by Rathong Glacier stream is 49.94 td^{-1} and 37.11 td^{-1} in ablation season of 2013 and 2014 respectively.



Daily variation of Suspended Sediment Concentration(SSC) collected for ablation season (2014)at East Rathong Chu from morning to evening.

Study of ablation and vertical thinning:

It was found that the glacier has retreated vertically on an **average of 3.849 m** in the ablation period of 2014 (June to September) along the centreline of the glacier, which is considerably higher than the last year melting record in the ablation season.

Team performing ablation stakes measurement in East Rathong Glacier

Meteorological studies

The data meteorological studies are collected by the manual equipments for the ablation period of 2013 -2014 in East Rathong Glacier.

Sl No	Observations	Instruments	Time of observations
1	Temperature	Thermo hygrometer	5:30 hr, 9:30 hr, 13:30 hr and 17:30
2	Rainfall	Ordinary Rain gauge	5:30 hr and 17:30 hr
3	Humidity	Thermo hygrometer	5:30 hr, 9:30 hr, 13:30 hr and 17:30
4	Water level	Manual Water level Gauge	5:30 hr, 9:30 hr, 13:30 hr and 17:30
5	Dry and wet Bulb Temperature	Dry and wet Bulb Thermometer	5:00 hrs to 18 :00 hrs
6	Wind Direction	Wind vane	5:30 hr, 9:30 hr, 13:30 hr and 17:30

Other important studies are:

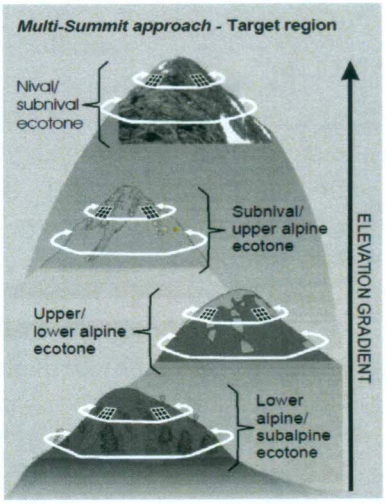
- Contour mapping of East Rathong Glacier.
- Frontal area retreat of East Rathong Glacier using Remote Sensing Techniques.
- Glacier Ice Velocity studies using Topcon DGPS.
- Snow cover Monitoring of East Rathong Glacier Catchment.

- Study of Flora along the recessional moraines in semi Glaciated regions of East Rathong Glacier.

Recently, the State Council submitted the status report on East Rathong Glacier to funding agency. The duration of the project is extended for another one year by DST, GOI.

➢ **Alpine ecosystem dynamics and impact of climate change in Indian Himalaya**

Alpine ecosystem dynamics and impact of climate change in Indian Himalaya (PRACRITI-II). This Project Sanctioned by Space Applications Centre, ISRO, Ahmedabad, under the Himalayan Alpine Dynamic Research Initiative (HIMADRI). The purpose of the research initiative is to find out the suitable site for long term monitoring of climate change impacts on the alpine tree line habitats and to establish long-term observation network for the comparative study of climate change impacts on mountain biodiversity. The project is taken by "Sikkim State Council of Science and Technology" and funded by "Space Applications Centre" (ISRO), Ahmedabad.



The primary objectives of the project are:

- Establishment of long term ecological records in alpine ecosystems of Indian Himalaya.
- Understanding alpine ecosystem response using remote sensing data, *in-situ* data and modelling.

The Secondary objectives are:

- Remote sensing based seamless geospatial database development of the alpine ecosystem towards creation of baseline national data.
- Reconstruction of past alpine tree line with state-of-the-art techniques.
- Simulation of future climate change impact on alpine landscape.

Field Studies for site selection

A study tour to Gnathang, East Sikkim and Thangu, North Sikkim was conducted by a Scientific team of Sikkim State Council of Science and Technology, Space Applications centre (ISRO), Ahmedabad and CSIR-National Botanical Research Institute, Lucknow, to find out the suitable site for long term monitoring of climate induced impacts on the alpine and tree line habitats.

Fig: Survey team at different parts of Sikkim.

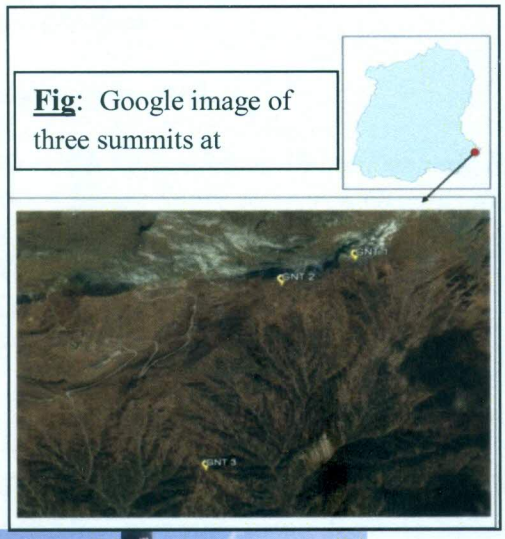


Fig: Google image of three summits at

However, in Thangu, North Sikkim, the scientific team was unable to locate appropriate highest summit points, which could fulfill the objectives of this project. Therefore, team surveyed at Gnathang, East Sikkim where The team first selected 3 highest summit points (GNT1: 4003 m , GNT2: 3933m & GNT3: 3707 m as permanent ecological site for the long-term monitoring of vegetation diversity. Plot Establishment and Sampling has been done to see vegetation diversity of the area, using 3x3m quadrat below 5m from HSP in all 4 directions (North, South, East and West) of the HSP. In each 3X3m quadrat of all the direction, 1x1m quadrat was laid in 4 corners of the quadrat. The same has been performed in remaining 2 HSPs.

Fig: Team monitoring the floral diversity using quadrat method.

Sites were visited twice (April & October) and vegetation sampling in each of HSPs were carried out. A total of 53 plant species belonging to different Genera were found. About 48% of the families were represented by a single species. Moreover, to understand floral diversity of Sikkim Himalaya and to observe plant habitat from previous period, BSI (Regional Center, Gangtok), herbariums has been frequently visited and so far, details of 1100 specimens has been recorded successfully..

Picture: herbariums

The five days mid-term progress review meeting & training programme was organized at SAC, Ahmedabad on December which was attended by Junior research fellow of this project, where various lectures were delivered and hands-on lab activities were conducted for the researchers.

Abbreviation used:

HIMADRI = Himalayan Alpine Dynamic Research Initiative.
ISRO = Indian Space Research Organisation
SAC =Space Applications Centre
GNT= Summit code for Gnathang
HSP= highest summit point
BSI= Botanical Survey of India

- **Ground Water Prospects Mapping for Rajiv Gandhi National Drinking Water Mission Phase-IV.**

Rajiv Gandhi National Drinking Water Mission (PH-IV) has taken up the ground water prospect and quality mapping using Remote Sensing and Geographic Information System techniques at 1:50,000 scales. The Ministry of Rural Development (MORD) Govt. of India wants these maps to be used by the engineers and hydro geologist of the line departments in respective states for identifying ground water sources covering all the habitations. The IRS 1C/1D satellite data with UTM WGS 84 projection have been used as the input. The digital map can be viewed on a workstation with Arc GIS software.

The ground Water Prospects Map includes:

i. Base map layers (Administrative Layer, Settlement, Road layer)
ii. Hydrological Layer (Drainage, Water bodies, Spring, Rainfall , Recharge structure and Irrigated area layers)
iii. Geology Layer (Lithology, Structure and Geomorphology).

Ground Water is the major source of Drinking water. It is a hidden resource is often developed without proper understanding of its occurrence in time and space. The main objective of the project is to identify the ground water sources through scientific means especially for Non-Covered (NC) and Partially Covered (PC) habitation with potable water supply schemes. In the case of Sikkim which is a hilly terrain, natural water such as spring, stream water is the main resource of drinking sources of people in all four districts of Sikkim. The ground water prospect map is prepared and submitted to NRSC, Hyderabad.

- **Mapping of Glacier Lakes and development of GIS based Glacier Lake Management Information System**

The lakes located on the snout of the glacier are mainly dammed by the lateral or end moraine, where there is high tendency of breaching. Such lakes could be dangerous as they may hold enormous amount of water. Breaching and the instantaneous discharge of water from such lakes can cause flash floods enough to create huge damage in the downstream areas. In order to assess the possible hazards from such lakes it is, therefore, essential to have a systematic inventory of all such lakes formed at higher altitudes. This is feasible by identifying them initially through high resolution satellite images.

Besides making a temporal inventory, a regular monitoring of these lakes is also required to assess the change in their nature and aerial extent. The main objectives of the present study is to assure that mountain inhabitants in the State of Sikkim enjoys a sustainable livelihoods through a better understanding of environmental hazards associated with Mountain Glaciers and glacial lakes, with which to address environmental policy, planning and impact/risk mitigation.

- Preparation of various base maps at large scales.
- Mapping of various Glacier Lakes using High Resolution satellite data. Classification of lakes types and identification of hazardous lake.
- Understanding of GLOF phenomenon and monitoring the GLOF events on a regular basis using remote sensing and geographical information system technology.
- Generation of Digital Elevation Models (DEMs).
- Development of model for river channels profiles and estimation of volume of water in the lakes.
- Development of a model for prediction of Glacial Lake Outburst Floods (GLOFs), are likely to be inundated/affected by GLOFs, and Impact assessment of GLOFs.
- Developing a participatory GLOF monitoring protocol jointly with local high altitude experts.
- Developing preparedness and resilience in the event of GLOFs.
- Organizing important stakeholders meet about the potential danger of GLOFs.
- Development, installation and commissioning of GIS based Glacier Lake Management Information System in the state of Sikkim.
- Installation of sensors on potential hazardous lakes on pilot basis.
- Disseminating the results and outputs that could be used for GLOF hazard prevention and mitigation planning.

Identification of Critical ('Potentially Dangerous') Lakes

Evaluation of the possibility of catastrophic drainage is based on the characteristics of a lake, its dam, associated glaciers, and other topographic features (Mool et al. 2001a). The factors taken into account include the size; rate at which the lake is expanding; position with respect to the associated glacier; height of the moraine dam; overtopping height (free board); origin of the lake (supra, cirque, moraine dammed);

physical condition of the surroundings, such as the existence of hanging glaciers or potential rock and debris fall or slides; and the volume of water that could drain out.

