BIOTECHNOLOGY DIVISION

Background:

The unexplored state's rich biodiversity is a treasure house of flora, fauna and useful microorganisms which can be utilized for development of numerous products in a sustainable manner through the application of biotechnology. It will create entrepreneurs, jobs and boost the state economy. The applications of Biotechnology on biodiversity are vast and offer unaccounted opportunities and avenues to be explored in the state of Sikkim. It ranges from production of secondary metabolites from medicinal plants to development of resistant and high yielding crops, to production of enzymes and proteins to development of bio-fertilizers etc.

Sikkim State Council of Science & Technology, an autonomous organization of Department of Science & Technology & Climate Change, Government of Sikkim is actively involved in laying strong foundation of Biotechnology in the state of Sikkim.

State-of-Art Biotechnology Laboratory established at Vigynan Bhawan, Deorali

Biotechnology division was created under DST& CC 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. With the humble beginning with a tissue culture laboratory, the division has made significant progress and established state of art biotechnology laboratory in the state.

With its establishment a solid foundation of biotechnology in the state is laid. The exploration and sustainable utilization of state's rich bio-resources and their sustainable utilization through the application of biotechnological tools has now become possible. This is considered as a biggest achievement.

State Biotech Hub under Biotechnology division of DST&CC was established with the support of Department of Biotechnology, Government of India and State Government. State-of-Art biotechnology laboratory has been established for Research and Training in the field of biotechnology and allied field. With the establishment of laboratory, number of trainings on various laboratory techniques has been imparted to Research Scholars, Assistant Professors, Post-graduate science teachers, graduate and post graduate students. More than 40 batches of such trainings has been conducted till date. Besides hands-on training, exposure visits of students

has also been arranged to give exposure to the students on the latest technique in biotechnology and inculcate interest in this field.

Objectives:

1. To promote Biotechnology and allied science in the state of Sikkim through R & D, training and awareness activities.
2. Development of trained human resources; promote entrepreneurship in the field of biotechnology and allied field.
3. To identify and work in the area that will helps to improve the socio-economic condition of the people through the application of biotechnology and allied technology.
4. To undertake research and explore the prospect to solve the current the environmental, food, healthcare problems of state through the application of biotechnology and allied technology.
5. To work in tandems with the State Government policy and intervene on the areas which can assist in successful implementation of its policy.

Goals:

- Undertake research on new product development; explore the solution of current problems of crops, environment, and healthcare through the application of biotechnology.
- Generate maximum awareness especially amongst students, teachers and researchers to inculcate interest in the field of biotechnology.
- Setting-up of Biotechnology Incubation Centre in Sikkim for entrepreneurs' with the financial support of Government of India and State Government.
- Setting-up of Biotech labs in science labs of Senior Secondary Schools with the support of Department of Biotechnology, Government of India under BLISS programme.
- Setting-up of Regional Biotechnology Research and Training Institute in Sikkim.
- Generation of job oriented trained and skilled human resources in the field of biotechnology and allied field.

Operations and Activities

Biotechnology division is headed by Director (Biotechnology) who is also the coordinator of most of the projects and centres under the division. He is being supported by Assistant Scientific Officer and is also the co-coordinator/Co-Principal Investigator of all the projects and centres under the division. There are two government of India funded centres namely, Bioinformatics centre and Patent Information Centre which has Information Officer & scientist 'B' respectively supported by technical staffs. The Government of India funded projects have the temporary manpower to run and implement the project. Permanent employs under State Council submit projects relevant to the state for funding from time to time.

Ongoing projects:

Currently, there are 05 ongoing projects including to centres under the Biotechnology division, they are as under:

Sl. No.	Name of the project	Funding agency	Year of implementation/ establishment	Grant released/carry forward for the current financial year (Amount in **lakh)**
1.	Establishment of Advance Level State Biotech Hub	Department of Biotechnology, Government of India	2010	25.24
2.	Distributed information sub-centre (Bioinformatics)	Department of Biotechnology, Government of India	2001	24.00
3.	Patent Information Centre	Department of Science & Technology, Government of India	2001	Rs. 5.61
4.	Mass production and propagation of large cardamom for livelihood sustainability of rural people in Sikkim using biotechnological intervention.	Department of Biotechnology, Government of India	2017	45.28
5.	Development of agro-techniques in Ginseng in Sikkim	Department of Biotechnology, Government of India	2015	43.10
	Total			**143.13**

1. Conducted Eight hands-on training on biotechnology:

Biotechnology division has developed its own in-house expertise on various fields of molecular biology, bioinformatics, plant tissue culture, microbiology, biochemical studies. The division has conducted eight (08) hands-on training on biotechnological tools and techniques of 3-5 days duration. Target groups were research scholars, science graduates, science undergraduates, science post-graduates and class XII PCB school

students. 85 research scholars, students were trained.

List of training conducted in 2018-19:

Serial No.	Topic	Duration	No. of participants	Level of participants
1.	Hands-on Training on Biotechnological Techniques	4 days	13	B.Sc Botany, Sikkim University & Research scholars
2.	Hands-on Training on Biotechnological Techniques	4 days	13	B.Sc Botany, Sikkim University & Research scholars
3.	Hands-on Training on Biotechnological Techniques	4 days	13	B.Sc Botany, Sikkim University & Research scholars
4.	Hands-on Training on Basic Biotechnological Tools and Techniques	3 days	10	XII Sc., Govt. Sr. Sec. School, Singtam
5.	Hands-on Training on Basic Biotechnological Tools and Techniques	3 days	10	XII Sc., Govt. Sr. Sec. School, Singtam
6.	Hands-on Training on Basic Biotechnological Tools and Techniques	3 days	10	XII Sc., Govt. Sr. Sec. School, Singtam
7.	Training on basic microbial and molecular Techniques	4 days	16	BSc. Zoology Sikkim government Collge. Sikkim University
8.	Training on Biotechnology and its tools	03 days	10	SRM University, Sikkim Students

2. Exposure visit of students arranged and organized a lecture on biotechnology:

About 850 students visited molecular biology laboratory and had exposure in different biotechnological, microbiological, biochemical techniques. The programme was arranged to develop interest on science and technology. Also organized a lecture on biotechnology.

Serial No.	Topic	Duration and Date	No. of participants	Level of Participants
1.	Laboratory Exposure and awareness on Biotechnology	1 day	22	Xll and XI Sc. Students, Teacher Govt. Sr. Sec. School, Enchey
2.	Laboratory equipment demonstration	1 day	20	B.Sc. Students Sikkim Government College
3.	Biotechnology awareness programme	1 day	25	XII Sc (Bio). Students, Teacher Govt. Sr. Sec. School, Singtam
4.	Laboratory exposure and science awareness programme	1 day	124	IX, X & XII Student, various school all over Sikkim
5.	Lecture on Role of Biotechnology in Organic Farming	1 day	70	XII Sc. Students, Principal, Teachers Palzor Namgyal Sr. Sec. School.

Figure: Glimpses of Lecture Series

3. **Courses/Study programmes supported:** Biotechnology division is supervising 05 PhD scholars under the guidance of Dr. B. C. Basistha, Additional Director. Sikkim State Council of Science & Technology has signed an MOU with the Kumoan University in this regard. Other PhD scholars are also using the facility.

Sl. No.	**Level (UG/PG/PhD)**	**Name of the Course/Study programme**	**Nature of support**
1.	PhD	PhD work and laboratory facilities for five scholars	Laboratory, Infrastructure and internet facility
2.	PhD	PhD work and laboratory facilities for four scholars of Sikkim University	Laboratory facilities online research article

			and technical guidance
3.	Forest Department, Govt. of Sikkim	Sustainable use of Sikkim Himalayan Biodiversity for socio-economic development of mountain villages with special reference to *Ophhiocordyceps sinensis, Hippophae salicifolia, Docynia indica* and *Rhus chinensis*: Technology development, alternative livelihood and conservation.	Laboratory, Infrastructure and internet facility

4. **Outreach programme on biotechnology conducted in forty two (42) secondary and senior secondary schools:**
   Outreach programme on biotechnology conducted in forty two (42) secondary and senior secondary schools. Total of 4400 students benefited from the programme. The programme was conducted to inculcate interest on biotechnology.

Serial No.	Topic	Name of the institution where conducted	Level of participants
1.	Biotechnology and its Application	Govt. Sr. Sec. School, Central Pendam, East Sikkim	XII Sc. Students, Teachers
2.	Biotechnology and its Application	Govt. Sr. Sec. School, Lingdok, East Sikkim	XII Sc. Students, Principal, Teachers
3.	Biotechnology and its Application	Govt. Sr. Sec. School, Chuchachen, East Sikkim	XII Sc. Students, Teachers
4.	Biotechnology and its Application	Govt. Sec. School, Adampool, East Sikkim	X & IX Students, Teachers
5.	Biotechnology and its Application	Govt. Sec. School, Dalapchand, East Sikkim	X & IX Students, Principal, Teachers
6.	Biotechnology and its Application	Govt. Sec. School, Tarpin, East Sikkim	X & IX Students, Principal, Teachers
7.	Biotechnology and its Application	Govt. Sec. School, Duga, East Sikkim	X & IX Students, Vice Principal, Teachers

8.	Biotechnology and its Application	Govt. Sr. Sec. School, Rumtek, East Sikkim	XII Sc. Students, Principal, Teachers
9.	Biotechnology and its Application	Govt. Sr. Sec. School, Bhojoghari, East Sikkim	XII Sc. Students, Teachers
10.	Biotechnology and its Application	Govt. Sr. Sec. School, Central Pendam, East Sikkim	XII Sc. Students, Teachers
11.	Biotechnology and its Application	Govt. Sr. Sec. School, Sichey, East Sikkim	XII Sc. Students, Vice Principal, Teachers
12.	Biotechnology and its Application	Govt. Sr. Sec. School, Sang, East Sikkim	XII Sc. Students, Principal, Teachers
13.	Biotechnology and its Application	Govt. Sr. Sec. School, , East Sikkim	XII Sc. Students, Teachers
14.	Biotechnology and its Application	Govt. Sr. Sec. School, Samdong, East Sikkim	XII Sc. Students, Teachers
15.	Biotechnology and its Application	Govt. Sr. Sec. School, Khamdong, East Sikkim	XII Sc. Students, Teachers
16.	Biotechnology and its Application	Govt. Sr. Sec. School, Dikling, East Sikkim	XII Sc. Students, Teachers
17.	Biotechnology and its Application	Govt. Sr. Sec. School, Ranka, East Sikkim	XII Sc. Students, Teachers
18.	Biotechnology and its Application	Govt. Sr. Sec. School, Namchi, South Sikkim	XII Sc. Students, Teachers
19.	Biotechnology and its Application	Govt. Girls Sr. Sec. School, South Sikkim	XII Sc. Students, Teachers
20.	Biotechnology and its Application	Govt. Sr. Sec. School, Saddam, South Sikkim	XII Sc. Students, Teachers
21.	Biotechnology and its Application	Govt. Sr. Sec. School, Tokal Bermiok, South Sikkim	XII Sc. Students, Teachers
22.	Biotechnology and its Application	Govt. Sr. Sec. School, Namthang, South Sikkim	XII Sc. Students, Principal, Teachers
23.	Biotechnology and its Application	Govt. Sr. Sec. School, Jorethang, South Sikkim	XII Sc. Students, Teachers
24.	Biotechnology and its Application	Govt. Sr. Sec. School, Chakung, West Sikkim	XII Sc. Students, Teachers
25.	Biotechnology and its Application	Govt. Sr. Sec. School, Soreng, West Sikkim	XII Sc. Students, Teachers
26.	Biotechnology and its Application	Govt. Sec. School, Timburbong, West Sikkim	X & IX Students, Teachers
27.	Biotechnology and its Application	Govt. Sec. School, Chumbung, West Sikkim	X & IX Students, Teachers
28.	Biotechnology and its Application	Govt. Sr. Sec. School, Buriakhop, West Sikkim	XII Sc. Students, Teachers
29.	Biotechnology and its Application	Govt. Sr. Sec. School, Sombaria, West Sikkim	XII Sc. Students, Teachers

30.	Biotechnology and its Application	Govt. Sr. Sec. School, Daramdin, West Sikkim	XII Sc. Students, Teachers
31.	Biotechnology and its Application	Govt. Sec. School, Dodak, West Sikkim	X & IX Students, Teachers
32.	Biotechnology and its Application	Govt. Sr. Sec. School, Rateypani, South Sikkim	XII Sc. Students, Teachers
33.	Biotechnology and its Application	Govt. Sec. School, Melli, South Sikkim	X & IX Students, Teachers
34.	Biotechnology and its Application	Govt. Sec. School, Melli Gumpa, South Sikkim	X & IX Students, Teachers
35.	Biotechnology and its Application	Govt. Sec. School, Melli, South Sikkim	X & IX Students, Teachers
36.	Biotechnology and its Application	Govt. Sr. Sec. School, Rhenock, East Sikkim	XII Sc. Students, Principal, Teachers
37.	Biotechnology and its Application	Govt. Sr. Sec. School, Kitam, South Sikkim	XII Sc. Students, Teachers
38.	Biotechnology and its Application	Govt. Sr. Sec. School, Nandogoan, South Sikkim	XII Sc. Students, Teachers
39.	Biotechnology and its Application	Govt. Sec. School, Maniram, South Sikkim	XII Sc. Students, Teachers
40.	Biotechnology and its Application	New Sec. School, Namchi, South Sikkim	XII Sc. Students, Teachers
41.	Biotechnology and its Application	Govt. Sec. School, Assangthang, South Sikkim	XII Sc. Students, Teachers
42.	Biotechnology and its Application	Govt. Sr. Sec. School, Ravangla, South Sikkim	XII Sc. Students, Teachers

5. Developed two new cymbidium hybrid

Two new cymbidium hybrids developed. One is hardy and long lasting type and another large flowered. In both the cases the traits of original *Cymbidium lowenium* of the region is re-expressed. Sikkim is also known for orchids. Most of the hybrids are developed in advance countries like Australia, New Zealand. The parents are mostly collected from the Himalayan region of our state and its corridor. There are very few indigenously developed orchid hybrid which will have the commercial importance.

Newly developed Cymbidium hybrids

6. Invited lectures/hands-on trainings offered at other institutions:

Sl. No.	Name of the resource person	Topic	Organized by	Duration & Date
1.	Dr. B.C. Basistha, Director	Biotech and IPR Issues	SRM University	One day 16th March 2019
2.	Dr. B.C. Basistha, Director	*Frankia* Biotechnology: Genetic diversity of microbes and its ecological implications	Sikkim University	One day 22nd June 2018
3.	Dr. B.C. Basistha, Director	Biotechnology and its ethical issues	Sikkim University	One day 17th August 2018
4.	Shri. K. B. Subba	Scientific agro-techniques of Large Cardamom	Sikkim University	One day 06th March 2019
5.	Dr. Bhushan Gurung	Panax Pseudo-Ginseng – its overview	Forest Department	One day 04th May 2019
6.	Dr. Sushen Pradhan, RA	Biotechnology and Biodiversity	Chimsey Training Center, Tourism Department, GOS.	One day 8th April 2019

7. Research activities

Molecular laboratory is actively undertaking various research on biotechnology and allied field.