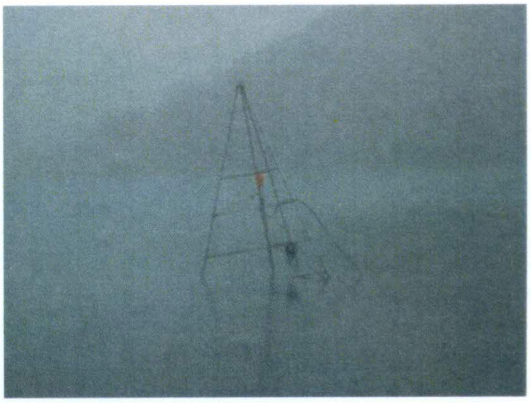
The methodology for the suitability assessment / prioritization was actually implemented in GIS environment by using the weightages method. As part of this a comprehensive data base has been created and organized in GIS for the study area. The following lake has been prioritized as potential hazardous lakes in Sikkim.

Sl. no	Potential Hazardous lakes
1	Lhonak Lake
2	Lake above the Lhasa Valley above Thangu village (Sakho Chu)
3	Teesta Khangsey (Khangchung chho):
4	Unknown lake in west Sikkim
5	Dod Pokhari (East Rathong Glacier)
6	Gurudogmar Lake
7	Chho Lhamu lake
8	Lake on North west above Lhonak valley

Monitoring, Early Warning and Mitigation

Identification of potentially dangerous glacial lakes and recognition of risks associated with them, including ranking of the critical lakes, has been done. The scientists involved in this project with the technical help of CDAC, Pune had install a sensor in the identified critical lakes to reduce the potential risks from these lakes.

Measures include: monitoring, to provide an early indication of changes; early warning systems, to prov ide dow nstr eam resi



dents and owners of infrastructure time to take avoidance action; and mitigation measures, to physically change the situation and thus reduce the risk.

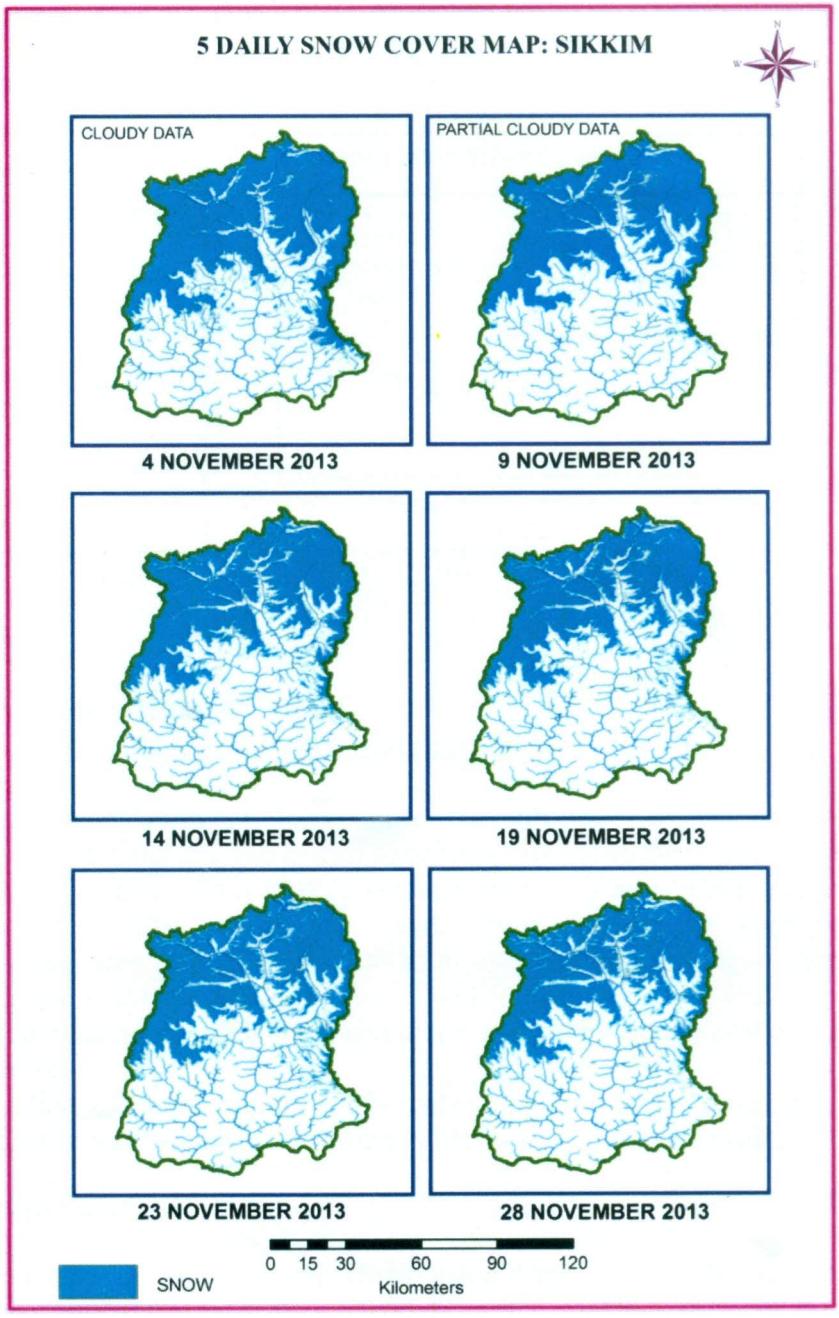
Keeping in view Sikkim State Council of Science and Technology in Collaboration with CDAC-Pune, CDAC-Trivandrum (Thirvananthapuram) installed a Early warning Sensor in Sakho Chu Lake above Thangu, unfortunately some item of the equipment was stolen by unknown person

Now with the communication with CDAC-Trivandrum team they are ready to provide the sensor equipment for the installation of same lake for the experimental purpose. The sensor equipment has been reached in our office in the month of March 2015. It is expected to install the same in between the month of May-June of 2015.

- **Mapping and Monitoring of snow cover in Sikkim**

Mapping and Monitoring of snow cover is an important part of snow and glacier studies. Monitoring of snow for a longer period helps in understanding the changes in our environment. The database created on the extent of snow cover also help in various studies to overcome the challenges posed by the global warming and climate change effects. At present monitoring of snow cover of entire Himalayas of India from Jammu and Kashmir to Arunachal Pradesh is going on under the Joint Project of Indian Space Research Organization and Ministry of Environment, Forests and Climate Change, Govt. of India. Mapping and monitoring of seasonal snow cover using field methods are normally very difficult in a mountainous terrain, like the Himalayas. Therefore in this study, remote sensing techniques have been extensively used for snow cover monitoring.

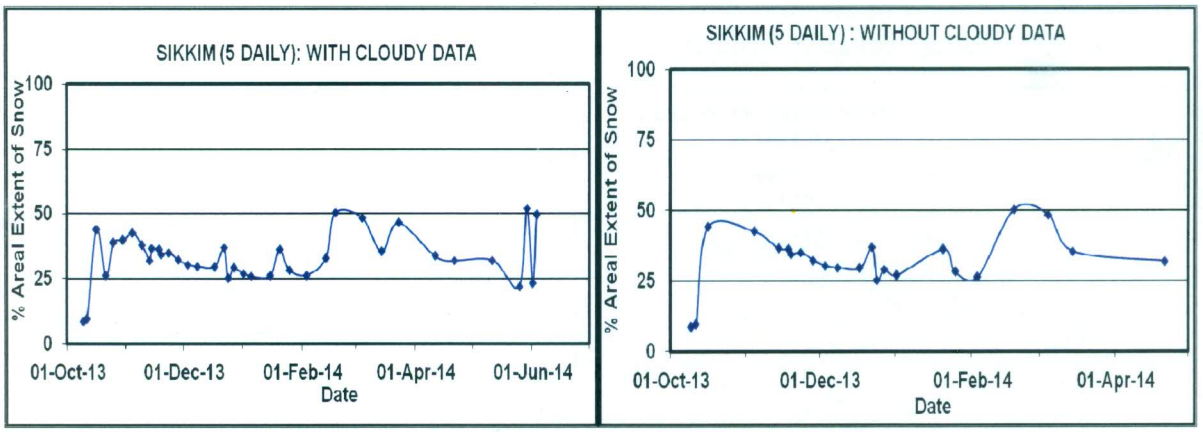
In context of Sikkim, the snow monitoring work is being carried out with collaboration with Sikkim State Council of Science and Technology and Space Application Centre (SAC) from the year 2004-2005 onwards considering Tista and Rangit basin and Sikkim as a whole. Recently report on Snow cover for the year 2013-2014 is completed and submitted to Space Application Centre, Ahmadabad. In this atlas, state and basin-wise snow cover statistics, maps, and seasonal depletion curves have been provided from October 2013 to June 2014. Snow ablation pattern was estimated for Sikkim state, Tista and Rangit basins in the Sikkim Himalaya. In Sikkim, maximum areal extent of 52% snow was observed in the month of May 2014 in cloud cover data of 29 May 2014, and 50% snow was observed in cloud free data in the month of February 2014. The highest snow extent of 59 % observed in Tista basin in the months of February and March with cloud free data and in the month of June in cloudy data. In Rangit basin, maximum areal extent of snow of 28% and 23% observed in the month of May 2014 and October 2013 with cloudy data and 21% snow with cloud free data in February 2014 respectively. In Sikkim, the lowest snow recorded in the month of October with 9% snow followed by 25% snow



in December in cloud free data. Similarly, the lowest areal extent of snow of 10% in Tista basin and 3% in Rangit basin recorded in the same month of October 2013.

With this atlas the second phase of Snow Cover Monitoring is completed and new phase may start from next year onwards.

SNOW COVER DEPLETION CURVE



- **Desertification Status Mapping (DSM) 2nd Cycle**

A project in collaboration with MPSG/ EPSA/SAC/ISRO, Ahmedabad-15

Desertification is a continuous degradation of land under the influence of natural and anthropological causes in arid, semi-arid and dry-sub humid conditions. Desertification affects two third countries of the world and one third of the earth's surface, on which one billion people live(one sixth of world population). The causes for desertification are mainly improper management practices, over grazing, tree felling, over cultivation etc. The vegetal degradation, erosion processes, water logging and salinization leads to loss of soil fertility, soil compaction and soil crusting. In addition to this, urbanization, mining and recreation will also have adverse effects on the land leading to desertification.
To assess the status of desertification for entire country is a herculean task and needs to be carried out using fast, accurate, cost effective and less laborious methods like satellite remote-sensing.

The main objectives of this project are:

- To map the desertification status of entire country (DSM) using AWiFS data (2012-13) on 1:500,000 scale.
- To map the desertification status of selected vulnerable districts of India using LISS III (2012-13) data on 1:50,000 scale.
- Desertification Vulnerability Modelling (DVM): To prepare Desertification Vulnerability Map on 1:50,000 for one district in each state.

- Development of methodology for preparation of desertification combating plans at larger scale for selected watersheds.
-

METHODOLOGY:

The methodology has already been developed and operationally used during the DSM project carried out earlier. In the proposed study, about 24 scenes (60 quadrants) of multidate AWiFS satellite data will be digitally interpreted through on-screen digitization method by employing ARC GIS software. As a reference, desertification status maps prepared earlier at 1:500,000 scale using AWiFS satellite data of 2003-05 will be used and changes in degree of severity will be incorporated. Limited ground checks will be carried out throughout the country.

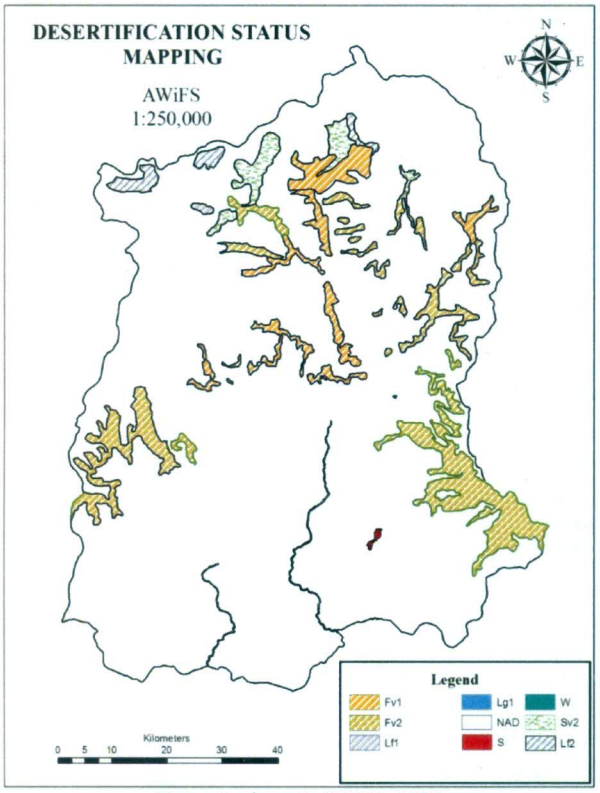


Figure 1: dsm_1_AWiFS_2004

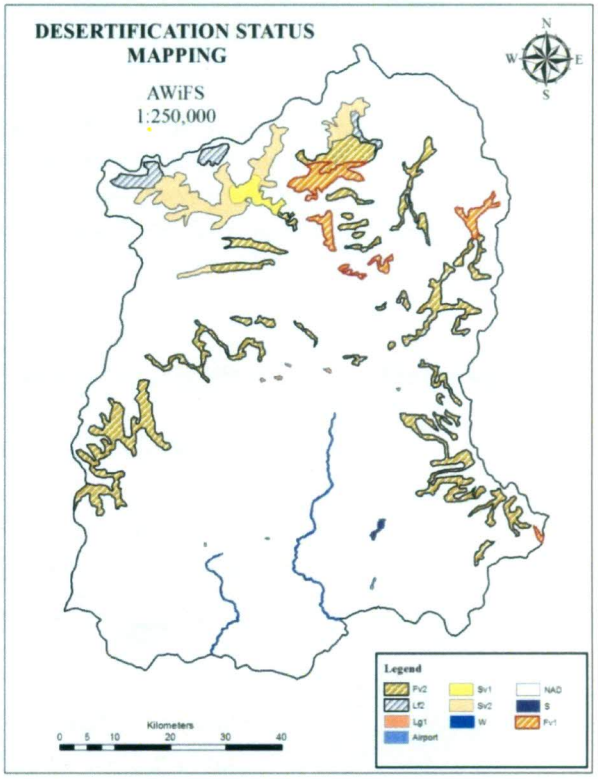


Figure 2: dsm_2_AWiFS_2011

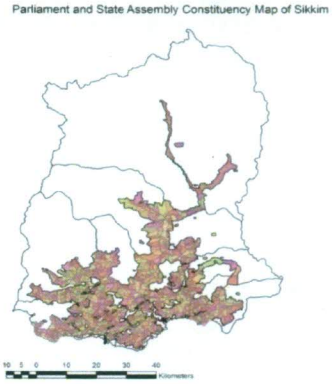
The proposed study area includes the Arid, Semi-arid and Sub-humid regions as well as the North-East region of the country. There after DSM for some selected vulnerable districts will be carried out. It is proposed to study the vulnerable regions of India like the drought prone areas, regions of high degradation etc. Visual interpretation at 1:50,000 scale will be carried out using temporal LISS-III data so as to compare the change in the status of the desertification in these areas over the years. Desertification Vulnerability modeling will also be carried out for a district each in every state possible. Development of methodology for combating plan will be attempted at few places on larger scale, in selected micro-watersheds.

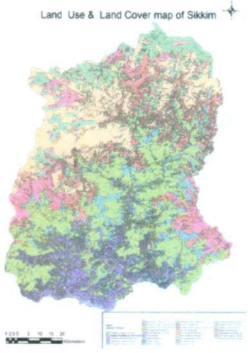
Fig: Field photograph of frost Shettering (Degraded land)

DSM_FIRST CYCLE:
The above maps are generated from AWiFS images taken in the year 2004 and 2011 respectively. The map has been accepted by SAC, Ahmedabad, Funding Agency for the atlas publication. Now, The second cycle of Desertification status Mapping is being carried out and the same procedure is being implemented but, at the greater scale.(1:50,000) and the severity level will be higher in this cycle.

- **SIS-DP (Spatial Information Support System for Decentralization Planning)**

The Space Based Information Support for Decentralized Planning project started in Sikkim from July 2011, the main objective of the project is mapping of various thematic layers of Sikkim in 1:10,000 scale. The Cartosat data and LISS IV data for the same has been received from RRSC-E, Kolkata and NESAC, Shillong.





The Cartosat 1 and LISS IV ortho rectified data from RRSC-E Kolkata has been received the layer generation for the same has been completed. The SISDP Layers includes Land use and land cover (LULC), Roads, Drainage, Slope, Soil and Village, Constituency etc.

The all above layers has been forwarded to NRSC Hyderabad, they requested to depute concern scientist for further action of the project, now we are planning to depute our scientist to NRSC Hyderabad in the month of April-May for quality check of all required layers

➢ **2X100 KW MicroHydel demonstration project, Thangu**

The 2x 100 KW Thangu micro-hydel demonstration project 'at extremely high altitude (13,500ft) is a unique project of the State Council of Science and Technology in the alpine eco-region of Tista, Sikkim Himalaya. The fund for the project has been provided by the Ministry of Science & Technology, Government of India and Government of Sikkim.

This project aimed at socio-economic development of the ethnic community through provision of electricity for domestic purposes as well as for community based rural enterprises leading to enhanced livelihoods and poverty improvement.

Finally, pilot demonstration project was inaugurated by Member Secretary Sikkim State Council of Science and Technology on 14th of November 2014 in the presence of Ravinder Gaur, Scientist and Member Secretary, Technology Development and Transfer Division, Department of Science & Technology, Government of India and T.Ronya, Director and Member Secretary, Arunachal Pradesh Council of Science and Technology, SDM Chuntghang, representatives of SPDCL, Officials of Power Department including Pippon of Lachen.

Inaugural function Thangu Microhydel power project on 14/11/1014 at Thangu, North Sikkim

Initiatives on Climate Change programme:

- Various training related to climate change has been attended in different part of country
- Sikkim State climate change cell establish
- Training imparted to the teachers in DITE on Climate change
- Training imparted to the field level officer at SIRD Karfectar in forest pulse programme

SUPPORT TO THE USER DEPARTMENTS/AGENCIES

Centre, being nodal for Remote Sensing and GIS applications in Sikkim, has contributed handsome support to many user department and agencies in Sikkim. Some of the support includes-

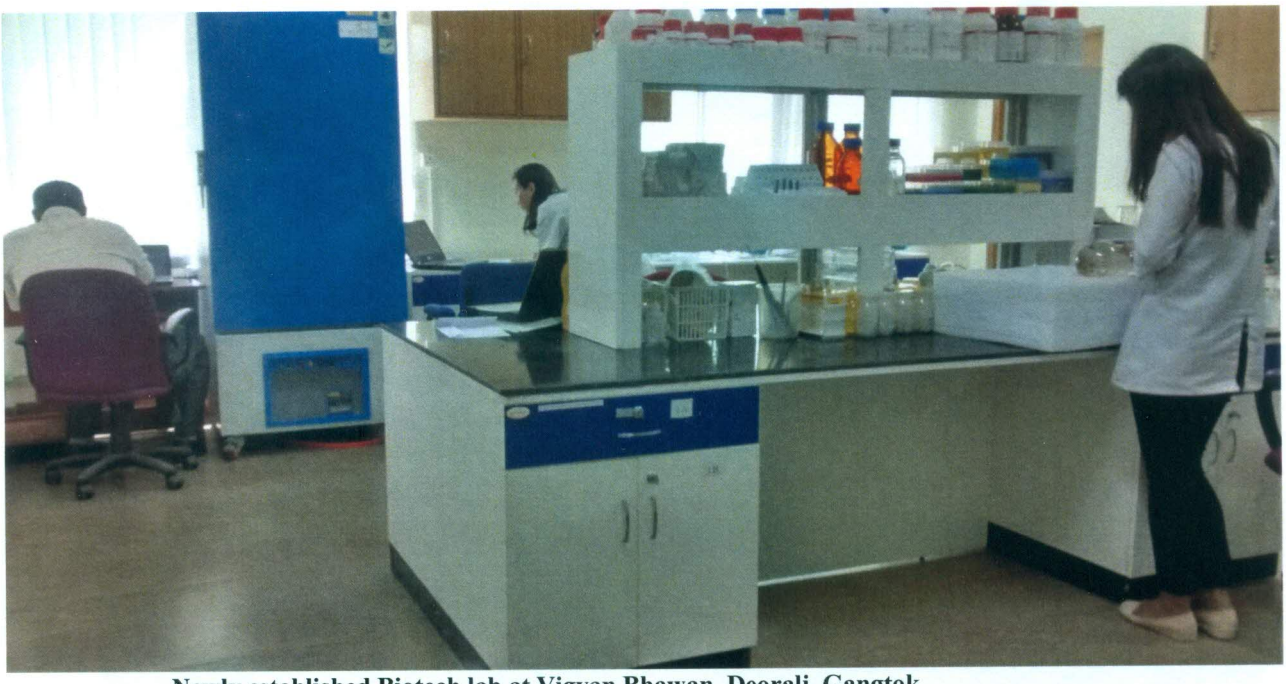
- Preparation of various GIS map for General Election 2014
- GPS data collection and mapping of the polling station of Sikkim for the Election Department
- Catchment area mapping for the various projects of Irrigation and Flood Control Department.
- GIS maps provided for Agriculture Department, GoS to submit project proposal.