Sl. No.	Title of the research	Persons involved	Status (Ongoing/completed)
1.	Molecular taxonomy of bamboo species found in Sikkim	Sushen Pradhan, Dr. BC. Basistha Neelam Gurung, (SSCS&T)	Ongoing
2.	Molecular taxonomy of rhododendron species found in Sikkim	Sushen Pradhan, Dr. BC. Basistha Neelam Gurung, (SSCS&T)	Ongoing
3.	Isolation of beneficial microorganism from cow dung for organic farming.	Sushen Pradhan, Dr. BC. Basistha Neelam Gurung, (SSCS&T)	Ongoing
4.	Genetic diversity study of Zingibereceae species of Sikkim	Sushen Pradhan, Neelam Gurung, (SSCS&T)	Ongoing
5.	Genetic diversity study of leguminacece cash crops.	Sushen Pradhan, Neelam Gurung, (SSCS&T)	Ongoing
6.	Standardization of protocol for micropropagation of *Bambusa nutans and* its genetic diversity found in Sikkim Himalaya	Neelam Gurung, (SSCS&T) Sushen Pradhan (SSCS&T)	Ongoing
7.	*In vitro* propagation of six cultivars variety of *Musa paradisiaca* found in Sikkim Himalaya and its molecular studies	Prerna Pradhan, Sushen Pradhan (SSCS&T)	Ongoing
8.	Molecular studies of 36 Rhododendron species found in Sikkim Himalaya	Dr B.C Basistha Sushen Pradhan, K.B Subba	Ongoing
9.	Standardization of *in vitro* protocol of *Cymbidium whitae*	K.B.Subba, (DST) Samriddhi (Symbiosis college)	completed
10.	Algal Diversity from high altitude lakes of Sikkim	Swastika Gurung (Research Scholar, Kumon University) Dr. B.C. Basistha	Ongoing/published
11.	Biology of Large Cardamom	K. B. Subba, DST and Prof. Dr. Mitra (Sikkim Manipal University) Dr. B.C. Basistha	Ongoing
12.	Protoplast fusion of large cardamom cultivars and wild	K. B. Subba, DST and Prof. Dr. Mitra (Sikkim Manipal University) Dr. B.C. Basistha	Ongoing

	relative.		
13.	Antagonistic effect of Rhizosphere bacteria isolated from *Zingiber officinale* against pythium soft rot and formulation of effectual biopesticide	Neelam Gurung, (SSCS&T), Dr. B.C. Basistha	Ongoing/communicated
14.	Genetic diversity of *frainkia* associated with *Elaeagnus* of north Sikkim.	Prerna Pradhan Dr. B.C. Basistha	Ongoing/communicated
15.	Genetic diversity studies on *Citrus tristiza virus*	Pratima Ghimiray, Dr. B. C. Basistha (SSCS&T) & Dr. Kajal Biswas, IARI	Ongoing/published
16.	Documentation of ethnic foods of 21 communities from Sikkim.	Sushen Pradhan, Neelam Gurung, (SSCS&T)	Started

8. Papers published/presented with impact factor:

Recent Publication	Impact Factor
Talambedu Usha, **Sushen Pradhan**, Arvind Kumar Goyal, **Bharat Chandra Basistha**, Sushil Kumar Middha et al., (2017). Molecular Simulation-based Combinatorial Modeling and Antioxidant Activities of Zingibereceae Family Rhizomes, *Pharmacogn Mag.* 13(3), 715-722.	1.7
Amrit Kumar Panda, Satpal Sigh Bisht, Bodh Raj Kaushal, Surajit De Mandal, Nachi muthu Senthil Kumar and **Bharat C. Basistha** (2017). Bacterial diversity analysis of Yumthang hot spring, North Sikkim, India by IIIumina sequencing, Big Data Analytics, 2,7.	-
Swastika Gurung, Veena Pande, Faristha Yasmi, **B.C. Basistha** (2017). Algal diversity in the scared lake of Tung Kyoung, Dzongu, Northern Sikkim, Phykos. 47(2), 95-99.	-
Pratima Ghimiray, **B.C Basistha**, K. K. Biswas, Veena Pande (2018). Incidence And Molecular Diagnosis Of Citrus Tristeza Virus In Mandarin (Citrus Reticulata) Orchards Of Sikkim, CIBTech Journal of Biotechnology, 7(1), 1-7.	-
Sushil Middha, Talambedu Usha, **Bharat Basistha,** Arvind Kr. Goyal **(2019).** Amleoration of Antioxidant potential, toxicity and anti-hyperglycemic activity of Hippophae salicifolia D. Don leaf extracts in alloxan-induced diabetic rats. 3Biotech 09:308	-

Other activities

9. Publication of IVth volume of Bioresource of Sikkim: The publication is the compilation of biological researches of Sikkim. The IVth volume of same is published.

10. Major achievements of the Biotech division during the year:

a. Institutional Biosafety Committee constituted and meeting held to guide the ethical issues involved in research related issues in Biotechnology and microbiology or any other life science related research being/ will be carried out in Advance Level State Biotech Hub.
b. Scientific Advisory Committee formed to increase the quality of research which is undertaken in Biotechnology Division.
c. Seven (07) hands on training on Basic Biotechnological Tools and Techniques of 3-5 days duration were conducted for Research scholars, graduates, under graduate and XII PCB School Students.
d. Total eighty five students were trained on Biotechnology tools and techniques.
e. Outreach Programme on Biotechnology and its application were conducted in 42 different schools targeting 4200 students.
f. Presented oral/ poster presentation during International Conference "**State of the Cryosphere in the Himalaya: with a focus on Sikkim and Eastern Himalayas**"
g. Four (4) research papers were published with the support of State Advance level Biotech Hub.
h. Seven (7) invited lectures delivered at Sikkim University, SRM University and Schools.
i. Fifteen (15) schools students approximately (850) were laboratory exposure and awareness programme conducted.
j. With the support of Advance Level State Biotech Hub, two students from Sikkim University attended training at ACTREC, Mumbai for 15 days.
k. State Level Essay Competition is being organized by ALSBT for young people on Topic "**Biotechnology: Biggest tool of 21st Century**" targeting more than 3000 students of XII & XI Science.
l. Four series of News Letter were published and uploaded in email and website.
m. Collaborated with nine different institutes for research and training purpose.

1. Published a book on "Organic Agro-farming in Sikkim-compilation of field survey and reference compendium on 22 crops for farmers". The book was launched on the occasion of Independence day on 15th August, 2018 by Hon'ble Chief Minister, Dr. Pawan Chamling. The book is a reference guide for farmers and researcher, laymen and covers the package of practices, marketing, crop economics etc.

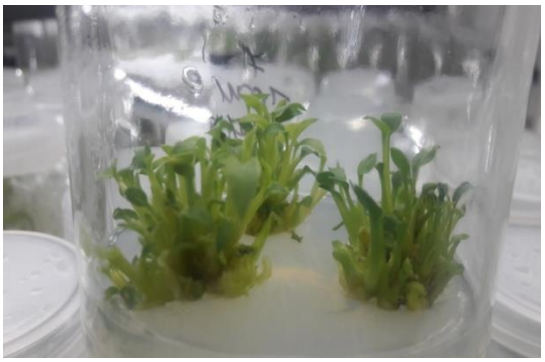
Activities at Biotechnology Research Application Centre, Sajong

I. Implementation of Large cardamom project:

The major work of large cardamom project is undertaken at Sajong centre which includes tissue culture of elite large cardamom, hardening, transfer to nursery, germlasm collection and maintenance, construction of shade houses, field plantation etc. The following works are undertaken:

i. Standardization of protocol for *in vitro* propagation and *in vitro* mass production:
Protocols for micropropagation of three important commercial cultivars of large cardamom, viz., *Seremna, Dzongu Golsai* and *Varlangey* have been standardized. The

plants are being mass multiplied *in vitro* using the standardized protocols and hardening of *in vitro* plants.



ii. Maintenance of Large Cardamom Germplasm

Maintained 10 cultivars of large cardamom germplasm in the field of Sikkim State Biotechnology Research and Application Centre, under Department of Science, Technology and Climate Change, Sajong, Rumtek (**Figure 2**). There are more than 15 cultivars of large cardamom are reported in Sikkim. Therefore, Survey and field tour was proposed at the department for the collection of large cardamom cultivars from farmers field and for maintenance of germplasm in the office field.

iii. Morphological study:

There are different stages of morphological study of large cardamom. Two cultivars (Ramsai and Sawaney) are taken for study. In this study fruiting and mature stages were completed and different stages like (budding and flowering) of morphological study yet to be done. This will be carried out in the month of June to August.

iv. Agro-Technique for cultivation of large cardamom

Study for development of new agro technique for large cardamom cultivation is just started. Different parameters were used in the study for the development of new agro-technique. In this study the following works like, clearance of jungle, pit digging and addition of manure and other organic materials were just completed Further, plantation of large cardamom will be carried out during the months of raining seasons.

v. Construction of Temporary Agro-Net-House

Constructed bamboo frame net houses at State Research Application Centre, Sajong for hardening of micropropagated plants. Total areas 2684 sq ft. of net houses were constructed (**Figure 4**). The details are as follows:

- Temporary agro net Shed no. 1 Size 68 X 23 ft =1564 ft
- Temporary agro net Shed no. 2 size 16 X 70 ft = 1120 ft

Total 2684 ft

11. **Developed and demonstrated integrated method of azolla cultivation and System Rice Intensification(SRI):**

    In this method, low requirement of water and rice seedling is demonstrated during rice cultivation. The integration of azolla in the SRI method of rice cultivation helped in considerable weed control in the rice field and enrichment of nutrients.

12. **Successfully developed the protocol for tissue culture of large cardamom for propagation of elite quality planting material:**

    The protocol for tissue culture of large cardamom for propagation of elite quality planting material is successfully developed for all the popular cultivars. In the next phase, large scale production will be made and distributed to the farmers under a project funded by DBT, GOI.

13. **Demonstration of azolla cultivation to the farmers:**

    Azolla is found to have multiple use such as cow feed, pig, chiken, fish feed. They are also used in rice field to control weed and enrich the soil. The use and method of azolla cultivation is demonstrated to the farmers of the locality.

14. **Developed technology on integrated fish farming, azolla cultivation and vermin-composting:**
A technology is developed on integrated fish farming whereby azolla and vermin-worms are used as fish feed for faster growth. The technology is being demonstrated to the farmers.

15. **Technology developed for less water requirement for large cardamom cultivation:**
Large cardamom cultivation requires high volume of water and humidity which is has now become scarce due to various reasons. Technology has been developed for conservation of water required by plant.

16. **Technology for multi-layered cropping system for large cardamom cultivation developed:**
In order to increase the income of farmers from small and medium land holding, multi-layered cropping system has been developed for cardamom in which fruit trees are planted as shade trees, some creeper fruits are introduced and in between coffee plants are planted.

Brief activities of ongoing projects:

1. **Establishment of State Biotech Hub in Sikkim**

Funding agency:	Department of Biotechnology, Govt. of India
Yr. of commencement:	2010
Project duration:	3 year(initially, ongoing 6th year)
Total project cost:	Rs. 304.03 lakhs

The project "Establishment of State Biotech Hubs (SBT hubs) in Sikkim" is funded by Department of Biotechnology (DBT), Govt. of India under special programme for North Eastern States of India. The project is being coordinated by Biotech Consortium India Limited (BCIL), a government of India enterprise promoted by Department of Biotechnology, Government of India. The project has the component of establishment of state of art biotechnology infrastructure facilities in the state, a nucleus research centre for biotechnological research. The total project cost is Rs. 304.03 lakhs and is of three years duration. The main objective of the project is the establishment of major biotechnology infrastructure facility in the state, to train the coordinators of the institutional hubs, to provide support for research and training and to have a linkage with other institutional hubs in the respective state.

Work done:

Some major work is being done under the project. The state of the art biotechnology infrastructure facility both at Vigyan Bhawan and cell and tissue culture laboratory, Sajong, Rumtek established under the project. The laboratory has 43 newly procured high end instruments and machineries and most consumables required for the molecular and biochemical studies.

Overview of the established molecular and biochemical laboratory and some of the instruments

Under the project, number of workshops, trainings and outreach programme has been conducted and published research papers in national and international journals. More than 20 workshops, seminars and trainings has been conducted. The outreach programme to inculcate interest on biotechnology amongst the students has been conducted in 40 senior secondary and secondary schools.

State Biotech Hub conducts training on biotechnological techniques

SE Report

GANGTOK, August 7: State Biotech Hub under Science & Technology department organized a three-day hands-on training on biotechnological techniques and tools from August 5 to 7 at Molecular Biology Laboratory, at Vigyan Bhawan here.

The hands-on training was conducted on isolation of plant DNA, its quantification, gel electrophoresis, polymerase chain reaction and analysis of molecular data using bioinformatics tools, informs a press release.

The resource persons of the training were Science & Technology director (Biotechnology) Dr. B. C. Basistha, assistant scientific officer K.B. Subba, research associate Dr. Sushen Pradhan, research associate Dr. Bhuwan Gurung and information officer (Bioinformatics) Laydong Lepcha.

The training programme concluded with the distribution of certificates by Science & Technology secretary K. C. Lepcha. The secretary urged the participants to conceptualize an idea for conservation of ecology and environment, livelihood sustainability through the application of biotechnology and submit the same to his office for consideration in rewarding such noble concept or idea. The participants were BSc. (Botany) students and professor of SRM University.

Printed news on Hands on training on molecular biotechnology

Outreach programme Biology techniques

2. **Molecular and digital documentation of ethno-traditional knowledge with special reference to folk healing practices for protection of intellectual property rights**

   Funding agency: Department of Science & Technology, Govt. of India
   Yr. of commencement: 2015
   Project duration: 3 year
   Total project cost: 33.99 lakhs

   The main objective of the project is to document the ethno-traditional knowledge specially the folk healing practices by various practitioners in digital form as well as in written document form. Molecular documentation shall also be carried out of those plants used by the practitioners.

   Interview with the folk healers and documentation ethno-traditional practices of more than 100 folk healers has been done. Videographich documentation and DNA finger printing of plants is completed.

3. **Mass production and propagation of large cardamom for livelihood sustainability of rural people in Sikkim using Biotechnological interventions**

   Funding agency: Department of Biotechnolgy, Govt. of India
   Yr. of commencement: 2017
   Project duration: 5 year
   Total project cost: 126.27 lakhs

   In the project, the following objectives will be met:-

   (I) Identification of different large cardamom cultivars using morphological descriptors.
   (II) *In vitro* propagation and hardening of micro propagated sapling.
   (III) Improvement of Agri-technique for cultivation of large cardamom.
   (IV) Standardization of protocol for virus detection in large cardamom using molecular technique.
   (V) Establishment of large cardamom nursery, experimental-cum-demonstration site, training to farmers and distribution of quality planting materials.
   (VI) Phytochemicals studies of seed from all cultivars of large cardamom.

   Demonstration-cum-training area developed in 5 acre of land for large scale multiplication of elite, disease free large cardamom plants to be distributed to farmers. Standardized tissue culture protocol for large cardamom cultivars and plants are under multiplication in the laboratory. Morphological identification of cultivars initiated. Improved cultivation practices developed for transfer to farmers. Nursery established for large scale multiplication.

   Plantation, field preparation, micropropagation, and viral indexing and production of disease free planting material for cardamom have been completed.

4. **Development of Agro-techniques and new molecular markers in Ginseng (Panax sp) in Sikkim**: The project is being funded by Department of Biotechnology, Government of India. The main objective of the project is the development of agro-technique of ginseng

using local material in the local environment of commercial importance, breeding, in-vitro plant regeneration and hardening. The project work has been initiated.

Collected Ginseng seeds from different locations including Arunachal Pradesh for germplasm collection and development of agro-technique. Identified Ginseng growing area within Sikkim. Initiated the work of agro-technique development. Further collection of seeds has been started and shall be planted in a suitable location in collaboration with the Forests Department, Government of Sikkim. Germplasm collection and plantation of all the collected seeds from different locations shall be done shortly.

Panax sp.

I. Bioinformatics centre

Background

Bioinformatics Sub DISC (Distributed Information Sub-Centre), Sikkim State Council of Science & Technology, was set up 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 non profit public funded research and training organization established under Department of Science and Technology, Government of Sikkim.

Research Area: Biodiversity, Biotechnology and Bioinformatics

Activities

Bioinformatics centre since its establishment conducted number of trainings, workshops and seminar and actively involved in the promotion of bioinformatics in the state.

Trainings conducted:

During 2017-18, Bioinformatics centre conducted the following trainings:

- Training on computational biology
- Training on application of bioinformatics.

Book published:

Compilation of research paper on bioresources of Sikkim.

Training imparted as resource person:

Information Officer imparted training at St. Edmond College, Shillong on Computational biology.

Other activities:

A new Executive Committee consisting of seven members has been formed to streamline the activites of the Bioinformatics Centre as per the guidelines of Department of Biotechnology, Government of India.

A project on Sexually Transmitted Diseases (STD) and its rate of growth in Sikkim was completed by the Bioinformatics Sub-DISC.

Research on morphological and ecological studies of Capsicum annum carried out.

II. Patent Information Centre

Patent Information Centre (PIC) is established in the year 2001 under the aegis Sikkim State Council of Science & Technology (SSCS&T), Department of Science Technology & Climate Change (DST&CC), Govt. of Sikkim. PIC, SSCS&T is funded and supported by Department of Science and Technology (DST).

Objective:

To create awareness about Intellectual Property Rights (IPR) especially Patents, Geographical Indication (GI), Copyright, Trademark, Protection of Plant Variety & Farmers Right (PPV&FR), Integrated Circuit & Layout, etc. To facilitate filing and searches of related IPR to the universities, industry, government departments & R&D institutions, students and teachers. Sensitization on IPR to the rural innovator, block level officers.