- Three days training on Remote Sensing and GIS application to the students of Sikkim Government College

Three days training on Remote Sensing and GIS application to the students of Sikkim Government College

BIOTECHNOLOGY DIVISION

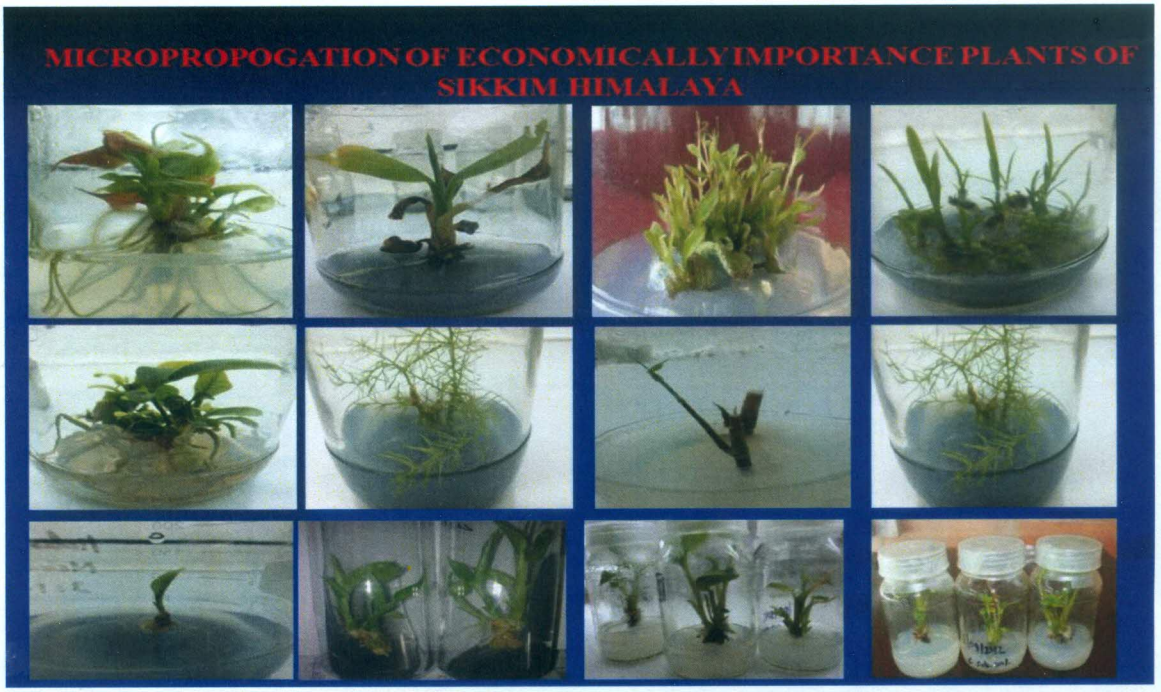
Biotechnology division was created with the objective to undertake research and development work on biotechnology, its promotion in the state and sustainable utilization of biological resources with its application. Biotechnology in the state made its beginning with the establishment of tissue culture laboratory in 1994 as then under the state forest department which was later transferred to Science and Technology along with existing manpower in 1998. The division has state of art biotechnology laboratory with the latest and high end equipments and machineries to carry out the basic and advance research. With the synergetic support of both State Govt. and the Department of Biotechnology (DBT), Govt. of India, the division is now **fully equipped to carry out both basic and applied research.**



Newly established Biotech lab at Vigyan Bhawan, Deorali, Gangtok

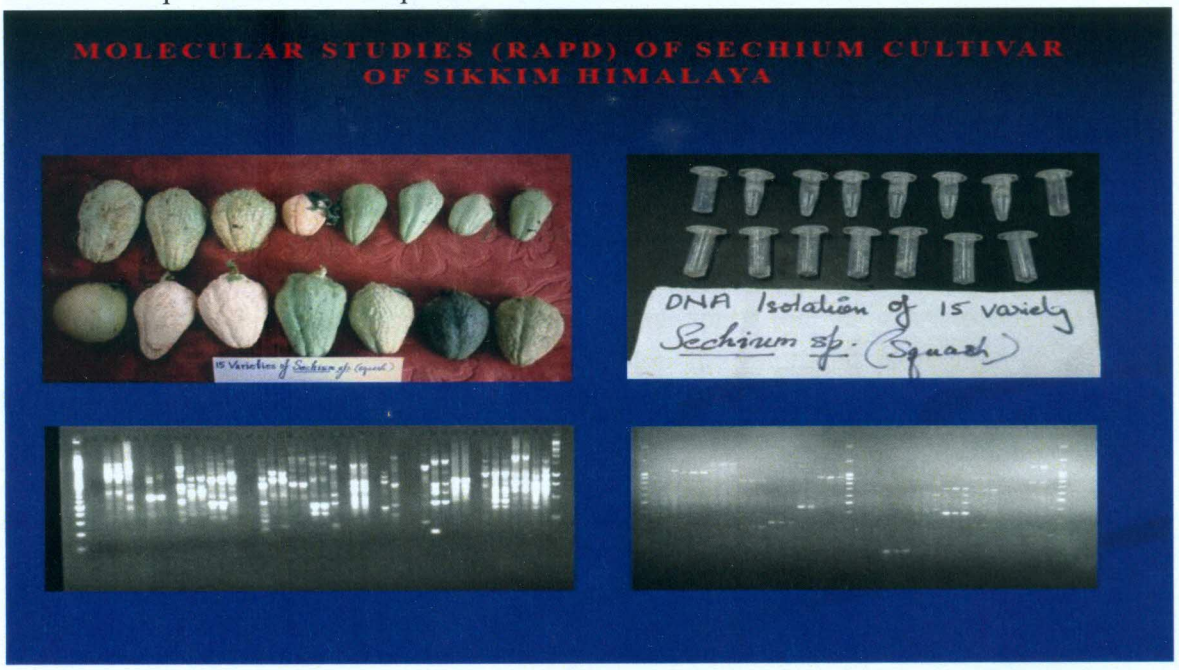
The following activities are undertaken under the Biotechnology division:

1. **Plant tissue culture of rare and endangered species of Sikkim Himalayas.**
   Sikkim is not only one of the hotspots of biodiversity but also a home to some of the rare and endangered species. These include few orchids, medicinal plants, canes, Rhododendrons and some tree species. The work for their multiplication through micropropagation is being undertaken at tissue culture laboratory.



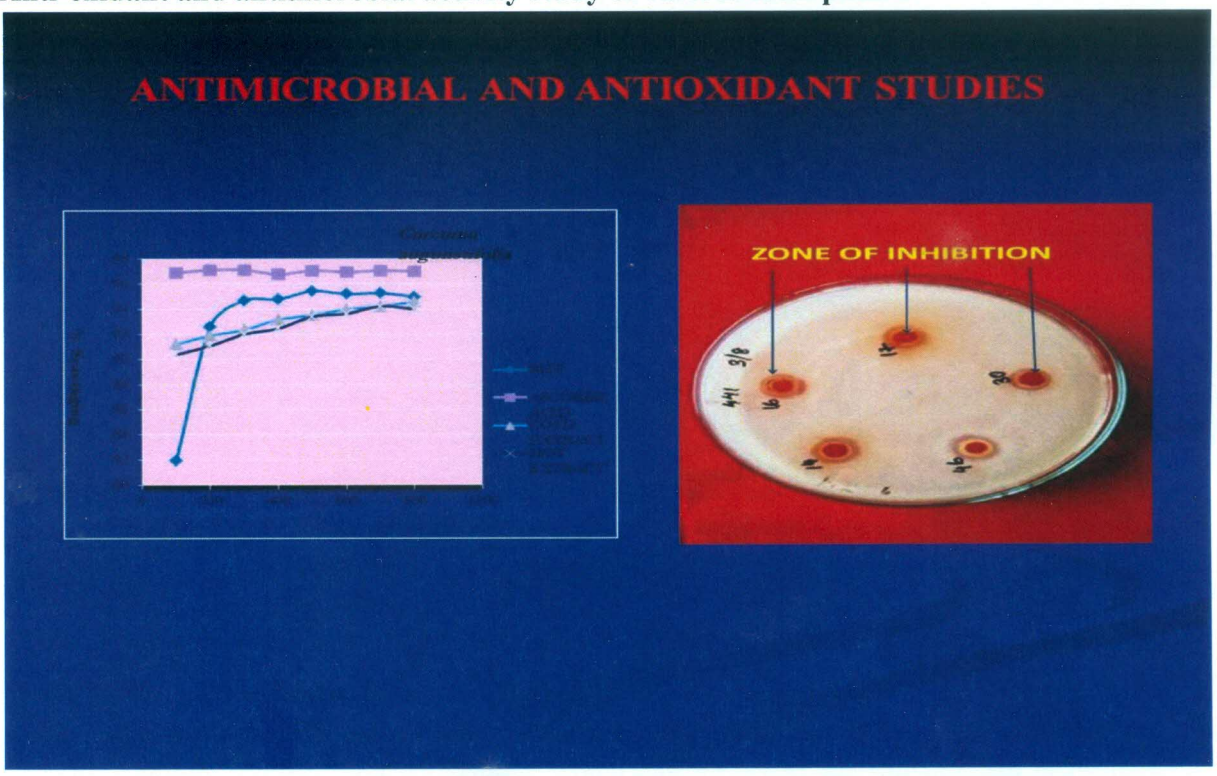
Plant tissue culture of rare and endangered and economically important species

2. **DNA Barcoding of important plants of Sikkim Himalayas.**
   DNA bar-coding plays an important role in identification of species or genera from the genetic level and also helps to protect the native species from biopiracy. DNA bar-coding of medicinal plants and cash crops are undertaken.



3. Screening of native microbial diversity for antagonistic study on pathogenic fungi, bacteria and development of Biofertilizer.

4. **Study on Frankial diversity associated with actinorhizal plants of Himalayas.**
   There are number of actinorhizal plants in the Himalayan region capable of fixing atmospheric nitrogen with the help of Frankia lodged in the root nodule of the plant.
5. **Anti-oxidant and antimicrobial activity study of various local plants.**



6. **Herbal garden**
   Herbal garden was created to generate awareness among the students and public on the importance and uses of herbal plants found in the region. Another objective of the creation of herbal garden is to have the ready research material to the researcher of the institute.
7. **Maintenance of germplasm of large cardamom and ginger**
   The main objective of the collection and maintenance of these two cash crops cultivars of Sikkim is to have the ready research material to apply the various biotechnological approaches for the crop improvement and develop the improved cultivation practices. Micro-propagation of large cardamom is being standardized and saplings transplanted which started bearing capsule. Seven cultivars of large cardamom and 5 cultivars of ginger of Sikkim are being maintained. Inter cultivar breeding programme has been started. Ginger cultivars has been maintained and used for various biotechnological studies including DNA bar-coding.

Large cardamom germplasm under net house condition

8. **Study on the wild kiwi species found in Sikkim**
   Kiwi is an important fruits having good market potential. Sikkim has two wild kiwi species namely. *Actinidia callosa* and *A. strigosa* which can be tested for rootstock to grow the cultivated varieties and for breeding programme. The cutting of wild kiwi has been collected and is being raised for further studies.
9. **Introduction and promotion of Russian Seabuckthorn varieties.**
   The Russian Seabuckthorn varieties are being raised in the farm located at Sajong, Rumtek and growing well. These seeds were obtained from abroad through NBPGR, N. Delhi in the national interest as the national programme on Seabuckthorn cultivation (with local species) is a failed story till date. These varieties have been introduced in over 20 countries and have many success stories as they are nearly thorn less, large fruits, higher yield, less sour, bushy and multiple products can be made out of it. This programme is a part of multi-institutional project of Seabuckthorn, of which we are not the part yet.
   Beside above activities following centres and projects are being executed by the Biotechnology division. The projects and centre is being supported by Department of Science and Technology and Department of Biotechnology, Government of India.

I. Bioinformatics centre

Background:

Bioinformatics Sub DISC (Distributed Information Sub-Centre), Sikkim State Council of Science & Technology, was established in the state in the year 2001 with the support of Department of Biotechnology, Government of India. Sikkim State Council of Science and Technology is an autonomous nonprofit public funded research and training organization established under Department of Science & Technology and Climate Change, Government of Sikkim.

Area of specialization: Biodiversity, Biotechnology and Bioinformatics

Details about Staff members working in the centre:

SN	Name	Designation	Specialization	Absorption Status
1.	Dr. B. C. Basistha	Additional Director and Coordinator and Coordinator	Biotechnology, IPR, Biodiversity & Bioinformatics	Permanent
2.	K.B. Subba	Assistant Scientific Officer and Co-Coordinator	Sustainable development	Permanent
3.	Laydong Lepcha	Information Officer	Environment & Biodiversity, Bioinformatics,	Temporary
4.	Ongkit Lepcha	Data Entry Operator	BTech	Temporary
5.	Kishore Prasad Sharma	Data Entry Operator	BTech	

Training/Workshop organized in the year 2014 – 2015.

1. Bioinformatics Sub-DISC, Sikkim State Council of Science & Technology has conducted a training programme on 31st March 2015 in conference hall, Vigyan Bhawan, Deorali. Dr. L. Shantikumar Singh, Scientist, RCIBSD, Dr. Sushen Pradhan, Research Associate, State Biotech Hub and Shri. Laydong Lepcha, Information Officer, Bioinformatics Sub-DISC, were the Resource Persons of the training programme.

Scientists, Senior Research fellows, Junior Research Fellows from Sikkim State Council of Science & Technology and MSc. students of Medical Biotechnology Department, Sikkim Manipal University have attended this training programme.

2. On 14th March 2015, Bioinformatics Sub-DISC, Sikkim State Council of Science & Technology has conducted a training programme on Bioinformatics in Plant Genomics

Researches. The Resource Persons of the training programme were Dr. Pardeep Bhardwaj, Scientist, RCIBSD and Dr. Bikram Saha, NBU. Scientists, Senior Research fellows, Junior Research Fellows from Sikkim State Council of Science & Technology and MSc. students of Microbiology Department, Sikkim University have attended this training programme.

3. Bioinformatics Sub-DISC, Sikkim State Council of Science & Technology has conducted a NATURE's journals on-site training programme on 18th November, 2014 in Conference hall, Vigyan Bhawan. Shri. Rajendra Kumar, Manager, Marketing & Training – SLBU India, NATURE Publishing Group (NPG), Gurgaon, was the Resource Person of the training.

   Scientists and Researcher from Regional Centre of Institute of Bioresources and Sustainable Development (RCIBSD) and Sikkim State Council of Science & Technology, have attended this crucial training.

4. Bioinformatics Sub-DISC, Sikkim State Council of Science & Technology organized a training programme on Application of Bioinformatics in Biological Researches, on 13th, March 2014, in Conference Hall, Department of Science & Technology and Climate Change, Deorali. The Resource persons of the training progarmme were Dr. Pardeep Bhardwaj, Scientist, RCIBSD, Dr. Kiran Sunar, NBU and Shri. Laydong Lepcha, Information Officer, Bioinformatics Sub-DISC, Sikkim State Council of Science & Technology. The trainees were Scientists, Research Scholars, Research Assistants, MSc. students of various institutes and university such as Sikkim State Council of Science & Technology and Botany Department, Sikkim University.

5. On 31st March 2015, Bioinformatics Sub-DISC, Sikkim State Council of Science & Technology successfully organized a training programme on Phylogenetic Analysis in Molecular Biology. Dr. Mahua Rudra of North Bengal University and Shri. Laydong Lepcha,Information Officer, were the Resource Persons of the training programme. The training programme was attended by scientists, researchers from JICA institute, Sikkim Biodiversity Forest Project (SBFP), Sikkim State Council of Science & Technology and science students of Sikkim Government College, Tadong.

6. Bioinformatics Sub-DISC, Sikkim State Council of Science & Technology has successfully conducted a month long Bioinformatics Education Programme (BEP) in schools and colleges of Sikkim w.e.f. 19th August to 22nd September, 2014. The main objective of this programme is to help the students to understand

the fundamental of Bioinformatics and inspire them to interact with Bioinformatics in their academic careers. The month long Bioinformatics Education Programme (BEP), was taken place under the guidance and supervision of Dr. B.C. Basistha, Additional Director and Coordinator and supported by Shri. K. B. Subba, Assistant Scientific Officer and Co-coordinator, Bioinformatics Sub-DISC, Sikkim State Council of Science & Technology. During the programme Shri. Laydong Lepcha, Information Officer, Bioinformatics Sub-DISC, Sikkim State Council of Science & Technology, accompanied by Miss Ongkit Lepcha, Bioinformatics Sub-DISC, informed the students upon the importance and happenings of Bioinformatics in the world and its role in Biological Sciences.

7. **Research activities**
   - **I.** Ecological studies and its distribution pattern of VAM (Vesicular Arbascular Mycorrhiza) of *Citrus reticulata* (Mandarin) of Sikkim.
   - **II.** Understanding the Significance value of *Rhododendron arboreum* Scarleti of Sikkim.
   - ***III.*** Published and launched a compiled book of research articles on *Ethno-Medicinal Plant research of Sikkim Himalaya.*
8. **Papers published in journal (2014):**
   Laydong Lepcha, Basistha BC, Subba KB, Pradhan S, Gurung R, Sharma NP (2014). Understanding the Significance value of *Rhododendron arboreum* Smith Scarleti of Sikkim, India. *International Journal of Engineering Science and Innovative Technology (IJESIT).* Volume 3, Issue 4, July 2014.P554-559.

II. State Biotech hub project

The project is being funded by Department of Biotechnology (DBT), Govt. of India. The main objective of the project is the establishment of major biotechnology facility and trains the coordinators of the institutional hubs as well as providing support to research and training. The project is being coordinated by Biotech Consortium India Ltd (BCIL), a company promoted by DBT, Govt. of India.

As per the objective of the project state of the art laboratory is being established with high end equipment and machineries to carry out the various biotechnological researches. The hub has the following facilities.

1. Facilities to carry out molecular research work.
2. Facilities to carry out plant tissue culture work.
3. Facilities to carry out anti-oxidant, anti-microbial work.
4. Facility to carry out microbial isolation and culture.

The following equipment has been procured in the 2014-15 financial year.

LIST OF ASSETS (2014-15)

S. No.	Name of Equipment	Qty
1.	Nano Spectophotometer, Eppendorf	01
2.	Stackable incubator, New Brunswick	01
3.	Real Time PCR, Picoreal, 96, Thermo scientific	01
4.	Liquid nitrogen canister, 20 ltr, IOC	01
5.	Rotary evaporator, Medica instrument	01
5.	BOD incubator, Equitron, Medica instrument	01
6.	Colony counter, Medica instrument	01
7.	Water bath, Equitron, Medica instrument	01
8.	Vertical autoclave, Equitron, Medica instrument	01
9.	EC/TDS Temperature meter	01
10.	Micromanupulator photometer	01
11.	Gel Electrophoresis(Horizontal) with power supply	01
13.	Hot plate with stirrer	01
14.	Dry bath	01
15.	Rota spin	01
16.	Refrigerated centrifuge	01
17.	Homogenizer	01
18.	UV/Multiband transilluminator	01
19.	Ice flaking machine	01
20.	UV vis spectrophotometer	01
21.	Laboratory tables, with granite top/without granite top, sink, reagent rack etc., all complete	07

Lab facility established under biotech hub project

TRANSFER OF TECHNOLOGY

AND

COMMUNICATION
&
POPULARISATION OF SCIENCE

(i) Establishment of Sikkim Science Centre, Marchak

The Sikkim Science Centre is one of the important facilities created for communication, popularization and outreach of science and technology in the State .This Centre has been set up at Marchak, East Sikkim with the support of National Council of Science Museums, Government of India. The Science Centre has a number of thematic galleries, outdoor science park and facilities for training and capacity building programme.

- The further extension of Sikkim Science Centre is being taken up with the support of National Council of Science Museums, Ministry of Culture, Government of India. This will include 8 metre dia Planetarium, 3D shows as well as thematic galleries on biotechnology and biodiversity. .