Awareness and sensitization activities were conducted through opening IPR cells in the state Govt. colleges, writing article in daily local paper, radio talk, workshop, seminar, IPR camps, brochure, palm plates, flex display, hoardings etc.

Summary of the progress:

PIC, SSCS&T has organized many workshops, seminars and camps on IPR (GVK, school, college and village level/community level). The centre is also actively involved in filing and Registration of different IPR like Geographical indication (GI), Patent, Copyright, Protection of Plant Variety & Farmers Right (PPV&FRA), Trademark and Logo, etc. PIC has published many articles on IPR in the local newspaper of the state, Research Journal and Books. The centre has opened eight IPR cells in the different colleges and universities with the objective to create awareness and sensitization on IPR. PIC has also broadcast Radio talk on IPR in the All India Radio Gangtok. The centre provides Patent search facilities to the researcher, scholar and visitors free of cost. The centre has maintained hoarding and Flex display on IPR at Vigyan Bhawan, Deorali, Gangtok and Sikkim Science Centre, Marchak.

1. Awareness and sensitization program on Intellectual property Rights (IPRs) with special reference to "Geographical Indication" (GI) and "Trademark" on "Capacity Building cum Entrepreneurship Development Program of Food & Fruit Processing"

Fig. Lecture on GI and Trademark to the participants of the Program.

2. Patent Information Centre (PIC) has also provides information and deliver lecture and presentation about different forms of IPR to the students and visitors in Science Exhibition at White Hall, Gangtok.

3. PIC, SSCS&T identified six potential local items for Geographical Indication (GI) registration from Sikkim.

1. Sikkim Mandarin *(Sikkim Soontala),*
2. Sikkim Dzongu Lepcha Hat *(Sumok Thyaktuk),*
3. Sikkim Dzongu Lepcha Darri *(Thokro/Darrey),*
4. Sikkim Temi Tea *(Sikkim Temi Chiyapatti)*
5. Sikkim Chilly Pickle, *(Dalley khorsani ko acchar)*
6. Sikkim Ginger, *(*var; *Bhaisey, Majauley)*

4. The centre has done Radio talk on "Importance of IPR & potential of GI & its importance" in local language of Sikkim which has been broadcast in the All India Radio Gangtok. The program on IPR was conducted during the All India Radio Science talk scheme.

5. Geographical Indication Registration filed to TIFAC and following two items were accepted by Technology Information Forecasting Assessment Council (TIFAC), New Delhi.

The centre has applied for four items to the TIFAC for providing support for GI registration. Among four which includes Sikkim Temi Tea, Sikkim Mandarin, Sikkim Dzongu Lepcha Hat (*Sumok Thyaktuk*) & Sikkim Dzongu Lepcha Darri (*Thkro*), two items has been accepted for the process GI registration. They are Sikkim Temi Tea & Sikkim Mandarin. (Registration under process)

Pic 1: Sikkim Mandarin

Pic. 2: Sikkim Temi Tea

Sikkim Mandarin: Applicant address

Sikkim Temi Tea: Applicant address

6. PIC provides Patent Search Activity to the visitors, researcher and scholars free of cost. (Both online and through patent CD RoM database)

7. PIC has established eight IPR cells in the school, colleges and universities in Sikkim with the objective to create awareness and sensitization on IPR and related issues.

The name of IPR cells opened in the colleges and universities were:-

i. Sikkim Sr. Sec. School, Mangan, North Sikkim
ii. Sikkim Government College (SGC), Gaylshing, West Sikkim
iii. Sikkim University (SU), 5th Mile, East Sikkim
iv. Sikkim Manipal University (SMU), Gangtok, East Sikkim
v. Sikkim Government College (SGC), Namchi, South Sikkim
vi. Sikkim Government College (SGC), Rhenock, East Sikkim
vii. Sikkim Government Law College (SGLC), Burtuk, East Sikkim
viii. Sikkim Govt. B. Ed College, Soreng, West Sikkim

8. PIC has published brochure on IPR, articles in the local newspaper of the state, Research Journal and Books.

The lists are as follows:

1) Brochure of PIC on IPR
2) "Sikkim Biodiversity - Significance and sustainability" with title "A Future Prospective; Intellectual Property Rights (IPR) in Sikkim Himalaya.
3) Published research paper in the Indian Journal of Traditional Knowledge (IJTK) with title "Traditional *Lepcha* craft *Sumok-thyaktuk* (*Lepcha* Hat) and its conservation in Dzongu Tribal Reserved Area (DTRA), Sikkim, India.
4) "Patent an Intellectual Property Rights" has been published in the local paper of the state 'The Himalayas'
5) "Trade of Intellectual Property (IP) in the world" has published in the 'Sikkim Mail' & 'Sikkim Express'.
6) "Traditional Knowledge, Folklore, Biodiversity and Intellectual Property" has published in the local paper of the state Sikkim Express.
7) Patent- an Intellectual Property Rights (IPR)
8) Intellectual Property Rights (IPR)- Importance of Patent
9) First GMO (Genetically Modified Organism) to be subject to a Patent
10) Concept of Geographical Indication (GI)
11) Protection of local products through GI
12) Intellectual Property Rights (IPR)- Protection of Plant Variety & Farmers Right (PPV&FR) PART-I
13) Intellectual Property Rights (IPR)- Protection Genome, Savior, Rewards & Recognitions (PPV&FR) PART-II

9. The PIC has organized four workshops on IPR in the following different colleges

The lists of the awareness program organised are as follows:-

i. Sikkim Govt. College Gayzing, West Sikkim
ii. Sikkim Govt. College Tadong, Gangtok.
iii. Sikkim Govt College Rhenock.
iv. Sikkim University, 5th Mile, Samdur.

10.Copyright filing.

The following two copyright has been filled by the centre:-

i. Gyapo (A story)
ii. Kathaa (A story)

Both literary items are of Shri. Prashant Rasailey, a young enterprising film Director from Sikkim.

11. Plant Protection Variety & Farmers Right (PPV& FR) Filing

One local variety of rice, *Kalo Nunia* has been applied for the registration of Farmers Variety as a *Kailash Rana Manger* under Plant Protection Variety & Farmers Right has (PPV & FR) Act, 2001 and Plant Protection Variety & Farmers Right, Rule 2003.

12. PIC, SSCS&T Notified as a IPR Nodal Agency of Sikkim

PIC,SSCS&T has been notified as a Nodal Agency for IPR in the state of Sikkim Vide Notification No. 15/DST/2013 Dated 20/03/2013

Picture:- Sikkim Govt. Law College (SGLC), Burtuk, East Sikkim


Picture:- Sikkim Govt. College (SGC), Namchi, South Sikkim

13.IPR hoardings and Flex display for awareness

Picture:- IPR awareness display at Vigyan Bhawan, Deorali, Gangtok

14. PIC has organized 16 workshop covering School level, college level, Gram Vikash Adhikari Kendra and Village and Community Level.

The list of the IPR conducted in different venues are as follows:

1) Outreach program on IPR at Khamdong GVK
2) IPR awareness program at Pakyong GVK
3) Awareness program on IPR at Ravangla GVK
4) IPR sensitization program at Yangyang GVK
5) Outreach program on IPR at Namthang GVK
6) Awareness program on IPR at Sumbuk GVK
7) IPR awareness program at Dentam GVK, West Sikkim
8) IPR awareness program at Hee-Yangthang Sr. Sec. School, West Sikkim
9) IPR awareness program at PNGSS School, Gangtok. East Sikkim:
10) IPR awareness program at Government Senior Secondary School, Mangan, North Sikkim
11) Outreach programme on IPR at Government Girls' Senior Secondary School, Deorali, East Sikkim
12) Outreach program on IPR at Government Senior Secondary School, Tadong, East Sikkim
13) Sensitization program on IPR at Government Sr. Sec. School, Bojoghari, East Sikkim
14) IPR awareness workshop at Sikkim Govt. College Namchi, South Sikkim
15) IPR Awareness program at Lingdem, Dzongu, North Sikkim
16) IPR Awareness program at Passingdang, Dzongu, North Sikkim


Picture: IPR program at school, BAC and Community level

15. PIC has published three more article in the local newspaper of the state "SIKKIM EXPRESS" with the objective to inform facilities of Department of Science, technology & Climate Change (DST&CC) regarding IPR.

The lists of the articles are as follows:

1. Traditional Culture & Intellectual Property Rights
2. Trademark as a tool for strengthening services sector
3. World Intellectual Property Day

25. Registration of GI (status)

1. Sikkim Temi Tea & Sikkim Orange

   A Meeting on status of GI registration regarding Sikkim Temi Tea & Sikkim Orange was held on 5th January 2016 in the chamber of Principal Secretary, DST&CC at Vigyan Bhawan, Deorali Gangtok, between assigned Kolkata based legal Attorney S.Majumdar & Co. and stake holder of SikkimTemi Tea & Sikkim Oange/Mandarin. Shri. Monosij Mukherjee was representing from S.Majumdar & Co. from Kolkata, Shri. Ravi Kumar, IFS, Managing Director and Shri.Mohan Chamling were representing from Sikkim Tea Estate, Shri. H.C Pradhan, Additional Director (Fruits) representing from Horticulture & Cash Crop Development Department (HC&CCDD), Govt. of Sikkim were present during the meeting. All the documemnts have been submitted to the attorney assigned by TIFAC at Kolkata. We are still waiting for the response and action taken from the Attorney
2. Sikkim Dzongu Lepcha Hat *(Sumuk thyaktuk)* & Sikkim Dzongu Lepcha Darri *(thokro)* PIC is seeking additional financial support for this case.

26. Patent filing

PIC received two cases for Patent filing. After examination and patent search repot, one case invention (A device use to pick object from a distance) has been filed to TIFAC (Technology Information Forecasting & Assessment Council). TIFAC suggests modifying few claims on his inventive steps. Currently PIC is supporting in developing strong claims in his invention.

Regarding another invention after PIC examination, it is found that it does not fall under patentable invention under section of Indian Patent Act, 1970 but PIC is in touch with them for encouraging other patentable invention in future.

27. Protection of Plant Variety & Farmers Right (PPV&FR) Act

Recently PIC, SSCS&T has received a letter from Protection of Plant Variety & Farmers Right Authority (PPV&FRA), New Delhi regarding the local rice farmer's variety filed by PIC. The PPV&FR Authority has send the format of authorization letter and requested to fill and send authorization letter from applicant mentioning the PIC, SSCS&T will be authorized agency for filing Farmers variety on his behalf. The authorization has been made and sent to the authority, New Delhi. Registration is under process and certificate is awaited.


Picture: Dr. Anil Mainra Principal Secretary on the left and Dr. B.C Basistha, Additional Director –cum Coordinator, PIC addressing the audience during IP day celebration program at Vigyan Bhawan.

A. Establishment of Biotechnology Research and Application centre at Sajong, Rumtek

Established state-of-art biotechnology laboratory including plant tissue culture laboratory at Sajong, Rumtek with the experimental field in 5 acre of land. The centre has main laboratory building with offices, hi-tech greenhouse, poly-house, shed-house chowkidar quarters and field. The laboratory and the field is used for research and training. The centre has multiplied some rare orchids of Sikkim like *Cymbidium whitae*, *Cymbidium eburneum* and also commercial orchids, medicinal plants etc. The laboratory has developed an intermediate flowering vanda by crossing cool growing vanda with warm growing vanda. The orchid is under multiplication in the laboratory. The centre has maintained germplasm of large cardamom with most of the available cultivars for research and training. The experimental field is used for research on Azolla cultivation and its application, improvisation of large cardamom cultivation method, SRI method of rice cultivation, natural farming etc.

The pioneer work of plant tissue culture in the state was carried out in our laboratory and successful initiation and multiplication protocols of economically important plant species such as

orchids, cardamom, medicinal plants has been developed. The establishments of government and private labs are the direct or indirect results of our successful laboratory. Such venture was an unsuccessful both in the private and public sector before in the state. Now, number of successful private as well as government laboratory has been established and producing quite a good number of plants. This, it is considered as a positive impact made by the laboratory. The laboratory has imparted number of training on plant tissue culture and nursery techniques to the entrepreneurs. Some of them have established laboratory and nurseries.

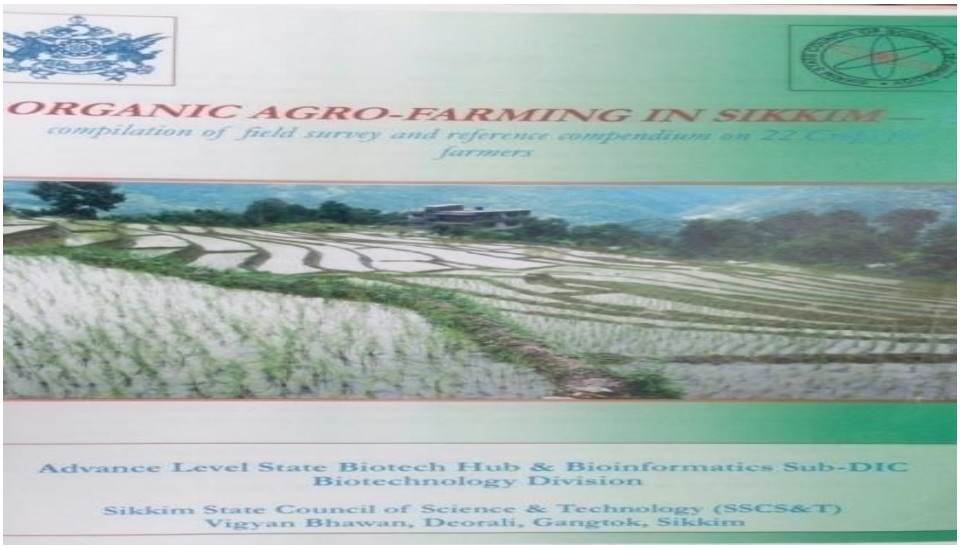
The laboratory is working on the development of resistant variety of large cardamom through protoplast fusion, cell culture and some significant progress has been made.

Developed two new cymbidium hybrid

Two new cymbidium hybrids developed. One is hardy and long lasting type and another large flowered. In both the cases the traits of original *Cymbidium lowenium* of the region is re-expressed. Sikkim is also known for orchids. Most of the hybrids are developed in advance countries like Australia, New Zealand. The parents are mostly collected from the Himalayan region of our state and its corridor. There are very few indigenously developed orchid hybrid which will have the commercial importance.

Besides laboratory work, the centre has developed and maintained germplasm of large cardamom, ginger and herbal garden for research and educational purpose. The centre has maintained 7 cultivars of large cardamom and 6 cultivars of ginger and numbers of medicinal plants are being planted in the herbal garden.

Published a book on "Organic Agro-farming in Sikkim-compilation of field survey and reference compendium on 22 crops for farmers". The book was launched on the occasion of Independence day on 15th August, 2018 by Hon'ble Chief Minister, Dr. Pawan Chamling. The book is a reference guide for farmers and researcher, laymen and covers the package of practices, marketing, crop economics etc.



1. Organized and imparted more than 60 hands-on training on various biotechnological and allied techniques to researcher, post-graduate teachers, professors, post-graduate science students, under-graduate students and Class XII science students.

2. Established Bioinformatics web laboratory to carry out research and training on bioinformatics. More than 30 hands-on training on bioinformatics conducted and published number of research paper.

3. Established Plant Tissue Culture Laboratory at Sajong, Rumtek to multiply the rare, endangered and economically important plant species for conservation and sustainable utilization. The laboratory developed some new orchid hybrids of economic importance.

4. Established Patent Information Centre with the support of DST, Govt. of India to act as facilitating centre for Intellectual Property Rights. Created mass awareness among the local populace. Facilitated to file some GI, Copyrights, Logo and patents.

5. Published more than 40 research papers in national and international journal.
6. Published 6 books on various topics.
7. Conducted more than 150 outreach programme on biotechnology, bioinformatics and Intellectual Property Rights in different schools of Sikkim.
8. Organized more than 30 exposure visit of students of different schools.
9. Organized more than 10 workshop/seminar in different topics.
10. Publishing newsletter on bioinformatics and biotechnology.
11. Executed 11 research and extension projects.

Road map for Biotechnology division(Vision document):

- Framing of State Biotechnology Policy.
  State Biotechnology Policy will be framed to have a framework of and give proper direction and helps in decision making for promotion of biotechnology in the state. The

policy will be framed in consultation with state stake holder, policy maker, scientist, technocrats and common people.

- Constitution of State Biotechnology Executive Committee
  Biotechnology executive committee will be constituted which will acts as working body and decides and gives direction on the major activities of biotechnology in the state. They shall meet at least every one year.
- Constitution of State Biotechnology Research and Development council.
  R&D council will review the research and development activities of biotechnology in the state. They will review the R&D activities every six months and give recommendations and suggestion on research activities.
- Establishment of Biotechnology Incubation Centre.
  In order to promote entrepreneurship in the field of biotechnology, Biotechnology Incubation Centre will be established in state with the financial support of Department of Biotechnology and State Government.
- Setting-up of Biotech labs in all senior secondary schools.
  Few biotech labs has already been established with the effort of Biotechnology division of DST&CC. Such labs will be established in all science senior secondary schools with the financial support of Department of Biotechnology, Government of India.
- Undertake R&D on product development.
  Product development especially through recombinant DNA technology will be taken up.
- Promotion of entrepreneurship in Biotechnology.
  Training of product development, up-scaling of production will be carried out on specific products to encourage entrepreneurship in the field of biotechnology.
- Explore the solution of current problems of crops, environment, healthcare etc. in collaboration with line department.
  The problems of declining large cardamom production due to disease, genetic erosion, waste management will be addressed and explore the possible solution for the same.
- Training, demonstration and extension in Biotechnology to the civil society/farmers/rural and urban population.
- Outreach/awareness to the students/researchers and local population.
- Strengthening of manpower in Biotechnology division of state council.

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REMOTE SENSING & CLIMATE CHANGE

A. CONTEXT:

Looking into the diverse natural resources and rich biodiversity in Sikkim Himalaya, the Sikkim State Remote Sensing Applications Centre (SSRSAC) was started under the Department of Science and Technology in the year 1997. The Centre now is well equipped with sophisticated Hardware and Remote Sensing and GIS software.

The SSRSAC has well trained manpower in the field of Remote Sensing and GIS. The Centre has provided training to the educated unemployed in the field of Geo-informatics for the period of six month. The centre also provides short term training to Students of different colleges in the field of RS and GIS application. It has been undertaking various projects funded by Central Government as well as State Government and also provides necessary data to the user departments 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.

B. GOALS AND OBJECTIVES:

1. Promoting research and development in various identified areas relevant to the state.
2. To generate scientific awareness and also to transfer appropriate technologies for economic uplift of the weaker section of the society.
3. To identify areas of long term development of the state by ensuring application of science and technology.
4. To supplement the efforts of the State Government in implementing various projects whenever and wherever called for.
5. Mapping of natural resources especially in the remote and inaccessible areas of the state.
6. Providing essential data to the line departments for developmental activities in the state.

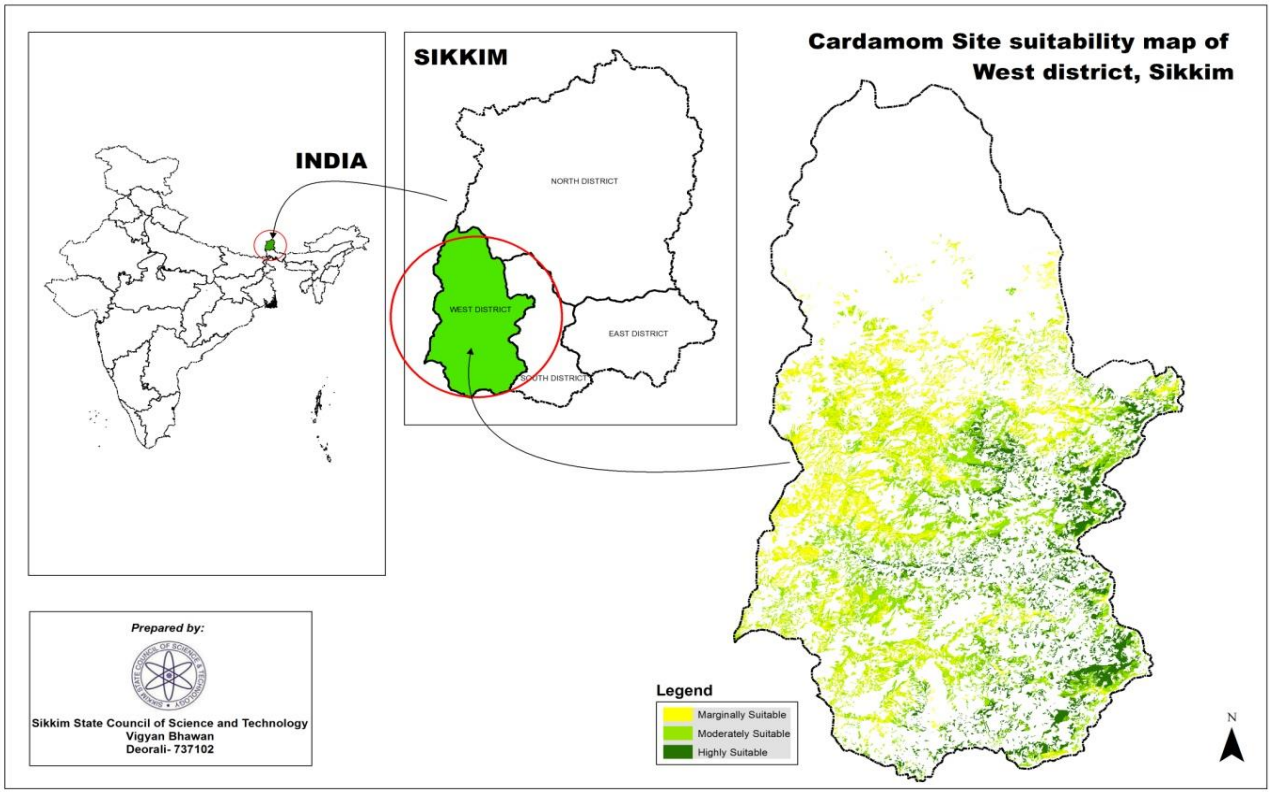
C. OPERATIONS AND ACTIVITIES:

1. Coordinated Horticulture Assessment and Management using Geoinformatics (CHAMAN)

Site suitability analysis under Coordinated Horticulture Assessment and Management using geoinformatics (CHAMAN) Project- Sikkim funded by Mahalanobis National Crop Forecast Centre (MNCFC), Department of Agriculture, Cooperation and Farmers' Welfare (DAC&FW), Ministry of Agriculture and Farmers' Welfare (MoA&FW), Govt. of India, New Delhi through NESAC Shillong, in collaboration with Space Applications Centre (SAC), Ahmedabad, NESAC and Sikkim State Remote Sensing Application Centre (SSRSAC).The objective of the project is to identification of potential areas for cardamom plantation in West Sikkim district.

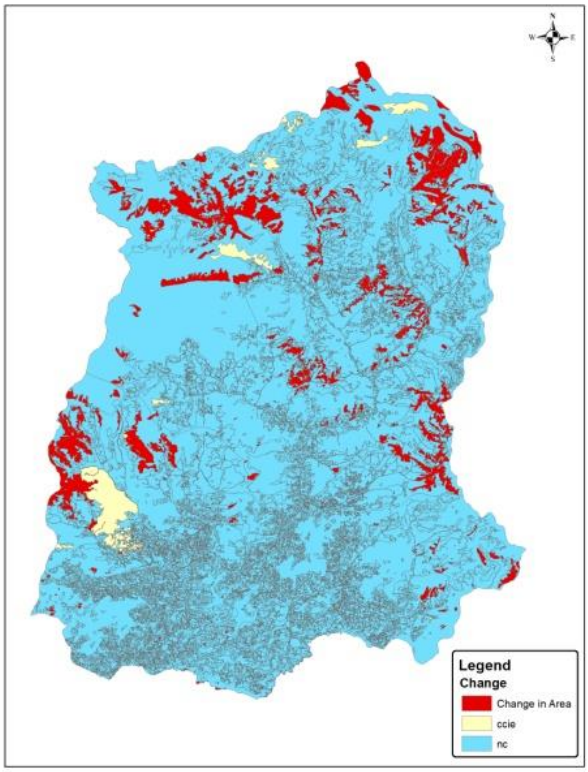
The potential areas for cardamom has been prepared for west district of Sikkim. It is prepared according to the methodology chart given above. All the required data/criteria have been adopted for modeling. Here three categories of suitability classes were considered viz Highly Suitable, Moderately Suitable and Marginally Suitable. Highly suitable class are those areas which are favourable to the conditions required for cardamom growth and plantation.
After preparing the final raster datasets. The LULC (wasteland) layer was used to crop the dataset. Already cultivated plantation areas were not considered for analysis, but the information were taken into considerations for suitability analysis.

The outputs of the project will be finally integrated into CHAMAN site suitability geo portal on Bhuvan portal.



SL. No	Suitability	Area (hactares)	Colour Indicator
1.	Highly Suitable	5855	Dark green
2.	Moderately Suitable	1336	Light green
3.	Marginally Suitable	377	Yellow
Total		**8587**	

2. Land use and Land cover Change 3rd Cycle

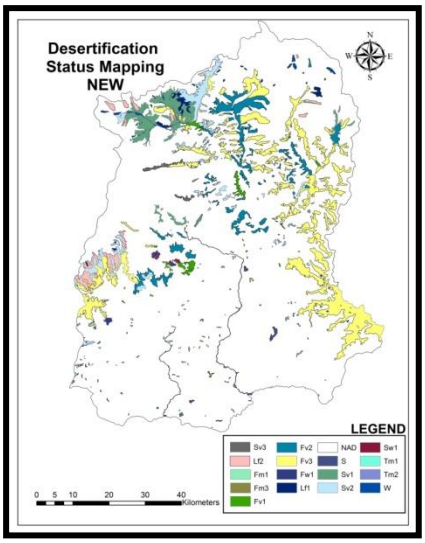


National Remote Sensing Centre, Indian Space Research Organisation (ISRO), Department of Space, Government of India in collaboration with various State, Central Government Departments and Institutions has completed first and second cycle of LULC 50 K interpretation using Resourcesat LISS III data of 2005-06 and 2011-12 respectively using NNRMS Level-III classification system on 1: 50,000 scale.

Establishing the Natural Resources Repository (NRR) is the overall goal under NNRMS. Reliable database on the spatial spread and monitoring the dynamics of the land use/land cover is the basic prerequisite for planning and implementing various developmental activities. Apart from this, nationwide land use information becomes important from the point of view of addressing changing pattern in land use/land cover in addition to overall reporting on the nation's land use/land cover scenario.

In the current exercise, existing spatial land use/land cover database will be modified to obtain LULC for 2015-16 for the entire country. This will be used as a base layer to arrive at land use/land cover changes from 2005-06 to 2011-12 to 2015-16. Maximum changes seen in the snow cover area, which is consider as temporary changes.

3. Desertification status mapping-Sikkim



Desertification is a continuous degradation of land under the influence of natural and anthropological causes in arid, semi-arid and dry-sub humid conditions. 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.

Mapping of Land degradation was carried out using the LISS III Satellite imageries in Collaboration with SAC Ahmedabad, the entire task was completed and it is publish as a desertification atlas.

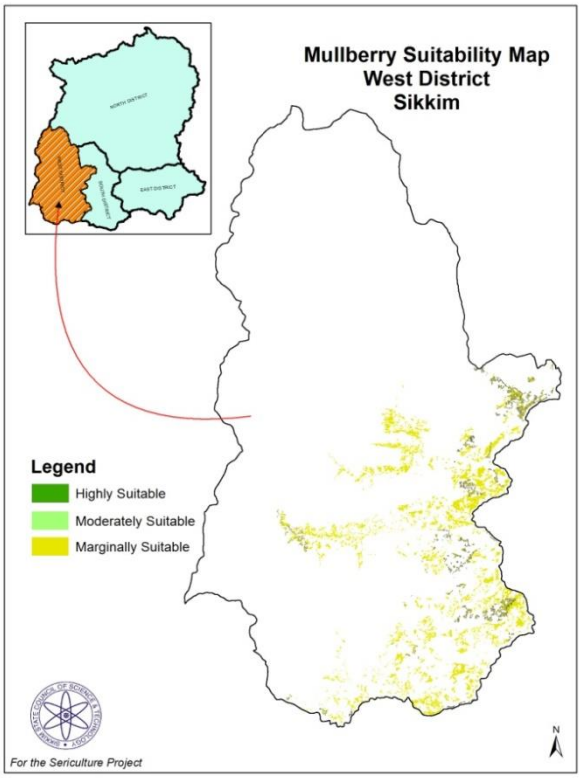
4. Application of Remote Sensing and GIS in Sericulture Development" Phase- I &II

Sericulture is one of the important sectors of economy in India and plays an important role in programmes of poverty alleviation. Compared to agricultural crops, sericulture provides more employment all round the year and fetches higher income for rural farm families.

Objectives of the project:

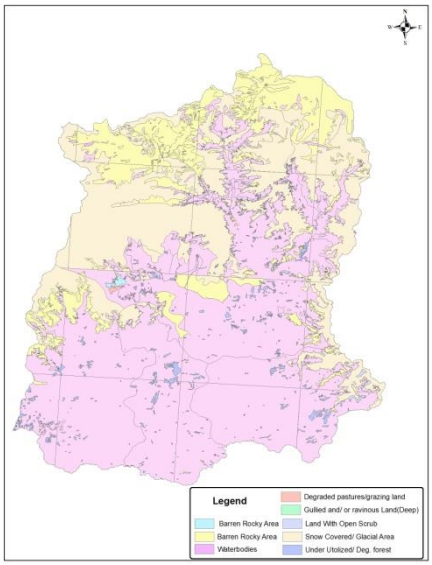
i) To identify potential areas for *mulberry and non-mulberry* sericulture development in *west districts Sikkim* and

ii) To develop Sericulture Information *Linkage & Knowledge System* (SILKS) for the west district.



SL. No	Suitability	Area (hactares)	Colour Indicator
1.	Highly Suitable	348.81	Dark green
2.	Moderately Suitable	8.3110	Light green
3.	Marginally Suitable	4640.9	Yellow
Total		**4998.021**	

5. National Wasteland Change Analysis 3rd Cycle



Previous cycles (2005-06 & 2008-09): The first exercise on National Wastelands Change Analysis has been executed at the behest of Dept. of Land Resources, Ministry of Rural Development.

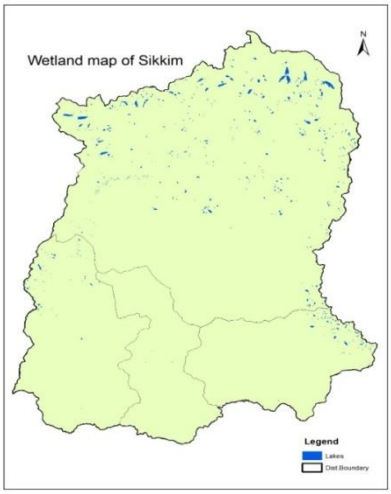
Satellite data: IRS LISS-3 (2005-06 & 2008-09)

In order to report the spatial changes in wastelands between 2008-09 and 2015-16, study was undertaken for Department of Land Resources GOI.

The final mapping is completed in the form of shape file using IRS LISS III Satellite Imagery and is submitted to funding agency i.e NRSC Hyderabad for final quality Check and publication

6. RS and GIS Mapping of Wetlands (Lakes & Rivers) of Sikkim

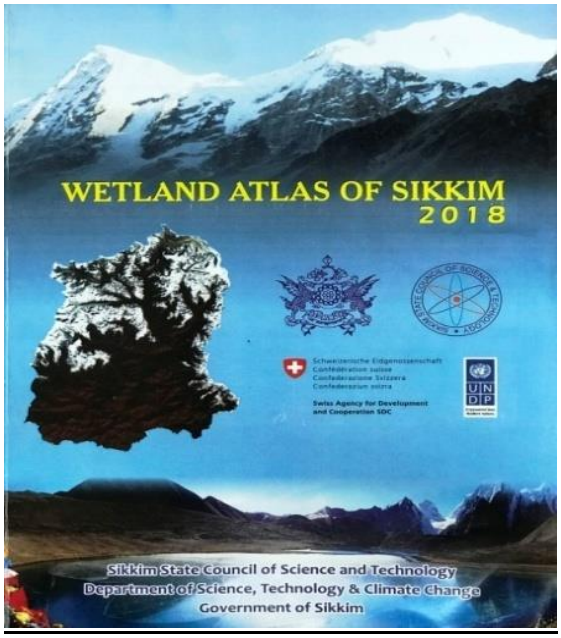
Wetlands are one of the world's most productive environments that provide the basic necessities for numerous species of plants and animals to survive. Using LISS-IV image of the year 2015-16 a total of **677** lakes have been identified, that covers an area of 3162 ha excluding rivers and small lakes below one hectare. The main objectives of the project are to **map the wetlands of Sikkim** using IRS LISS IV Satellite imageries following a standard wetland classification system as per National Wetland Atlas: India, 2011, creation of a seamless wetlands database of the states in GIS environment, etc. In Sikkim there are a total of **671** high altitude lakes. The remaining **6** are low altitude lakes. There are **102** rivers and streams in the state. The North District has the highest number of wetland, having **501** lakes. The West District has around **70** lakes and the East District has **103** lakes. The South district has the lowest wetland area, consisting of only **3** lakes.