The Innovation Hub is proposed to be set up in Science Centre, Marchak, funded by Innovation Council under 'Scheme for Promoting Innovation, Creativity and Engagement in Science' (SPICE) to inspire young minds and to develop a culture of innovation in the country. The Innovation Hub will have following facilities for students/mentors:

- **Discovery Hall**
- **Innovation Resource Centre & Hall of Fame**
- **Idea Lab**
- **Design Studio**
- **Mentoring and guidance**

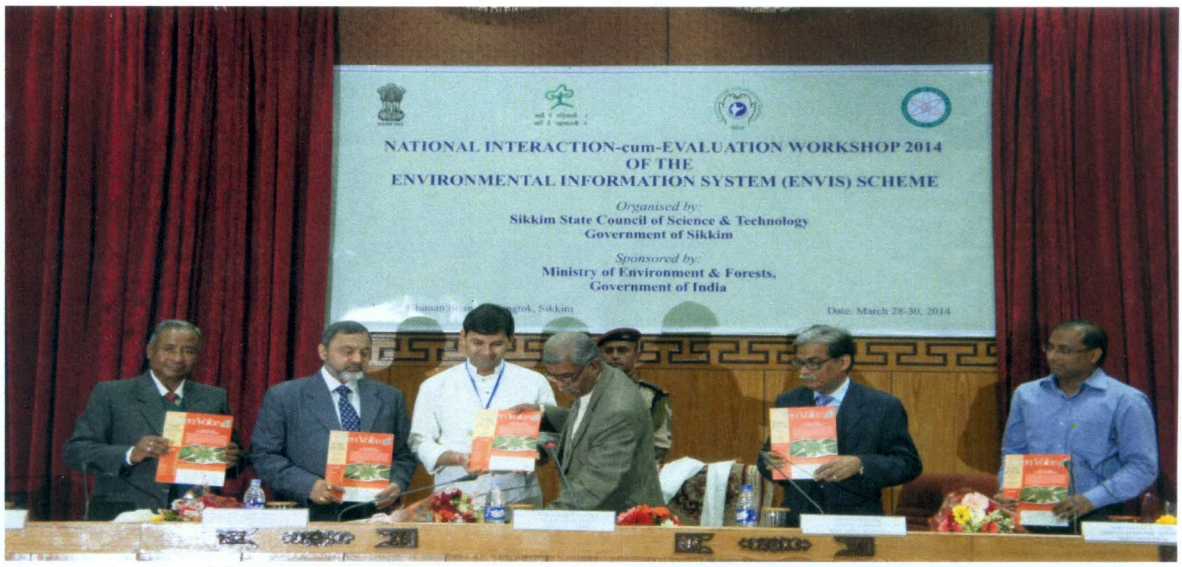
(ii) ENVIS Centre Sikkim on Eco-tourism:

ENVIS is a decentralized system with a network of distributed subject oriented centers ensuring integration of national efforts in environmental information collection, collation, storage, retrieval and dissemination to all concerned. The focus of ENVIS since inception has been on providing environmental information to decision makers, policy planners, scientists and engineers, research workers, etc. all over the country.

The Centre has been working on building up extensive information system on ecotourism in the country. The centre is continuously working on collection, collation and dissemination of information on Ecology, Environment and Ecotourism. The information system consists of state wise information on all parameters related to ecotourism. Information on National as well as state ecotourism policies of the country has been uploaded to bring it into a single platform for easy access and use by decision makers, planners as well as researchers. Parameters like Region wise Network of Eco-tourism sites, Wildlife and Avian Ecology and Endemicity in India, Wildlife sanctuaries & protected areas., Location wise distribution of threatened animals, Institutional Network of museums in India, State wise movement of Domestic and Foreign tourists, Situation of Agri-Tourism by region, Ecotourism travel infrastructure, Information system of eco-tourism, Economic benefits of birds and animals can be found in the website.

The website also gives comprehensive information on status of R&D in Eco-tourism, Documentation on Specie-wise details, habitat, food, human interaction, Educational, Research Institutions, Situation of wild life crime, misuse, Legal, regulatory network by region from all over the country

National Interaction-cum-Evaluation Workshop for ENVIS Centres held at Gangtok, Sikkim from 28th to 30th March, 2014



National Evaluation Workshop of ENVIS Centre-2014

A three-day National Interaction-cum-Evaluation Workshop for Environmental Information System (ENVIS) Centres was organized by the State Council of Science & Technology for Sikkim (SCSTS), Gangtok on behalf of M/o of Environment & Forests (MoEF),Government of India, at ChintanBhavan, Gangtok, Sikkim on 28-30 March 2014.

The purpose of the Workshop was to evaluate the performance in 2013-14 of the 68 ENVIS Centres, 28 of which are hosted by State Governments/ UT Administrations. Around 125 delegates participated in the Workshop, including 90 representatives from 36 out of 40 Thematic ENVIS Centres and 21 out of 28 State/ UT ENVIS Centres.

Shri S.K. Shilal, Secretary, Department of Science, Technology and Climate Change(DST&CC), State Government of Sikkim, in his Address welcomed the dignitaries on the dais,Expert Members and delegates from various ENVIS Centres. Among the dignitaries were Shri A.K. Srivastava, Chief Secretary, State Government of Sikkim, who graced the function as the Chief Guest, delivered the Inaugural Address, ShriAbhay Kumar, (Deputy Economic Advisor, MoEF)Shri B. Brahma,(Senior Adviser, MoEF, and Guest of Honour), etc.

Review of performance in 2013-14 of ENVIS Centres was carried out in two parallel sessions by four Expert Members appointed by MoEF viz., (i) Prof. M.N.V. Prasad, Department of Plant Sciences, University of Hyderabad, (ii) Prof. Avinash Chandra, Professor (Retd.),Centre for Energy Studies, Indian Institute of Technology (IIT), Delhi, (iii) Dr. N. Ramaiah,Chief Scientist, National Institute of Oceanography (NIO), Goa, and (iv) Prof. Bharat H. Desai,Centre for International Legal Studies, Jawaharlal Nehru University, Delhi.

The participating Thematic and State/ UT ENVIS Centres made presentations on their activities in 2013-14, highlighting the collection, compilation, verification and updating of databases on the subject area by them, in particular bringing out the new databases developed and publications/ information products brought out. Dissemination of information, through

various modes, such as user engagement based on statistics like visitor count on ENVIS Website and query-response were also depicted graphically.

The Experts evaluated the various Centers based on the criteria outlined in the Guidelines of the Scheme, as Category A: Very Good (≥80),B: Good (≥50 and <80) and C: Non-Performing (<50) prior to consideration of grant of fundsfor the next financial year 2014-15.A snapshot of the Grades for ENVIS Centre Sikkim on Ecotourism is below:

In the concluding remarks and summing up of the Workshop by Ms.Vandana Aggarwal, Economic Adviser, MoEF and Head, ENVIS Scheme, made some valuable points for the centres to deliver.

The Workshop concluded with a special vote of thanks for the hosting, organization and hospitality of the State Council of Science & Technology for Sikkim (SCSTS), and also other participating Departments, notably, the Forests, Environment & Wildlife Management Department, State Government of Sikkim, Gangtok.

The Grades of the ENVIS Centres have been put up on the ENVIS Portal, in the following link: http://envis.nic.in/grades.html.

(iii) Bio-Informatics infrastructure Facility (BIF) for the Biology Teaching through Bio-Informatics(BTBI) under BTISnet DBT at Sikkim Science Centre, Marchak

Activities of BIF at Sikkim Science Centre:

i. Developing the website to creating awareness of biotechnology through bioinformatics.
ii. Development of interactive information and interpretation kiosk with visuals on different facets of biodiversity of Sikkim
iii. Collection, collation, compilation & dissemination of biotechnology related Information to students.
iv. Nature interpretation facility about wild sanctuary and Nature Park.
v. Development of interactive computer based quizzes on bio resources of Sikkim.

(iv) Scientific evaluation of Water purification system in State of Sikkim.

The major objectives of the project are as follows:-

- To assess the performance of different types of water purification technology to provide safe drinking water in schools/institutions.
- To study the performance of the installed water purifier, quality and quantity of treated water produced and frequency of maintenance needed in school environment over a period of 12 months.
- To study the reliability of the product.

The filter selected works on various principles. It is a three staged filtration process consisting of pre filtration, Ultra-filtration and (UF) and ultraviolet (UV) filtration unit. The total output of this filtration system is 500 litres per hour per unit.

Installation of these three stage filtration system along with water tanks and drinking platform in 20 different institutions has been successfully completed in Sikkim.
The direct beneficiary of the project includes students and staff of twenty institutions across the state of Sikkim. The project is providing safe drinking water to an average of 1000 persons per school in different districts of the state which sums up to 20,000 persons per day. Hence, children in twenty different areas of the state are getting access to safe drinking water which ultimately indicates that they are safe and secure from common water borne diseases. Various physical, chemical and biological parameters are being evaluated to ascertain the work performance of these filters.

iv) Cane / Rattan Conservation and promotion of cane handicraft through value addition for sustainable livelihood for the Dzongu Tribal Reserve Area, North Sikkim.

The project " **Cane / Rattan conservation and promotion of cane handicraft through value addition for sustainable livelihood for Dzongu Tribal Reserve Area, North Sikkim"** was initiated in the financial year 2010 - 2011 and completed in the year 2013-14. The project was executed at Dzongu, North Sikkim. One of the important objectives of the project is the capacity building of the farmers for propagation of rattan through seeds and also to promote rattan handicrafts through possible value addition.

While executing the project, a total of 9 species of rattan species have been recorded from Sikkim, viz. *Calamus acanthopathus, C. inermis, C. flagellum, C. latifolius, C. leptospadix, C. tenious, C. erectus, Plectocomia himalayana, Daemonorops jenkinsiana* etc. Whereas, 6 species of rattan have been relocated and redefined the distribution patterns of the species from the Dzongu valley. The rattan population in Dzongu are mostly confined to the inaccessible areas such as dense forests, undisturbed areas except *C. latifolius, C. flagellum, Daemonorops jenkinsinana* etc. The propagation of the *Calamus acanthopathus, C. inermis and Plectocomia himalayanahas* been successfully done under the project under at Hee- Gyathang, Lower Dzongu, North Sikkim. Morethan 2000 rattan saplings of different species has been generated from the seeds propagation methods. Such kind of trail propagation has never tried in Sikkim before. As an experimentation, some species are also being raised at the Sazong, Rumtek, East Sikkim near State Biotechnology Research & Application centre.