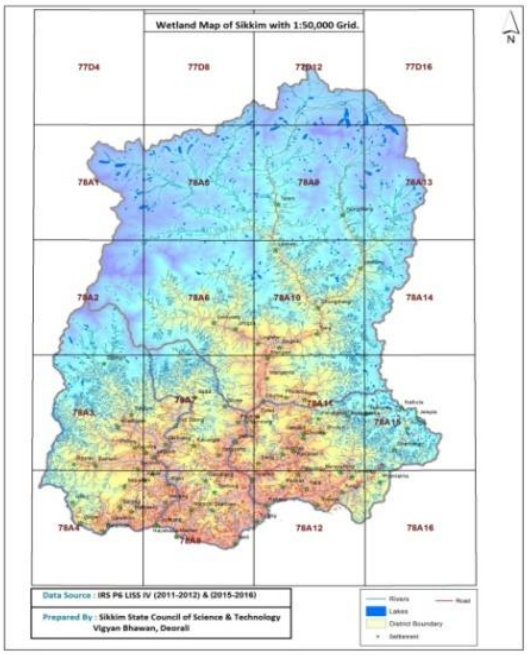


Publication of Wetland Atlas 2018

Sikkim is one of the glacier rich areas in Indian Himalaya and the world. Major portion of the state in North and West district is covered by glacial areas. Glacier being a storehouse of the fresh water, it provides perennial rivers system and forms an important natural resources of the state. Most of the glaciers throughout the world are melting very fast due to the impact of climate change and global warming. The monitoring of these glaciers is very important in order to know the impact of climate change. The Department of Science and Technology published a detail Glacier Atlas of Sikkim which provides a base for the glaciers study in Sikkim.

A book on "Wetland Atlas of Sikkim" was released on the occasion of State Day on 16th May, 2018 by Hon'ble Chief Minister, Shri. Pawan Chamling.





7. Vulnerability and Risk analysis of Geohazards in Himayan region

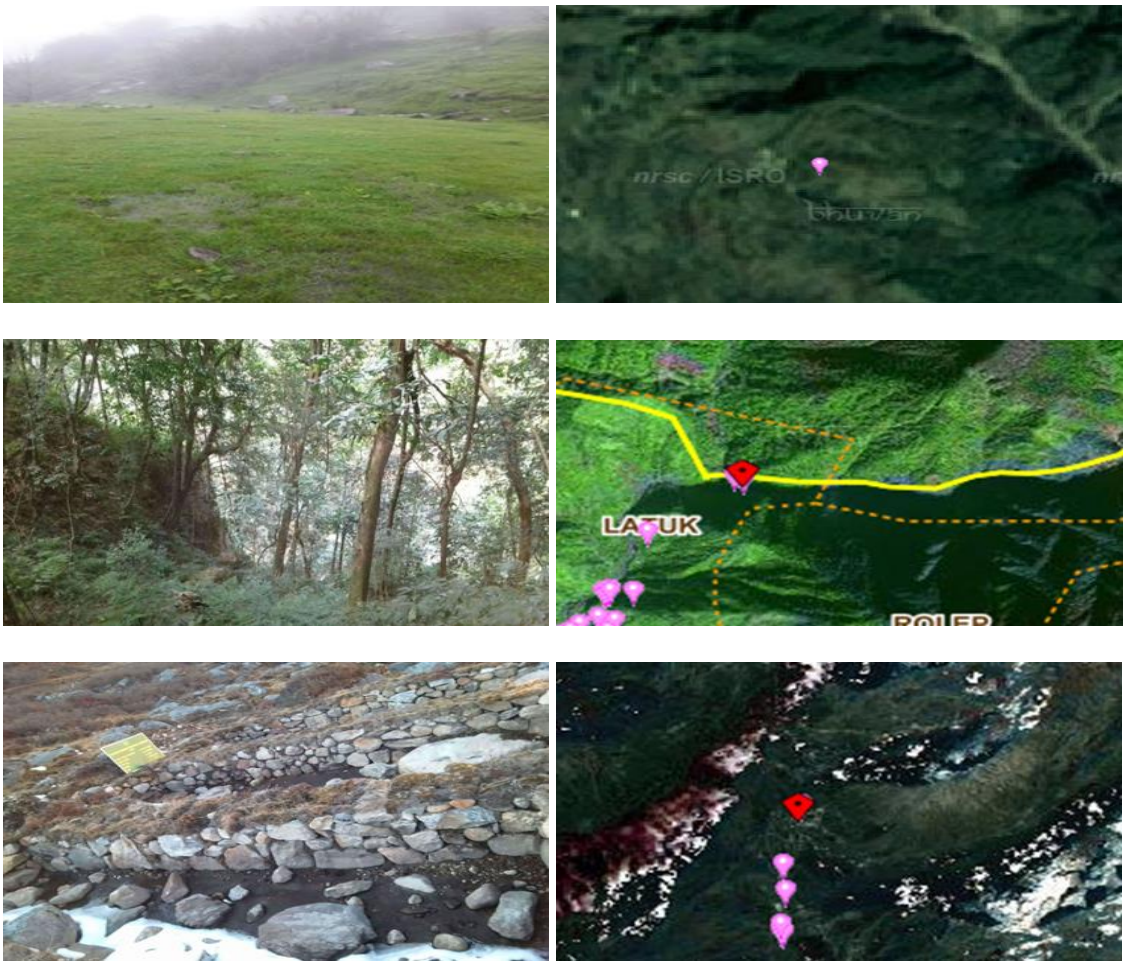
The project was funded by SAC, ISRO, Ahmedabad, Government of India, the main objective of the project is to map the vulnerable area for landslides and GLOF in Sikkim using the High resolution Satellite Imagery.

Mapping using the satellite Imagery is under progress, identification and mapping of landslide area of Sikkim using the Google Earth is in final stage.

8. Monitoring of Integrated Watershed Management Programme

The project envisages monitoring and evaluation of IWMP projects for the state of Sikkim. It has to be monitored for five (05) years. The work under this project includes processing of high resolution satellite data, correction of Watershed boundaries, and generation of LULC maps, NDVI maps and preparation of maps showing change detection in projects.

The project was taken over from the year 2017 and it is still ongoing.



9. Himalayan Aerosol Experiment at Sikkim:

Atmospheric aerosols, though are very small in size and share a small portion of the total atmospheric constituents, impart considerable influence on the Earth radiation budget, hence affecting the climate. Aerosol possesses varying physical, optical and chemical properties depending upon their production and transport pathways from distinct sources. In this context, the highest mountain plateau system in the world- the Himalayas and the Tibetan Plateau are very sensitive to climate change. These Mountain ranges are the world's natural water towers and provides water resources for millions of people. Recent studies indicate that long-range transport from the pollution hotspot of south Asia has significant influence on the seasonality in abundance, chemistry, spatial distribution of aerosols over the pristine high-altitude Himalayas. Hence with the aim of understanding the interaction of aerosol with climate change, a project title "Himalayan Aerosol Experiment @ SIKKIM" has been jointly started at Lachung, North Sikkim since August 2018 by Space Physics Laboratory, VSSC, Trivandrum, North Eastern Space Application Centre, NESAC, Shillong and (State Remote Sensing App. Centre) & Climate Change Cell Dept. of Science & Technology and Climate Change, Sikkim.

Fig: Monitoring the properties of Himalayan Aerosols

Scientific aspects

- To quantify the efficiency of aerosol radiation interaction at the eastern Himalayan site owing to their micro-physical and chemical properties
- To evaluate distinct source processes of aerosols (local and synoptic)
- To estimate the concentrations of Black Carbon/Dust/Water Insoluble Organic in Snow and quantify the impact on snow albedo

Achievement:

- A laboratory/station has been established at Lachung (27°41' 27.5" N and 88°44'35.6" E, 2653m a.m.s.l.) (Aug-Oct 2018)
- Installation of Aerosol monitoring Instruments: Aethalometer, Mictrotops sun-photometer, High volume sampler, Nephelometer, Aerodynamic particle size spectrometer(APS) and portable AWS (Oct-Nov, 2018)
- Monitoring, and data collection operation is being carried out till date.

10. Establishment of Sikkim State Climate Change Cell under NMSHE:

Sikkim State Climate Change Cell was established in October 2014 under Sikkim State Council of Science and Technology (SSCS&T). SSCS&T is engaged in fulfilling the needs and objectives of National Mission for Sustaining the Himalayan Ecosystem in Sikkim NMSHE. Sikkim State Climate Change Cell is working in this field since its establishment as according to the mandate given by NMSHE. Sikkim being located in the Himalayas is one of the vulnerable state in terms of climate change and its impact, there is an immense need to deal the climate change globally, at national level, state level and local level. There is a need to be aware about climate change and global warming to every individual so that there will be participation of maximum individual in fighting against the odds of climate change and its impacts.

Climate change cell

Sikkim State Council of Science and Technology under Department of Science and Technology is working on various aspects of climate change and its impact in Sikkim from last several years in the state. It is because of these initiatives Department of Science and Technology is notified as Department of Science and Technology and Climate Change in 2009 by Government of Sikkim and since then the Department is nodal in climate change activities in the state. However systematic studies in climate change in Sikkim initiated with the establishment of Climate Change Cell under Sikkim State Council of Science and Technology in October 2014. The Cell is working to fulfil the needs and objectives of National Mission for Sustaining the Himalayan Ecosystem in Sikkim one of the missions under National Action Plan on Climate Change, supported by Department of Science and Technology, Government of India one of the missions under National Action Plan on Climate Change, supported by Department of Science and Technology, Government of India.

Major Goals and Objectives of State Climate Change Cell

Broadly the major goals and objectives to be achieved are:

i. Vulnerability and Risk Assessment at Gram Panchyat Unit (GPU) and ward level: The state has total number of 176 GPU and 989 wards in its four district of Sikkim. Vulnerability and risk assessment provides level of vulnerability within GPU to prioritize the adaptation measures.
ii. Institutional Capacity building to attain the capability to handle climate change program and to find the solutions to address the problem of climate change in the state. To carry out Research and Development activities for data base generation as per the SAPCC and NMSHE requirements.
iii. Training programmes for stakeholders including Government officials, researchers, community based organizations, media etc in the state to work for the minimizing the effect of climate change in the state and to achieve the sustainable development.
iv. Involving masses to work for minimizing the impact of climate Change through awareness programme.
v. Research and Development activities

Operations and activities

A. Climate Vulnerability Assessment using common frame work in Indian Himalayan region (IHR):

Climate Vulnerability Assessment using a common framework has been carried out in all the IHR states where Sikkim has also taken the active part for bring out vulnerability profile of the State. The assessment was carried based on the latest IPCC (2014) framework. The most vulnerable district was identified as East District followed by west. For east district of Sikkim, high population density and higher slope were found to be the main drivers for the vulnerability.

B. Institutional Capacity Building :

The State Climate Change Cell under the State Council of Science and Technology has built the institutional capacity to carry out scientific interventions for Climate change with active support from the Department of Science and Technology, Government of India. The manpower of the Climate Change Cell is well trained in terms of carrying out Climate Vulnerability Assessment using latest IPPC Framework, field as well as remote sensing based assessment and monitoring of glaciers and glacial lakes including glacial lake outburst floods (GLOFs), Sectoral impacts of climate change etc. The capacities has been built up with the continuous support of Department of Science and Technology, Govt of India through different capacity building programmes like Vulnerability Assessment workshops for all the Himalayan States organised by IISc and IITs, Indo Swiss Capacity Building programme on Himalayan Glaciology (SDC-IHCAP-DST) and Field training Programme on Glaciology(GSI-DST), etc. Further, the officials are trained in constructions of Ice Stupa-artificial glaciers from SECMOL-Leh, with active support from United Nations Development Programme (UNDP) in the State. The kind of training programmes imparted has helped in building the institutional capacity of the State Climate Change Cell and Department as a whole.

Under Institutional Capacity building and R&D for data base/Information generation as per the SAPCC and NMSHE requirements following are the approved objectives of the project:

I. Glacier studies

- Glacier mass balance studies: Glacier Budget
- Glacier secular Movement studies-snout monitoring and glacial movement.
- Sub glacial studies-including internal structure of glaciers ice.
- Glacier Hydrology and Suspended Sediment Load.
- Meteorological studies: Air temperature, snow precipitation pattern, rainfall, evaporation rate etc are important meteorological parameters.
- Glacier inventory of Sikkim in every five years using satellite imageries
- Snow covers monitoring of Sikkim Himalaya yearly using AWiFS data.

II. Wetlands and GLOFs studies

- Inventory mapping of wetlands of Sikkim and its change detection.
- Identifications of drying lakes using geo informatics.
- Bathymetric analysis of potentially vulnerable lakes in terms of GLOFs.
- Geophysical investigation of moraine damming the lakes.
- Identification of vulnerable areas in case of GLOFs and river foods.

III. Agriculture and human health

- Study of climate change impacts on agricultural and other cash crops.
- Impact of climate change on human health.

IV. Biodiversity and Ecotourism

- Study of impact of climate change on tree line dynamics.
- Study of forest fire prone areas and its mapping
- Mapping of ecotourism sites and present status.

V. Study of Landslide Prone areas of Sikkim

- Mapping of landslides
- Hazard zonation

C. Climate Change Awareness and community participations.

The Sikkim State Climate Change Cell conducted Climate Change awareness programme in 22 Block Administrative Centres (BACs) in 4 districts of Sikkim. The programme was linked withNational Science Day 2015 on the Theme of “Science for Nation Building” organized by Sikkim State Council of Science and Technology. Almost 500 people including Panchayat members, NGOs, Self Help groups, staffs of BAC and students and general public were sensitized on Climate Change. The response of the participants was very impressive and most of them suggested carrying out more programme in upcoming days. So far awareness programme are carried out in Educational institutions, State Science Centre and Block Administrative Centres.

- **Mitigation of GLOF in South Lhonak lake:**

South Lhonak glacial lake, located in the extreme North-western parts of Sikkim, one of the fastest growing lakes in Sikkim is being monitored by Climate Change cell . The lake formed right at the snout of the glacier is located in the geographical coordinates of 27^0 54' 56.7" N and 88^0 12' 33.7" E at an altitude of 5201m. The analysis of satellite imagery revealed that the lake is growing very fast. 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. 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).

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 studies of the lake.

Scientific team of DST&CC, Sikkim first visited South Lhonak Lake in April' 2012, with support from CDAC. It was then identified that South Lhonak was one of the potentially vulnerable lakes in Sikkim in terms of GLOFs. Thereafter, DST&CC Sikkim requested DST Govt. of India for a working group. To further study the South Lhonak Lake, again in Aug'2014 with support from Govt. of India, DST&CC Sikkim made second visit to the lake for bathymetric study and electrical resistivity of moraines. After these analyses some short and long term Mitigation approaches were suggested by working group. Siphoning as one of the major Mitigation approach was executed; a Lake Water Monitoring System has also been installed in the third expedition to South Lhonak Lake in August 2016 with the help and support of Land Revenue and Disaster Management Department and SECMOL, Ladakh.

The Scientific team of DST and CC along with the team from line department again visited to South Lhonak Lake in 2018 for scientific study and to plan more mitigation work in terms of GLOF two team member Dr. N.P Sharma, Assistant Scientific Officer, DST Sikkim and Mr Tashi from SACMOL Ladhak also visited North Lhonak Lake to study the intensity of risk in terms of GLOF from North Lhonak Lake.

The Scientific teams including Geologist suggested to widening the outlet of South Lhonak Lake.

First Field visit to Changsang Glacial Lake for Scientific Studies

DST, GOI under National Network on Climate Change and Himalayan Cryosphere has sought a detailed full proposal on study of Changsang Glacier in North Sikkim from Sikkim State Climate Change Cell. In view of this, the State Climate Change Cell has visited Changsang Glacier in July 2018 in order to understand the field feasibility of the study prior to the submission of the final proposal to DST, GOI. Changsang Glacial Lake is one of the fastest

growing lake in Sikkim Himalaya. The exploration of past satellite images suggested that the existing glacial lake was almost not there till 1990. The lake started formation after 1990 and at present the length of the lake is more than 1.5 km long and about 0.5 km average wide and already attained the area coverage of more than 70 hectares.

Following Point has been noted:

The base camp of the glacier can be reached in three days trek from the nearest road located at Thangu Village near Kalapathar in North Sikkim. It take four days journey from Gangtok to Glacier base camp, one full days by road and another three days by trek. It takes another 2-3 hours to reach the snout of the glacier from the base camp of the glacier.

The trekking trail up to base camp site located at altitude around 5200 meters of the glacier is approachable with slope varies from steep slope in the first day of the track to gentle slope in the next two days trek. However, the trekking trail above 5300 meters which is composed of terminal moraine of the glacier is very difficult to cross with the head load and the equipment of the glacier study. The trek path leading to the glacier above terminal moraines is very difficult composed with numerous boulders which make it very difficult to cross the section. Further, the effects of the high altitude were clear due to the difficulty in breathing and headache to the visiting team members. In East Rathong Glacier, the study team of State Council is working in areas below 5000 meters.

After crossing the terminal moraine, the area is covered with glacial lake at the elevation of 5400meters. The glacier is approachable from the northern side of the glacial lake and the southern side of the lake is very narrow and steep. The area is also very difficult in certain sections of the lake.

The glacial lake is very active and in near future the approachable trekking trail leading to the glacier will come under the area of the lake. So in near future may be in next two-three years the glacier will not be approachable from the existing portion of the glacial lake.

The glacier is not approachable from the base camp located in the area below the glacial lake. The study team needs to cover almost 7-8 km from the snout of the lake to accumulation area of the glacier which is almost not possible to carry out at such altitude. As such, at least two camps need to be setup in the area above the snout of the glacier. The camping site is almost not available in the area above the snout area due to undulating surface moraines. Further camping site at higher altitude may pose the threat to the visiting study team.

The accumulation area of the glacier has number of avalanches site which increases the risk to the life.

Elevation wise, the glacier is located at very high altitude which posed one of the important hurdles to carry out the studies in the glacier. Comparing the other glacier in the Central and the Western Himalaya which are under study, the Changsang glacier in Sikkim is located at higher locations. For example the upper accumulation area of Gangotri glacier located at the altitude of 5300-5600 meters, 4800 meters in Chota Shigri glacier, even in the case of Siachen glacier the upper accumulation located at the altitude of 5500 meters to 5800 meters.

However, in case of Changsang glacier the snout of the glacier is located at the altitude of 5450 meters which is highly elevated location.

The exploration of past satellite images suggested that the existing glacial lake was almost not there till 1990. The lake started formation after 1990 and at present the lake has attained huge size. At present the length of the lake is more than 1.5 km long and about 0.5 km average wide and already attained the area coverage of more than 70 hectares. The lake as mentioned is very active and it is encroaches the moraines around the lake. The area at the lower side of the lake is also very active and the water is seen percolating very heavily from the lateral moraines. Though the lake has clear outlet but water from the lake passes through gentle surface meandering in the lower side of the lake. Erosion from the lake is very high. The lake in compare with the South Lhonak lake is very active and in much younger stage of formation. So the threat in the lake is much higher in the lake than the South Lhonak Lake.

11. The Long Term Monitoring of "Study on Glacier Dynamics of East Rathong Glacier:

East Rathong Glacier is one of the most important glaciers in Eastern Himalaya as being a source of River Rangit, which is the largest tributary of Teesta River. **The long term monitoring of "Study on Glacier Dynamics of East Rathong Glacier"** was sanctioned by SERB, DST-GoI in the year 2017, with the approved objectives are glacier secular Movement studies-snout monitoring and glacial movement, glacier Hydrometry including discharge and suspended sediments of East Rathong melt water stream, glacier vertical thinning and ablation, glacier Meteorology: temperature, humidity, snow precipitation pattern, rainfall, evaporation rate etc are important meteorological parameters, Glacier inventory of Sikkim in every five years using satellite imageries. Snow covers monitoring of East Rathong Catchment yearly using AWiFs data. The approved research objectives will achieved through the adopted of the set methodology.

Summary of Progress: The long term monitoring of " study on glacier dynamics of East Rathong Glacier" was sanctioned by SERB, DST-GoI in the year 2017 with the approved objectives viz. temperature indexed modeling, geodetic mass balance using DEMs, glacier hydrology, ablation measurements and vertical thinning, glacier surface velocity, snout monitoring etc. In this context, the study team have visited East Rathong glacier since 2017. The team consists of scientists form the concern department, watch and ward staff, cook and porter from the Yuksam. The major objectives of the expedition included Stakes installation for the vertical melting studies and glacier velocity study, Initiation of Hydrological study comprising discharge measurement and suspended sediment study, Snout monitoring of the glacier, Retrieving of Automatic Weather Station Data. The discharge has been calculated and sediment data are in the processed in the lab and data analysis has completed and included in the progress report and monitoring report too. The post processing of data pertaining to DGPS measurements of stakes for glacial movement has been processed. The sanctioned instruments are procured.

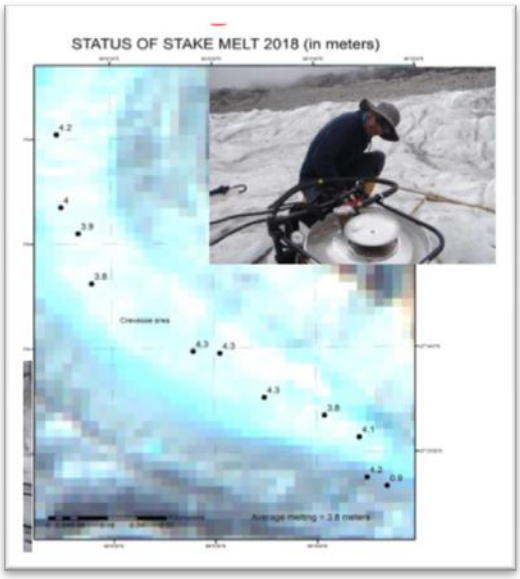
I. ABLATION MEASUREMENTS AND VERTICAL THINNING:
This includes the installation of bamboo stakes, seasonal measurement of installed stakes with DGPS and measurement of exposed height of the stakes to quantify the vertical thinning.
II. GLACIER VELOCITY:
Monitoring of stakes at the end of ablation session in the fields and calculating the displacement movement of stakes with DGPS coordinates in the lab.
III. SNOUT MONITORING
Snout monitoring by making permanent monitoring site with the help of Differential GPS (with X, Y and Z coordinates) near snout and also to generate retreat of the snout every year.
IV. HYDROLOGY
Discharge Measurements/Hydrometry: We have constructed a Hydrological site at about 0.8 km downstream of the snout of East Rathong Glacier, where discharge measurements are being carried out of cross section of stream is being monitored thrice during the ablation session in the field. Float method is used for velocity measurements and discharge Suspended Sediments: In the hydrological site, 500 ml water sample is taken 4 times a day for the suspended sediment analysis. The sample filtered through Whatman filter paper (ash less) and kept in incubator (Sci.

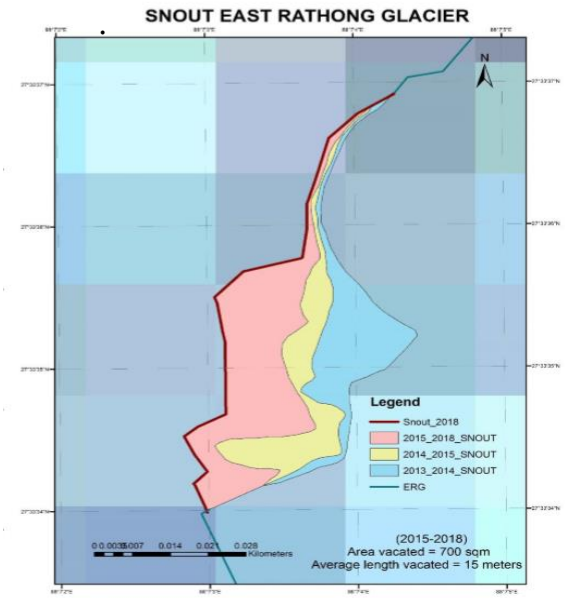
oven) and left drying for 24 hours. The net weight isw considered as suspended sediment concentration (SSC) (in mg/liter). The SSC in terms of daily discharge is again considered as Suspended sediment load (SSL) expressed in tons per day.

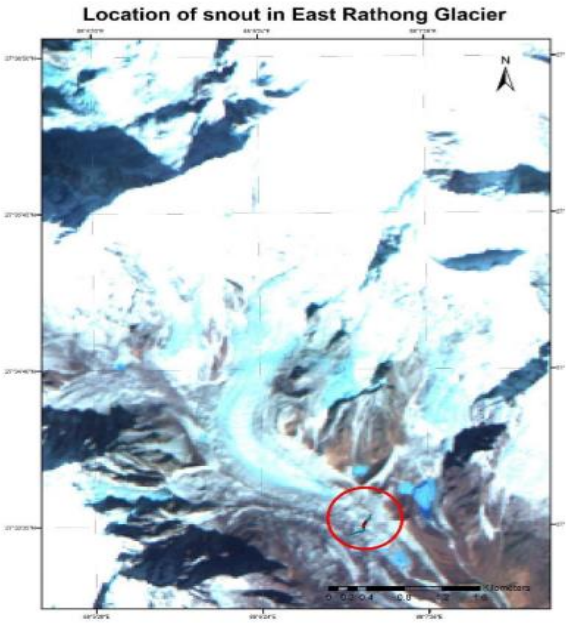
Abalation measurement and vertical thinning

2017: Overall vertical thinning: 3m, Debris cover: 2.5m, Clean ice: 3.1m

2018: Overall vertical thinning: 3.8m, Debris cover: 2.5m, Clean ice: 4.1m.







Construction of Hyderology Site of Below East Rathong Glacier

Salient Research Achievements:

- The average rainfall during the season 2017 and 2018 were 9.50 and 11.77 mm respectively. Overall, 52% of rainfall occurred during the night time.
- The average horizontal surface velocity during ablation season June 2018 to September 2018 was 4.16 m.
- Snout area of the glacier vacated in between 2015 and 2018 was 700sqm and average length vacated was 15m.
- The average daily discharge of East Rathong glacier was 4.9 and 4.8m^3s^{-1} for the ablation season 2017-2018.

Installation of stakes for the vertical melting studies and glacier velocity study

Stakes were fixed in the glacier in order to measure the vertical melting of the glacier as well as to know the rate of movement or flow of the glacier. The bamboo stakes were installed in the glacier.

Overall vertical melting in 2017 was 3m, in debris covered glacier the vertical melting was 2.7 and in the clean ice it is 3.1m while in 2018 the vertical melting is relatively high as compare to 2017. The overall vertical melting was 3.8m, in debris covered glacier the melting was 2.5m which is relatively low as compared to 2017 and in the clean ice it is 4.1m.

The maximum horizontal surface velocity during ablation season June 2018 to September 2018 in (my^{-1}), the maximum horizontal surface velocity 7.28 (elevation 4800m), minimum horizontal surface velocity is 0.6 (elevation 4644m), minimum vertical component of velocity is 14.28 (elevation 4644) and average surface velocity 4.16 m.

Snout Monitoring 2015-2018

Area vacated in between 2015 and 2018 was 700sqm and average length vacated was 15 metre. The figure above represent the significant result of snout monitoring of glacier using DGPS

12. Demonstration of Ice Stupa (Artificial Glacier) in Sikkim

Ice Stupa is an innovative technique for making artificial glacier which resemble the Stupa, a Buddhist monument in cone shape. In this technique the water from height bring down to a specific location through pipes and it makes sprinkles from the top of the cones, resembling the water fountain in temperature of -10 to -30 degree centigrade which usually reaches in winter season in high altitude areas. The water sprinkle when it come in contact with the freezing air it freezes and in the course of time it piles up to form giant Ice Stupa. The amount of stored water depends on the height and volume of the Stupa. Later in the lean season, the water starts melting and the melt water can be used for irrigation and drinking purposes. Usually in the months between March-May there will be crises of water in most of the Himalayan states including Sikkim due to the less or no rainfall during winter. Spring usually dries up or can fetch less water due to the less winter rainfall. So, Ice Stupa is a natural water conservation technique in high Himalayas in the air in the form of Ice for the use in water crises months.

There are three types of ice stupa artificial glaciers which were made in Leh, Ladakh in the state of Jammu & Kashmir by Er. Sonam Wangchuk and his team, - one is the conical Ice Stupa form, the other is egg tray structured Ice Stupa which can be made in multiple numbers in one place which joins one another to form a sheet of ice. It can be developed along the glacier area to check the retreat of glacier which can be a very important adaptation to reduce glacier melting in the context of climate change. The third one is horizontal form of artificial glacier which can be develop along the stream in high altitude area by constructing multiple terrace structure supported by retaining wall one above another. The horizontal Ice Stupa was conceptualized and developed by Mr. Chewang Norphel a retired Civil Engineer in Jammu Kashmir Government.

The winter rain is gradually decreasing over the years in Sikkim which is considered as one of the impacts of climate change. In coming days, it is predicted that there will be severe shortage of water during winter especially during the months of March-May due to the decreasing winter rain. The problem will be more during these months because the water table recharged during monsoon season will be dried up or come down heavily till those months. In this context Artificial glacier can be seen as one of the unique methods to revive the drying stream to meet out the water needs in the downstream areas. The successful implementation of artificial glacier techniques going to be effective adaptive measures to meet the water crises in the Himalaya during the water shortage months of March to May and it is also hoping to boost the tourism industry in the state.

In this context, Department of Science and Technology with the support of UNDP has been planning to carry out small scale experimental Ice Stupa Project in Sikkim in the winter months of 2018-19. Though the Ice Stupa is a proven technology in Trans Himalayan areas of Ladakh but it needs to be tested in the existing climatic condition in Sikkim in Eastern Himalayas. The major objective of the experimental Ice Stupa project will be to test the freezing condition of water in the prevailing climatic condition in the winter months in Sikkim.

Objectives

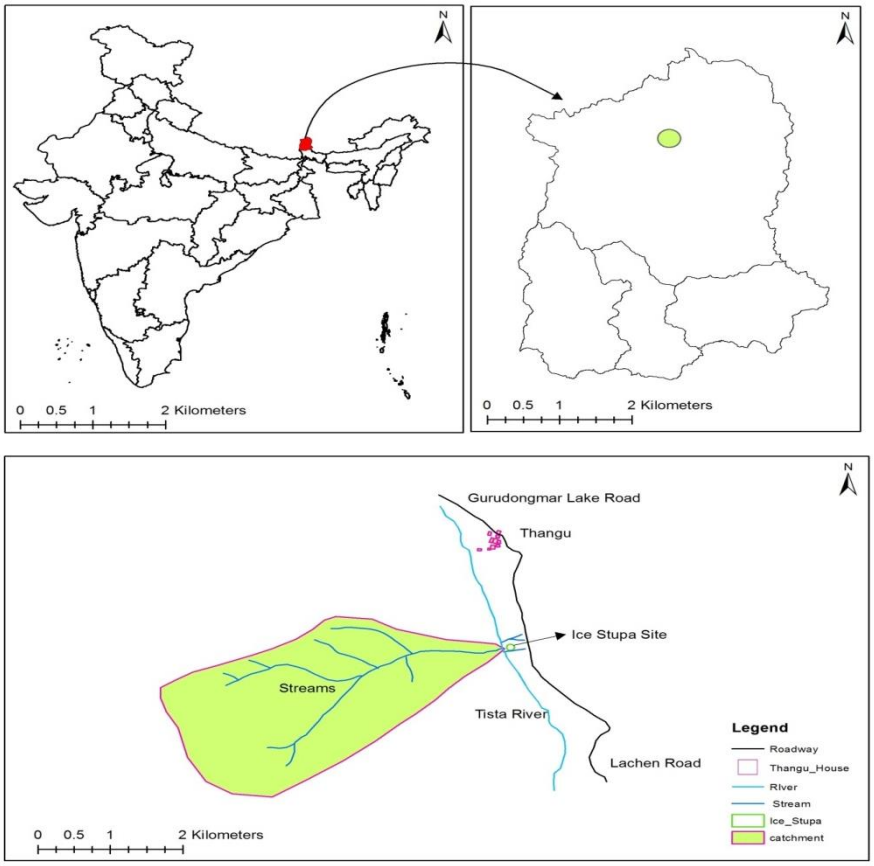
The objective of the experimental Ice Stupa project are -

To test the freezing condition of water in the prevailing climatic condition in the winter months in Sikkim. Both sprinkle dome shape Ice stupa and Egg Tray type of Ice Stupas will be tried in this experimental project. The success of the project will help to find out the new way of conserving water and thereby solving water scarcity in Sikkim in selected areas and more importantly to reduce glacier melting as an adaptation action to climate change threat.