The rattans are identified as an important source of livelihoods for the people of Sikkim including Dzongu. Series of resource survey has been undertaken at Dzongu, in regards to its populations, habitat, traditional usages and for possible threats. The survey reveals that rattan has been part of the Lepcha tribal those who are leaving in the valley for many centuries. They have been using the rattan for various purposes and but due to indiscriminate usages the rattan population is this part of the Sikkim is also facing thread. Amongst all other rattan species *Calamus acanthospathus* has been used extensively for various purposes. Almost all the parts of the species are being used for various purposes. The prolong use of the species by the tribals the population of the *C. acanthospathus* imposes huge pressures on the wild forests. The conservation status of *C. acanthospathus* also has not been explicitly studied in the past. Therefore being a vulnerable and rare species the conservation approach has been made for the reclamation of the species. One of the reasons for such lost in the populations is due to combination of its slow growth and overexploitations. *C. acanthospathus* has a solitary habit which means that each plant comprises only one stem. This makes the species susceptible to over-exploitation, as wild harvesting necessarily kills the whole plant. In contrast, all other species of cane in Sikkim are multi-stemmed, so each plant continuously produces offsets that can be either harvested for cane, or used for vegetative propagation. Therefore, the propagation of the *C. acanthospathus* through the seed and adoption for the farming of the same may ease the pressure on the natural habitation of the forests.

The team members working under the project

Creation of Rattan polyhouse and nursery at DTRA

Plate (25); One polyhouse and two rattan nurseries has been created at Hee- Gyathang GPU at DTRA

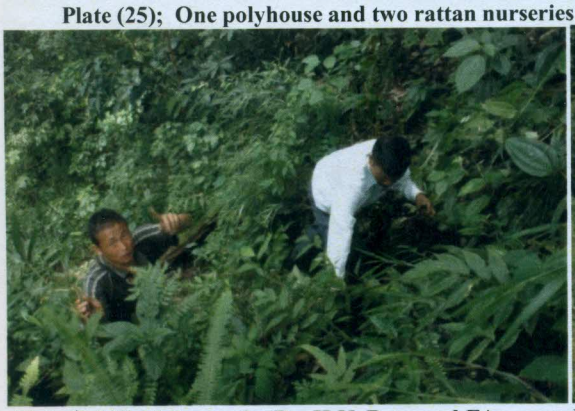


Plate (26) Field Survey by Dr. H.K. Bora and FA.

Plate 27) Rattan polyhouse at Hee-Gyathang, North Sikkim

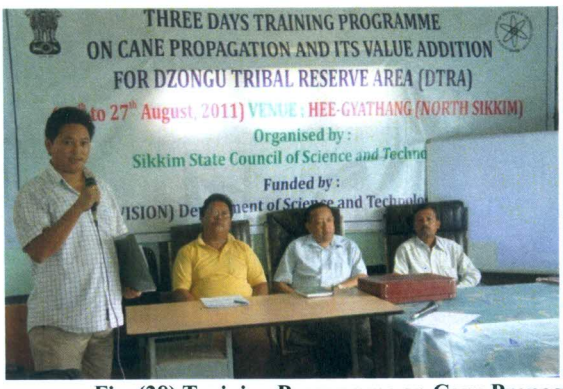


Fig. (28) Training Programme on Cane Propagation and its Value Addition in collaboration with RFRI.


Plate (29) Trail propagation of Rattan at Sazong (Rumtek) and at Dzongu

Plate 30) Splitted rattan's stem for ready use .

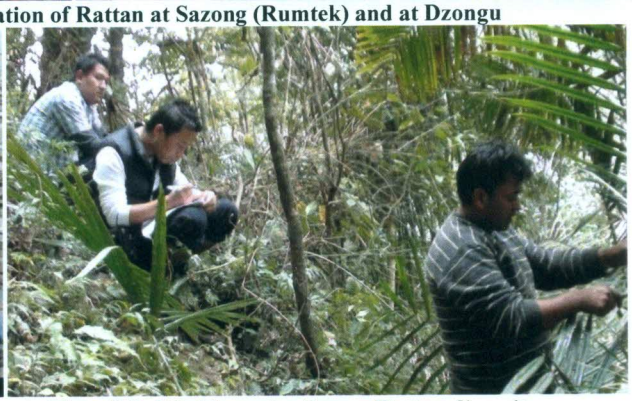


Plate (31) Filed investigation on Rattan diversity

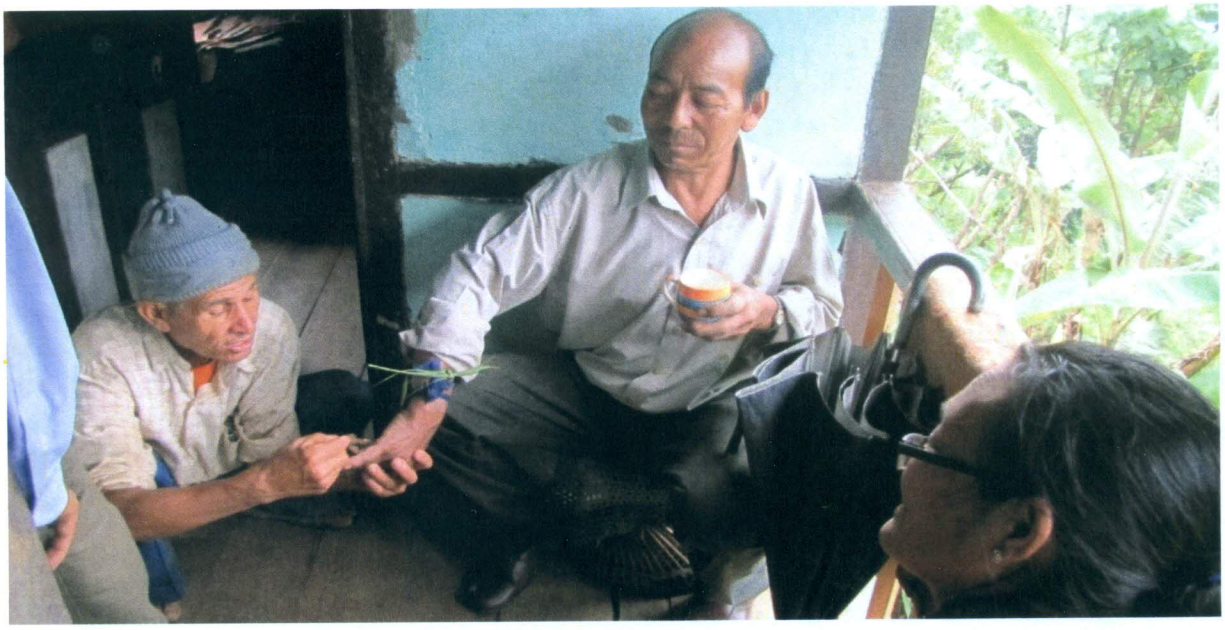
Documentation of traditional ethno-veterinary practice and its formulation"

The project "Documentation of traditional ethno-veterinary practice and its formulation" was initiated in the year 2010 and completed in 2014. The project has been funded by SEED, Division, Department of Science & Technology , Govt. of India under Young scientist award. One of the key objectives of the project was to documentation of existing traditional practices and their formulations in cattle treatment. A total of 250 villages under 29 BACs, of Sikkim has been successfully explored for recording the datas associated with Ethno-veterinary practices

uphold by the local communities living in far flung areas. During the process, 180 folk healers (medicinal plant practitioners), 145 livestock herders (farmers), 98 senior citizens and other amateur traditional ethno-veterinary plant practitioner has been thoroughly consulted and taped the information as per the format created through the suggestions of Local Project Advisory Committee (LPAC) of the project. As a result, 200 plant species has been identified as important herbs being used in ethno-veterinary practice across the state. Approximately, 180 ethno veterinary formulations has been recorded which is being practiced for cattle treatment in Sikkim. Out of which, a total of 45 new and unreported traditional formulations have been recorded for the treatment of livestock in Sikkim through the project. The study also reveals that those formulations possesses strong basis in claiming intellectual property right of the farmers. During the exploration on ethno-veterinary practices in Sikkim, near about 250 villages in 4 districts of Sikkim (80 % in North district, 85% in East district, 95% in south district and almost 85% in West district) has been successfully covered. Due to the rocky terrains and due difficult landscapes some areas such as Tholung valleys (towards Kishong) , Dzongri, Green lake, Karch- Mangnam, Kongri, were not being able to explored during the survey. However part of some important Wildlife conservatories such as Pangolakha Wilife sanctuary and Fambong Lho Wilife Sanctuary in East Sikkim and few areas of buffer zone of Kanchendzonga National park (North & West Sikkim) has been successfully explored and identification of plants species being used in the ethno- veterinary purposes. The sample collection of the specimens to study the species in detail has been successful done. The plants are properly being identified in consultation of expert from Botanical Survey of India. The species are preserve at herbarium of Sikkim State Council of Science & Technology for future use and can be use as a source of reference materials for the schools, colleges and even for the universities of Sikkim.

While executing the project, more than 300 folk healers, plant practitioners, livestock herders has been successfully sensitize on importance of the folk medicinal plants and its conservations within their territories. With series of awareness programme, line departments, research institutions, NGOs (Non Governmental Organization), SHGs (Self Help Group), has been also sensitized in taking up necessary actions on conservation of ethno-veterinary plants and its practices for future use. In many remote areas of the Sikkim, the majority of farmers are still dependent on ethno-veterinary mode of treatment than modern allopathic medicine. One of the important achievements of the project is to create traditional knowledge digital library for 180 different formulations on ethno-veterinary practices of Sikkim. The digitization of the ethno-veterinary practices and their formulations was successfully done with the concept of facilitation to the farmers to protect their traditional knowledge from possible infringes (bio-piracy) in future. This digital library will be uploaded into public domain for general references for line departments, institutions, policy makers, Scientists etc. However, the main aim of digitization of this knowledge is for the future

IPR related issues, protection of traditional knowledge, benefit sharing. The activities pertaining to creation of digital library has been done in collaboration of IPR cell, Sikkim State Council of Science & Technology, Gangtok Sikkim. While analyzing the data collected, its reveals that 52 formulations recorded have strong potential in claiming for intellectual property right on ethno-veterinary formulations of folk healers of Sikkim for traditional livestock treatment.