The other major objective of the project is to develop Ice Stupa as an attraction for tourist visiting the state to promote tourism activities. It will also help for promotion of eco-tourism activities and thereby generation of income for the local people and thus help in adapting the impact of climate change in high altitude areas.

Location of the Project site

The proposed project site is located in, Thangu, North Sikkim (below Kalapathar) at the altitude of3808 m meters above mean sea level.



The Selected Site has its following merits:

1. Gradient Slope.
2. Nearby Water source and Reservoir.
3. Closer to road connectivity.
4. Enough area available for making Dome Structure.
5. Local Manpower to handle and look for Ice Stupa.
6. Useful for Tourism.

Methodology:

- Perennial stream has been identified so that the flow of water will be there in the stream even during the extreme winter.
- Water from the stream is piped to the location of Ice Stupa site from uphill area (roughly 250 meters) so that enough head can be achieved to attain the height of Stupa.
- Area with higher slope gradient is preferred so that the water inside the pipe may not be frozen while flowing down to the site from intake point. Higher gradient provides higher pressure of water inside the pipeline which prevents water from freezing.
- In addition, the exposed pipeline will be covered from outside by thin sheet of Insulator which maintains require heat within pipeline to combat the freezing.
- At the end of the pipeline, a pipe will be attached vertically and the height of the pipe will depend on available head of the pipeline. The vertical pipe will be installed properly in a leveled position so that outflow water passes from all the side equally.
- The outflow water when come in contact with freezing temperature outside tend to freeze slowly to form ice stupa. Sprinkle may be used to break the water into the small droplets to enhance/accelerate freezing.

Making of an Ice Stupa in Thangu Valley, Sikkim Himalaya

It was in November 2018, the team from Sikkim State Climate Change Cell attended 3 (three) days Hand on training on making of Ice stupa in Phyang Village, Leh Ladakh. After successful completion of training, the team has identified the suitable location to build Ice Stupa. The site is selected about 1 km below Thangu village, North Sikkim.

After receiving of HDPE pipes, the team started building the foundation and structural components at the selected site from Jan 05, 2019. The principle behind the formation of ice in the selected site is the breaking of water droplets from sprinkle system to small nuclei which gets frozen when it comes in contact with open freezing environment that accumulates to give structure of the cone.

Fig. Stepwise detail photographs in making of Ice Stupa at the site

Attributes and Characteristics of Ice Stupa

1. Elevation: 3808 m
2. Water flow: HDPE Pipes (75 mm) and GI Pipes (50 mm)
3. Tripod: Made of GI pipes (50 mm)
4. Structural design and bracketing Ice stupa: Bamboo
5. Binding materials: Bamboo stripes (*Choya*) and binding wires
6. Diameter of Foundation: 15 feet

7. Max height of Interior: 11 feet
8. Nature of design: Used maximum of bamboo materials to designed the structure eco-friendly
9. Distance from the water Source: 270 meters
10. Slope from Ice stupa to Water Source : ~30^0
11. Flow control System: Gate Valve
12. Sprinkle system.

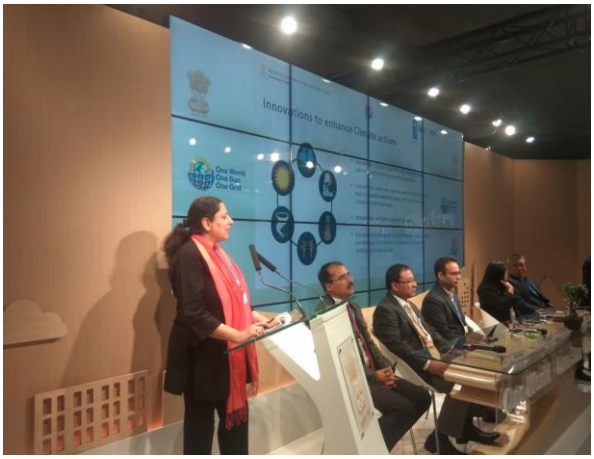
Department of Science and Technology Government of Sikkim successfully developed a prototype of Ice Stupa at Thangu, North Sikkim in the winter month of 2018-2019 with the support of UNDP. Though the project initiated quite late in the winter season of 2018-2019, but the output of the project was quite successful and it encouraged going ahead with further deep into the project in Sikkim.

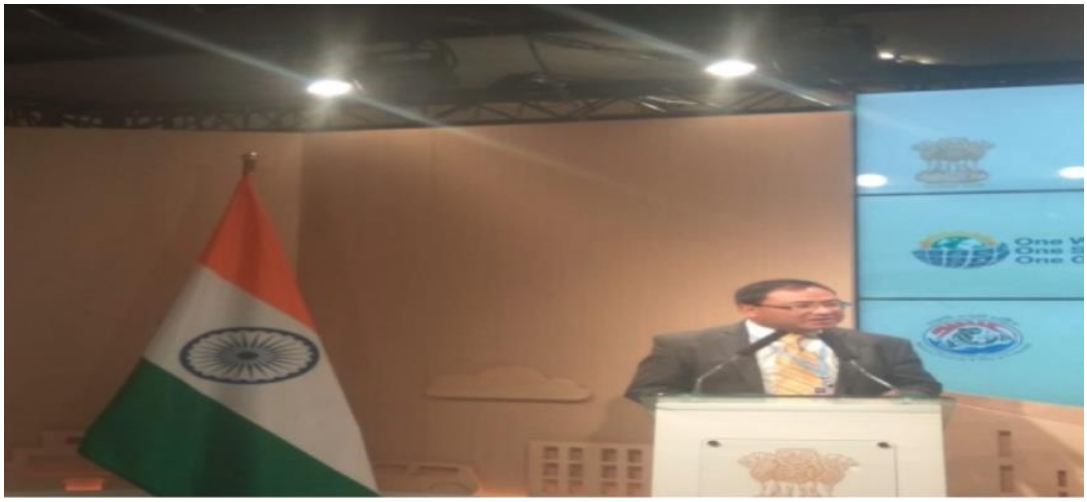
The success of this prototype in Sikkim has encouraged us to go to the next higher level with bigger mandate of reglaciation of glacier. Likewise in other areas, glacier retreat being a major issue in Sikkim Himalaya, an effort has been made to take the *ice stupa* to a next level for the reglaciation of some portion of the selected glacier which is a prime need of the present times.

Other Activities

Participation in COP 24, Katowice, Poland

The United Nations Climate Change Conferences are yearly conferences held in the framework of the United Nations Framework Convention on Climate Change (UNFCCC). The COP is the supreme decision-making body of the Convention. A key task for the COP is to review the national communications and emission inventories submitted by member countries of UNO which is referred as Parties. Mr D.G Shrestha from Department of Science, Technology & Climate Change and Ms Sarika Pradhan from Rural Management and Development Department were among the Indian delegates in COP 24 held at Katowice, Poland from 3-24 December 2018 where they presented the climate change initiatives taken up in Sikkim.





Participation in Climate Vulnerability Assessment for the Indian Himalayan Region

Realizing the high vulnerability of Indian Himalayan Region(IHR) with respect to climate change, Government of India launched the National Mission for Sustaining Himalayan Ecosystem(NMSHE). One of the key areas identified by NMSHE is to build capacities of the 12 IHR states for robust assessments of climate change vulnerability, adaptation planning and implementation. Sikkim being one of the Himalayan state, the Sikkim State Climate Change Cell actively participated in the series of training and capacity building programme organized by Indian Institute of Science, Banglore, Indian Institute of Technology, Guwhati and Indian Institute of Technology, Mandi. The assessment exercise carried out in the whole programme is unique because for the first time all the 12 Himalayan states have used a common framework, resulting in the production of comparable vulnerability among these states.

Awareness programme on Climate Change

Awareness programme on climate change is one of the important objectives of State Climate Change Cell. Climate change being a reality, awareness of the masses on the subject is very necessary. To fulfill this objective, the State Climate Change Cell has taken up number of climate change awareness programme in Sikkim. So far the State Cell have successfully

completed awareness programme in all Block Administrative Centers (BACs), more than 40 Schools, District

Institute of Education Training (DIET) in East District ect. Further such programme is being taken up by publication and distribution of pamphlets etc.

Installation of Automatic Weather Stations (AWS) in Sikkim

Sikkim witnesses a sharp variation in micro climatic condition due to its physical setting and high altitude variation. In order to understand this micro climatic variations at local level about 15 AWS has been installed in the different location of Sikkim. In long run, it will also help in understanding the impact of climate change at local level in Sikkim.

Capacity building of manpower of DST&CC on Climate Change activities:

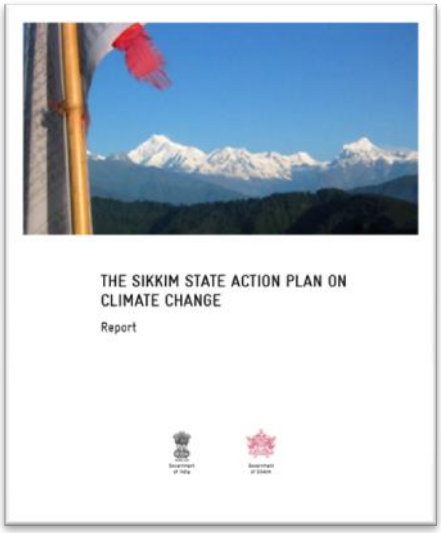
1. Field Training on Glaciology at Hamtah Glacier and Manali, Himachal Pradesh in August 2012
2. Level-I theorotical training programme on glaciology at Jawaharlal Nehru University in March 2013 under Indian Himalayan Climate Adaptation Programme (IHCAP) of Swiss Development Cooperation (SDC).
3. Level-II field based training programme on glaciology at Chota Shigri Glacier, Himachal Pradesh in July 2013
4. Training programme on climate modeling and climate change research, innovation and services at Jawaharlal Nehru University in April 2015
5. Vulnerability Assessment training on climate Change at Indian Institute of Science, Bangalore in March 2017.

6. Capacity building strategies for managing complex disaster in the face of climate change by Indian Institute of Public Administration, New Delhi at Gangtok in January 2018
7. Need Assessment Workshop on Vulnerability Assessment at IIT Guwhati 2018
8. Methodology Workshop on Vulnerability Assessment at IIT Guwhati in 2018
9. Training on development of *Ice Stupa* at Leh Ladakh November 2018
10. Write-shop on Proposal on NAPCC Funding at Guwhati 2018
11. Write-shop on project formulation-climate change mitigation and adaptation under Green Climate Fund(GCF) in October 2018

List of Activities in Colloboration with GIZ CCA-NER project

Development and Publication of State Action Plan on Climate Change- Sikkim

Department of Science and Technology and Climate Change, Government of Sikkim with technical support from GIZ CCA-NER has developed State Action Plan on Climate Change which was launched in 2015 and now the review of the State Action Plan on Climate Change is under progress. It is expected to complete the revision work by the end of this year.



Workshop on State Action Plan on Climate Change: Implementation and Revision:

A one day Workshop was held at Hotel Summit Denzong, Gangtok Sikkim on 27th March 2019. The main motive of the workshop was to make a revision and to make implementation on State Action Plan on Climate Change by bringing together multiple line Departments and Nodal Officer involved on Sikkim Climate Change issue. The objective of the program was to understand latest scientific developments in climate change, there problems and to find solution according to it.

The session was graced by Chief Secretary of Sikkim, and heads of UNDP, GIZ and other Organization. The task of further furnishing State Action Plan on Climate Change:

Implementation and Revision has been given to CITRAN, Orissa. The meeting had presentation, brain storming session etc overall the programme was a success.

Water conservation through participatory planning and recharge of drying natural springs in South Sikkim, Sikkim:

Rural Management and Development Department, Government of Sikkim, Department of Science and Technology and Climate Change, Government of Sikkim, with technical support from Climate Change Adaptation North Eastern Region (CCA-NER), of GIZ has profoundly works on conservation of drying off natural springs by implementing artificial rain water harvesting structures in the targeted recharge zone identified on the basis of scientific hydro geological studies at Tendong Hill, South Sikkim followed by water security plan preparation of the villages located around the Tendong Hill.

Fig1: springs during lean season

Fig 2: village water resource map of kitam GPU

Total 15 village water security plan was technical supported by GIZ, training was provided to the government functionaries and now it has became the independent program which is solemnly adapted by the Rural Management and Development Department.

Oak forest rehabilitation through direct seeding method

Forests, Environment and Wildlife Management Department, Government of Sikkim, Department of Science and Technology and Climate Change with technical support from Climate Change Adaptation North Eastern Region (CCA-NER) of GIZ is working on rehabilitation of Oak forest of Sikkim to assist poor natural germination by implementing artificial direct seeding method. Currently eight plots located in the various parts of Sikkim is under observation to understand the performance of the direct seeding in varied climatic conditions. The result of first observation is encouraging. Regular scientific monitoring is in progress in partnership with the local NGO Khanchendzonga Consrvation Committee (KCC), based in Yuksam. Furthermore, mapping of Oak forest of Sikkim and climate modelling of Oak forest of Sikkim with respect to global climate changing scenarios.

Conservation of native bees *Apis Cerena*

Department of Science and Technology and Climate Change, Horticulture and Cash Crop Development Department, Government of Sikkim, with technical support from Climate Change Adaptation North Eastern Region (CCA-NER) of GIZ is working on conservation of native honey bees *Apis Ceren* for biodiversity conservation through pollination and food, nutrition and livelihood security of beekeepers by providing technical skill to them on modern beekeeping techniques and introducing low cost climate resilient clay hives. Seven batches of training on modern beekeeping techniques was organized in Sorak Sampany GPU, South Sikkim in partnership with State Institute of Rural Development, Sikkim. Exposure visit, and study tour was organized by GIZ for selected beekeepers and government functionaries in Dr YSP university in Himachal Pradesh.

Fig: skill upgradation training for carpenters for fabrication of modern scientific bee box Supported by GIZ

Innovation in weaving techniques in the handloom

Department of Science and Technology and Climate Change, Directorate of Handloom and Handicraft, Government of Sikkim with technical support from Climate Change Adaptation North Eastern Region (CCA-NER) of GIZ is working on introduction of new low cost, user friendly, cost optimized loom called Flying8 Loom developed by the German expert. Two months long master trainer training was held in Meghalaya where one participant from Sikkim has undergone for the training. 14 days long loom building training was supported for skill up gradation of carpenters of Directorate of Handloom and Handicraft in Sikkim followed by 50 days long training for wavers was supported for 10 weavers of Sikkim to use flying8 loom. The activities were supported by GIZ. Trainer was invited from Germany and Meghalaya with the support from master trainer from Directorate of Handloom and Handicraft, Government of Sikkim.

Organized the International Conference on Cryosphere:

The Conference was held at Chintan Bhawan Gangtok Sikkim w.e.f 19th February to 20th February 2018. The main objective of the conference was to "bring together a synergy of scientists, policy makers, students and local communities on one platform, to understand latest scientific developments in glaciology and perceive the local communities problems and needs". During the International Conference there were 4 Key note talk from distinguished Scientists, from National and International Organizations. Altogether there were 34 oral presentations on different theme and around 22 Poster presentations.

Participation in the World Mountain Forum 2018 "Mountains in a Changing World:

Strengthening Partnerships and Pathways towards a Thriving Mountain Future", was held at Kyrgyzstan on October 23-26, 2018. Government of Sikkim was a special invitee to the event to share experiences and learnings on Pilot Project on Reducing Risks and Vulnerabilities due to Glacial Lake Outburst Flood (GLOF) at South Lhonak Lake at North Sikkim. Sikkim Government was represented by Mr. Rinzing Chewang Bhutia, Special Secretary, Land Revenue & Disaster Management Department, Mr. Dhirendra Gopal Shrestha, Additional Director, Department of Science & Technology and Climate Change and Mr. Keshav Koirala, Technical Expert, Disaster Risk Reduction, United Nations Development Programme.

Shri. D. G. Shrestha spoke about the vulnerability of South Lhonak Lake to GLOF. He explained the work done by Remote Sensing Centre under Sikkim State Council for Climate Change in researching and monitoring the glacial lakes of Sikkim.