"PARTNERSHIP AWARD-2015" BY NATIONAL INNOVATION FOUNDATION (NIF) INDIA

The team led by Shri T.W. Lepcha , Hon'ble Minster with Principal Secretary and other officials of Department of Science, Technology and Climate Change called upon Hon'ble Chief Minister at Samman Bhawan on 19th March 2015 to apprise about the award being conferred by National Innovation Foundation (NIF- India).

The Sikkim State Council of Science & Technology has been conferred **"Partnership Award-2015"** by **National Innovation Foundation (NIF) India**,an autonomous body under the Department of Science and Technology, Government of India.This award has been *awarded for furthering the cause of grassroots innovation movement.* The award consisting of a trophy,a certificate and cash prize of Rs 50,000/- was received by Shri. D.T. Bhutia,Additional Director and Dr. S. R. Lepcha Deputy Director of the Department of Science and Technology,Govt.of Sikkim from Dr. R.N Mashelkar, Chairperson of NIF, the former Director General of Council of Scientific & Industrial Research (CSIR)and member of the Scientific Advisory Council to the Prime Minister during a function held in the Rashtrapati Bhawan, New Delhi on 7th March 2015.Only two States have been awarded such awards,the other State being Uttar Pradesh.

NIF- India is pursuing the cause of identifying and recognizing grassroots innovations and traditional knowledge practices from rural and urban areas with a mission of making India innovative and a global leader in sustainable technologies. The idea is to build upon and provide a nurturing platform to unsung heroes of our society who have solved technological problems through their own genius without any outside help. Established in the year 2000, **NIF-India** has

been scouting, documenting, spawning, adding value, protecting intellectual property rights and disseminating contemporary unaided technological innovations as well as outstanding examples of traditional knowledge of individuals and communities from across the country.

The Sikkim State Council of Science & Technology has been associated with **NIF-India** since 2010 and has been actively involved in the mission and trained many academicians, researchers, entrepreneurs and stake holders. *The Council* has also been one of the key partners in organizing the **" 34th Shodh Yatra – 2015 "** from 28th February to 3rd March 2015 during which a journey was taken through the villages of Lower and Upper Dzongu in search of knowledge, creativity and innovations at grassroots.The **60 Shodh Yatris** who undertook the journey comprised of scientists,innovators and students from all over India. During this Yatra, a series of meetings, discussions and documentations were conducted to promote grassroots innovation, traditional knowledge and value addition. Bio-diversity competitions were also held among the school children and recipe competitions for promotion of local cuisine were also organized.In the course of the Yatra, innovative students,local innovators, experimental farmers were identified and felicitated. Some of the innovative ideas from the students of Dzongu have been noted by visiting scientists including the well known IIM Ahmedabad Professor, Dr. Anil Kumar Gupta,who is also the Executive Vice Chairman of National Innovation Foundation. The **Shodh Yatra** initiative has turned out to be one of the major movements across the country in carrying the spirit of innovation to the doorstep of common man.

(vii) North East Climate Change Adaptation Programme (NECCAP)

The State Government has taken various programees on issue related to Climate Change in the State with an objective to axes to chain varnablity, Climate Change impact of food, water and Forest sector and suggested an approach to identify venerable section and region and incorporate adaptation strategy and practices. The various inceptive has been started by Council at National and International level. Government has approved frame work of Climate Change Adaptation Programme to strengthen adoptive capacity of the targeted community and reduce there varnablity to Climate Change through sustainable climate change adaptation majors. The German Development Bank (Kfw) has agreed to support 5 million URO (INB-30 Core) for seven years period as North –East Climate Change Adaptation Programme (NECCAP). The initial reimbursable State contribution is required amounting to Rs 5 Core as per the agreed minutes of the meeting between State Government and Kfw. Hence Rs 5 Core has to be age mark for NECCAP for the financial year 2012-13.

- Goal: Strengthen adaptive capacities of the target (rural) communities and reduce their vulnerability to climate change through sustainable Climate Change Adaptation (CCA) measures.

Background

- Following the Feasibility Study of the proposals presented by the five states including Sikkim, the KfW Mission and the State government agreed on the framework for implementation of NECCAP in Sikkim (Minutes of Meeting, October 2010), The MoM outlined the broad focus and the structure, and highlighted the need to elaborate the feasible climate-change relevant proposals / measures in the form of Project Design Document (PDD). A team of consultant was appointed by KfW to assist the nodal agency in each state for the purpose.
- A multi-department core team constituted by the nodal agency (DSTCC) constituting representatives of DSTCC; RMDD; FSADD, HCCDD, FEWD, and SIMFED discussed and finalized the project design. For the purpose a series of core team meetings, department level meetings and district as well as cluster level stakeholder consultations were undertaken between Dec 11, 2011 and Feb 17, 2012 with the help of the KfW Consultant.

1. The details of work carried out under the different projects are as under Science Awareness, Communication and Science Popularization Programme:

Communication and Popularisation of Science is one of the areas of activity of the Council which pervades through all activities and initiatives of the council. This is a common platform where all divisions meet for popularization of extension work. The communication and information sharing is taken up at various levels and by identifying various location specific problems in which science & technology can play a manifested role for preparing young minds for future. Many planned activities are taken up every year which can be summarized as follows:

(i) National Childrens Science Congress **Annual Programme**

(ii) DBT-Natural Resources Awareness (DNA) Clubs programme in Sikkim State:

Objectives:

- To enhance understanding among students about the immense value of biological diversity of our country, the importance of locally available bioresources, their sustainable use and conservation;
- To equip them with relevant skills for bioresource conservation;
- To familiarize students with scientific and technological issues related to biotechnology;
- To provide students with an experimental learning opportunity;
- To create opportunities for hands on experiments in the field at the school level;
- To organize field trips to National Institutes and National Biological parks of the country.

(iii) Innovation in Science Pursuit for Inspired Research (INSPIRE):

INSPIRE Programme is centrally funded flagship programme of the Department of Science & Technology, Govt. of India which is being implemented through State Governments and UT administrations. The objective of this programme is to develop scientific temper amongst the young and to motivate them to take up scientific career for the scientific and technological advancement of the country. This programme has five components covering entire range of education and research from class VI to post doctoral stage of a student. The first component of this programme is INSPIRE Award which recognizes the talents among students at a very early stage.

(iii) Eyes on Comet ISON (International Scientific Optical Network)":

The Sikkim Council of Science and Technology in association with the Paschim Banga Vigyan Munch (PBVM) is organizing two days state level workshop and observation programme on "Eyes on Comet ISON (International Scientific Optical Network)" from 18th to 19th November 2013 at Sikkim Science Centre, Marchak. The programme is catalyzed and supported by the National Council of Science and Technology Communication (NCSTC), Department of Science and Technology, Government of India. Vigyan Prasar, an autonomous organization of Department of Science & Technology, Govt of India was also part of the programme for academic content and resource material.

State level workshop during November 18-19, 2013

Organization of series of workshop in collaboration with Vigyan Prasar:

Three days consecutive workshop on Innovative Experiments on Chemistry and Observing Nature and Bio-Diversity for teachers and students of Sikkim was organized during October 24-26, 2013 in collaboration with Vigyan Prasar. The programme was funded by Vigyan Prasar, DST, GOI, New Delhi.

Dr. Arindam Rana, Associate Professor, Kolkata the Resource Person for Innovative Experiment on Chemistry, expressed his happiness for conducting such workshops for school teachers and gave a presentation on understanding the chemistry of life. He demonstrated how to use the kit. He explained the objectives of the workshops and how the workshop may help teachers in doing hand-on activities in classroom teaching for better appreciation and understanding of science by students and experiments with natural products and their comparable synthetic substitutes were performed. A number of activities based on chemistry in daily life were demonstrated. He demonstrated how to use the kits developed by Vigyan Prasar and also demonstrated a number of innovative activities related to qualitative analysis; fundamentals of pH metric titration, quantitative analysis, and acid-base chemistry were carried out by the participants. Many participating teachers demonstrated different innovative activities related to classroom teaching involving the hand-on activities. A module "Teaching chemistry- an acti9vity based approach", specially designed for the workshop, explained by Dr. Rana.

Md J. Alam, Resource Person, Patna, for observation of nature and bio-diversity explained the different parameters to observe in nature i.e. shape of leaves, wings of butterflies, insects, etc. he also explained the biodiversity kits distributed to participants. All the sessions were interactive and participants took part in interacting with the resource persons and did hands-on activities themselves. A few participants shared their views on the workshop and explained how it would help them in utilizing the resource materials provided by VP in doing hand-on experiments.

All the participants filled the feedback forms of the workshops. A few participants shared their views on the workshop and explained how it would help them in utilizing the resource materials provided by VP in doing hands-on experiments.

State level science and sanitation campaign- 2014

Low cost science teaching aid in chemistry & physics for science teachers:

A series of Lowcost Science Teaching Aid in Chemistry & Physics for the science teachers of the state has been successfully conducted during the month of March 2015 in support of Vigyan prasar, Department of Science & technology , Govt. of India. The training was held in two places one at Sikkim Science Centre on 26th & 27th February 2015 for teachers representative from South & west district. The another programme was being held at Zilla Bhawan at North Sikkim for East and North districts on 2nd & 3rd March 29015.

During the workshop the participants were given hands on training on methods to teach science by using a very minimal cost waste materials. The programme is mainly to supports schools that belong to tribal villages and schools without appropriate facilities for scientific experimentations.

During the workshop, a key lecture cum demonstration on phenomena on physics was conducted by Dr. B. N. Das, a retired Professor in Physics, and a Guest Faculty at the Presidency College, Kolkata He. demonstrated a number of phenomena in physics. His activities were mainly focused on light, in order to celebrate the International Year of Light, 2015. Experiments on presence of atmosphere and its pressure was demonstrated. Many experiment were shown to the gathering using soap, broken screen of mobile phones, etc. The participants were also given hands on training with innovative experiments.

Dr. Arindam Rana, Associate Professor, from City College, Kolkata also shared numerous principles of Chemistry through demonstration. He also demonstrated some experiments using low cost household materials such as displacement of chemicals, method to memorize the periodical tables, acid- base reactions, starch-iodine reaction, etc. which can be carried out even in schools in remote areas, where facilities to laboratories are yet to come up. Some experiments pertinent to the equations the children come across in their text books. Hand on activity was also conducted with help of the Chemistry experiment kits developed by Vigyan Prasar, New Delhi, which was one set each to all the participating schools and also requested them to apply the technique for better inculcation of Science and innovations among the school children.

The workshop ended with distribution of the certificates to the participants.