COLABORATIVE PROGRAMME WITH UNDP/SDC

Strengthening State Strategies for Climate Actions under UNDP

Capacities of state authorities to plan and implement SAPCCs enhanced in the three states

Sensitization of Government officials from State Nodal Agency and other sectoral departments on climate change impacts, vulnerabilities and adaptation planning is a continuous process in the three project States. Specifically, the following activities were initiated/completed this year.

Training of Trainers: Following the detailed Training Needs Assessment(of technical and functional capacities) of State Nodal Agency and sectoral departments, specific training modules for mainstreaming adaptation planning and implementation have been developed for the three States. This was followed by intensive training of trainers with an aim to institutionalize the trainings in respective States.

a. Water: Water sector was identified as one of the most vulnerable sectors in all 3 states and training module on *Climate change Impacts, Vulnerability and Adaptation Planning in Water Sector* in the context of Madhya Pradesh, Sikkim and Uttarakhand was developed. The

module was customized especially for the hill states suiting the geographical context and water resources with emphasis on springshed conservation, and ecosystem services. Further, as part of the capacity building plan, training of trainers programmes for all the three States were organized and delivered. Participants from Uttarakhand (6) and Madhya Pradesh (14) were trained at EPCO, MP and for Sikkim participants (12), the ToT training was organized at Gangtok itself.

b. Forests: The forestry sector was identified as vulnerable in the Himalayan States of Sikkim and Uttarakhand. For these two States, a training module on Climate Change Impacts, Vulnerability and Adaptation Planning in Forestry Sector for Himalayan States (Uttarakhand and Sikkim) was developed. A training of trainers (ToT) was organized for Sikkim and Uttarakhand participants in one of the premier forestry institutions in the country – Indian Institute of Forest Management (IIFM), Bhopal. A total of 13 participants were trained during the 5 days training session. IIFM Bhopal would also use this module for further trainings on climate change.

c. Disaster Risk Reduction: For the States of Sikkim and Uttarakhand, mainstreaming of disaster risk reduction and climate change concerns into developmental planning was identified as an important need. The training module Disaster Risk Reduction and Mainstreaming Climate Actions into DRR Planning was developed and ToTs delivered for the officials of two States. This Tot was organized at Administrative Training Institute (ATI) Nainital, Uttarakhand. This ATI is already providing trainings in disaster risk reduction through DOPT programs and has agreed to integrate the module in their training curriculum for Uttarakhand. A total of 18 participants from the two States attended the 3 days training programme.

d. Climate Finance: Accessing global and national funds for climate change adaptation activities was identified as an area that required support and awareness – by all the three States. Specific module on accessing global and national climate change finance through various schemes and programmes was developed and ToT was delivered to officials in all three States.

Some of the other training and capacity building programmes for specific State Government Departments in the three States are:

Stakeholder consultation on Developing a Monitoring Framework for SAPCC organized by SNA, UNDP and Helvetas in April 2018

Regional Workshop on Mainstreaming Climate Risk in Disaster Risk Reduction with special reference to GLOF and Forest Fire in May 2018 with participation of experts and scientists from Nepal, Bhutan & North Eastern states.

Awareness and Sensitization with Capacity Building Programme jointly with UNDP

- Organized in 6 downstream locations of South Lhonak Glacial Lake in the months of April and May and recce mission roundtable on GLOF mitigation
- Training needs assessment (TNA) conducted by KMPG for all relevant Sikkim department**s**
- 8-day Training-cum-exposure visit on "Water Conservation and Management in the High Himalayas" conducted for 12 Sikkim government officials in SECMOL, Ladakh.
- Orientation workshop on "Climate Change Vulnerability and Risk Assessments in Sikkim" conducted for Sikkim government officials with Dr. N H Ravindranath, IISc.
- Capacity building workshop on "Conducting Vulnerability and Risk Assessment in Sikkim" conducted for Sikkim government officials.
- 4-day "Livelihood Training on Apiculture for Climate-Resilient Rural Development"

SAPCCs operationalized and communities benefitted from climate actions in Sikkim

Towards supporting the States in operationalizing the SAPCCs that would result in benefitting communities, several project activities or pilot interventions on climate change actions were initiated and/or completed this year. Most of these are a result of the proposals prepared earlier in consultation with the State Nodal Agencies, specific departments, and other relevant stakeholders:

1. **Reducing climate change induced risks and vulnerabilities from Glacial Lake Outburst Flood (GLOF) from South Lhonak Lake in Sikkim:**

This pilot project was aimed at enhancing resilience to prevent climate change-induced GLOF disasters in Sikkim. For this artificially lowering the water levels of South Lhonak Lake through siphoning has been suggested and implemented. Long-term planning of GLOF mitigation and awareness on disaster risk management, and implementation of early warning mechanisms amongst the potentially affected communities are some of the components of this pilot being undertaken in collaboration with the Sikkim State Disaster Management Authority, Land Revenue &Disaster Management Department and Department of Science and Technology & Climate Change, Government of Sikkim.

2. **Forest corridor Mapping in Sikkim:**

Climate change impacts on flora and fauna in Sikkim – which has large Protected Areas (PAs) will include shifting ranges for species and habitats, altered migration patterns and phenology,

etc. This unique pilot project aims at providing the Forest Department a plan for conserving biodiversity as well as reducing the potential animal-human conflicts by ensuring that both flora and fauna are able to move through landscapes, through viable climate resilient landscapes and connectivity corridors. The pilot intervention is supporting state government in using climatic data and measuring the structural diversity of the select landscapes; identify patches that act as movement corridor or have potential to facilitate movement as well as identify critical points along these corridors with high probability of negative human-wildlife interface.

3. **Ice-stupas:**

On the lines of ice-stupas in Ladakh region, the Department of Science Technology and Climate Change plans to develop ice-stupas as an adaptive strategy for water conservation and storage. Ice Stupa is an artificial glacier making techniques which resemble the Stupa. In this technique the water from height bring down to a specific location through pipes and it makes sprinkles from the top of the cones, resembling the water fountain in temperature of -10 to -40 degree centigrade which usually reaches in winter season in high altitude areas. Usually in the months between March-May there will be crises of water in most of the Himalayan state including Sikkim due to the less or no rainfall during winter. Spring usually dries up or can fetch less water due to the less winter rainfall. So, Ice Stupa is a water conservation technique in the air in the form of Ice for the use in water crises months.

State Climate Change Cell has published the results of the scientific and mitigation activities of South Lhonak lake. The scientific paper entitled "*Remote sensing and in situ-based assessment of rapidly growing South Lhonak glacial lake in eastern Himalaya, India"* has published in peer-reviewed reputed Journal *'Natural Hazards'*, Springer Publication, Journal of the International Society for the Prevention and Mitigation of Natural Hazards (DOI 10.1007/s11069-018-3305-0). The paper deals with the remote sensing as well as a field-based assessment of rapidly growing South Lhonak glacial lake in Sikkim Himalaya and recommends sustainable adaptation and mitigations measures to tackle the GLOFs in the region.

Achievements:

- ***State Meritorious Award:*** *Shri. D.G Shrestha, Director, Department of Science & Technology and Climate Change,* in recognition for initiating the field level Glaciology programme in Sikkim with respect to climate change and for undertaking in depth study of

South Lhonak Lake for disaster risk reduction, was conferred with State Award for Meritorious Service on the occasion of Independence Day 2018.

- ***Dr. N.P Sharma, Asst. Scientific Officer and Shri Pranay Pradhan, Scientist 'B'***, were felicitated by Hon'ble Chief Minister, Shri. Pawan Kr. Chamling for the valuable contribution in mitigation of Glacial Lake Outburst Flood in South Lhonak Glacial Lake on the behalf of Land Revenue and Disaster Management Department on 18 September 2018.

- **Development of New Model for Volume estimation of Glacial lakes in Indian Himalaya*. Shri. R.K Sharma Scientist 'B' and team*** has developed an empirical equation (model) for the volume-area relationship in South Lhonak Lake.

V=0.0522 ×A^(1.1766) (R2 = 0.99)

Where, V is the volume, A is the area, and R2 is the coefficient of determination.

The Equation is tested with the other moraine-dammed glacial lakes volume measured in Himalaya and the equation corresponds very well with the measured volume of glacial lakes.

- ***Book publication & release:***

A book on "Wetland Atlas of Sikkim" was released on the occasion of State Day on 16th May, 2018 by Hon'ble Chief Minister, Dr. Pawan Chamling.

SUPPORT TO THE USER DEPARTMENTS/AGENCIES

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

- Preparation of various GIS map for General Election 2014 and 2019
- 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.
- Training on Remote Sensing and GIS application to the students of Sikkim
- Hands-on training plus basics lectures on GIS & RS to different colleges of Sikkim.

OUTCOMES:

1. Data base of different natural resources generated through mapping, which includes
    - ❖ Base map and Resource map for various DPR for user Department .
    - ❖ High resolution land use and land cover map.
    - ❖ Potential sites for Sericulture development/Expansion.

- ❖ Potential forest fire prone areas were identified.

2. Publication of National Land use Atlas.
3. Publication of Desertification Atlas.
4. Final report preparation and publication
   i) Coordinated Horticulture Assessment and Management using Geoinformatics (CHAMAN)
   ii) Application of Remote Sensing and GIS in Sericulture Development" Phase- I & II
5. Publication of Wetland Atlas 2018.

TECHNOLOGY TRANSFER & TECHNOLOGY INCUBATION AND DEMONSTRATION CENTRE

AND

COMMUNICATION & POPULARISATION OF SCIENC

CONTEXT:

Technology Development Resource Centre & Technology Incubation and Demonstration Centre was established under the S&T Council considering the necessity in incubation and diffusion of appropriate technologies into common mass within the state and also to incubate and transfer the innovative ideas and technologies in collaboration with premier institutes within and outside the state identifying the gap areas in appropriate technologies in the. Priorities are given to low cost and innovative technologies basically for sustainable livelihood and skill development.
Different activities under Science Communication & Popularization programmes are being undertaken by the division to develop teaching skills among science teachers using low cost technologies and teaching aids. Various types of science awareness activities related to climate change, biodiversity, science festivals, organic farming, science exhibitions and exposure programmes are organized with the support from DST, GoI and State governments.

Goals & Objectives:

1. To incubate the appropriate technologies identifying the gap areas for reducing drudgery of farmers and rural and urban population and to promote new ideas
2. Develop socially relevant and profitable low cost adaptable technologies in the state involving different forms of alternative livelihood options
3. Transfer of proven low cost technologies to the target population.
4. Identify and act in areas requiring strategic interventions for Improvement of livelihood among the rural community.
5. Adaptation of sustainable livelihood.
6. Facilitates interaction between industry, scientists, technocrats and specialists and Assist partnerships with other, similar technology financing bodies and create new generation of entrepreneurs for alternative source of livelihood

1. Dryer for Cardamom, ginger, mushroom and other herbs and vegetable energized by Nano Hydel Power generated by local water streams:

a. Statement Of Project Purpose & Objectives

The Project goal is to reduce the pollutants while drying cardamom and other vegetables by providing clean energy through Power Generated by Local Water Stream and also to improve finished quality of dried Cardamom without affecting the environment in case. During Off-season the power generated is to be supplied to

1. Local Bakeries
2. Schools
3. Car Wash
4. Laundry / dry cleaning
5. And where electricity is needed

b. **Scope Of The Project**

This project is to installed a set each of cross flow turbine, synchronous generator and electronic load controller at Dentam, West Sikkim and Ronglu, East Sikkim at the first stage then to install one budget type batch oven at Rongli and one budget type batch oven and one standard type batch oven at Dentam.

c. Project Area

The location of the project area is at Chunabhatti Khola, Rongli village, East Sikkim and Dentam Khola, Dentam village, West Sikkim.

d. Components Of Nano Hydro Power Project (NHPP)

• Trench diversion weir and de-sander
• Bottom intake cistern with silt excluder
• HDPE penstock with isolation and air/vacuum release valves
• Surface Power House with indoor switchgear
• Tailrace pool and channel
. Electrified Oven

5. FEATURES:

LOCATION		
State	Sikkim	Sikkim
District	East Sikkim	West Sikkim
River	Chunabhatti Khola	Dentam Khola
Vicinity	Rongli village	Dentam village
Nearest Rail Head	New Jalpaiguri, Siliguri (NEFR)	New Jalpaiguri, Siliguri (NEFR)
Nearest Airport	Bagdogra (Siliguri)	Bagdogra (Siliguri)
Weir Location (*centr of weir*)	27○11'39" N, 88○42'37" E	27○15'4.9" N, 88○8'33.9" E
Powerhouse Location	27○11'43" N, 88○42'39" E	27○15'10.2" N, 88○8'33.2" E
Mean Max. Temperature	27.5ºC	27.5ºC
Mean Min. Temperature	5ºC	5ºC
HYDROLOGY		
Catchment Area	4.00 km2 (400 Ha.)	14.20 km2 (1412 Ha.)
Avg. Annual Yield (*at weir site*)	11.93 Mm3 (*Derivd Series*)	24.79 Mm3 (*Derived Series*
Mean Monsoon Inflow	0.867 cumec	1.62 cumec
Design Flood (*25-yr*)	7 cumec	32 cumec
DIVERSION WORKS		
Type of weir	Trench weir	Trench weir
Crest Elevation (FRL)	EL. 916.00 m	EL. 1360.50 m
Max. Water Level (MWL)	EL. 916.60 m	EL. 1361.50 m
Min. Draw Down Level (MDDL)	EL. 915.25 m	EL. 1359.75 m
Deepest River Bed Level	EL 915.00 m	EL 1360.50 m
Total Length at top	5.00 m	15 m
Width of Trench	1.00 m	1.00 m
Silt Excluder	flash board control	flash board control
INTAKE STRUCTURE		
Type	Rectangular with inclined MS trashrack (14° inclined) with silt flushing pipes	Rectangular with inclined MS trash rack (14° inclined) with silt flushing pipe
Top Elevation	915.00 m (u/s), 914.50 (d/s)	1359.5 m (u/s), 1359.0 (d/s)
Bed Level	912.30 m	1356.80 m
Width × Length	2.00 m × 1.50 m	2.00 m × 1.50 m
Location	On right bank	On left bank
Top of Intake	EL. 917.50 m	EL. 1362.00 m
Max. Water Level (MWL)	EL. 917.00 m	EL. 1361.50 m
Designed discharge	0.09 cumec (90 lps)	0.138 cumec (138 lps)
Type of trash rack	Meshed Grating	Meshed Grating
Width × Length	1.20m × 1.50 m	1.20m × 1.50 m
Intake regulation	Gate valve with air vent, 315 mm dia.	Gate valve with air vent, 355 mm dia.
PENSTOCK		
Type, Material	HDPE(PN 2.50 Grade)	HDPE (PN 2.50 Grade)
Diameter	315 mm (Nominal Dia.)	315 mm(Nominal Dia.)

Length	140.00	164 m	
Centerline Elevation	**Start:** EL. 913.00 m **End:** EL. 883.682 m	**Start:** EL. 1357.50m **End:** EL. 1338.50 m	
POWER HOUSE			
Structure			
Type	Surface Type	Surface Type	
Size (L × W)	6.00 m × 3.50 m	6.00 m × 3.50 m	
Normal Tail water Level	EL 882.695 m	EL 1337.21 m	
Maximum Tail Water Level	EL 882.706 m	EL 1337.26 m	
Minimum Tail Water Level	EL 882.588 m	EL 1337.15 m	
High Flood Level	EL 882.516 m	EL 1337.800 m	
Service Bay Level	EL. 883.182	EL. 1338.00 m	
Turbines			
Type & Nos	Cross flow, 1 no.	Cross flow, 1 no.	
Centre Line of Turbine	EL. 883.634 m	EL. 1338.50 m	
Rated Discharge	0.09 cumec(90 lps)	0.122 cumec (122lps)	
Runner Diameter	220 mm	300 mm	
Turbine Speed	1500 rpm	1500 rpm	
Rated Head	18.16m	18.16m	
Installed Capacity	15 kW (1 × 15 kW) 110% COL	15 kW (1 × 15 kW) 110% COL	
Generators			
Type	Horizontal shaft, Synchronous	Horizontal shaft, Synchronous	
Number	1	1	
Nominal Speed	1500 rpm, 4 poles	1500 rpm, 4 poles	
Voltage, Frequency	415V, 50 Hz	415V, 50 Hz	
TAILRACE POOL & CONDUIT			
Tail Race Pool	1 m long, width 600 mm	1 m long, width 600 mm	
Bed level	**Start**: EL 882.53 **End**: EL 882.403	**Start**: EL 1337.07 **End**: EL 1337.00	
Shape	Rectangular	Rectangular	
Length of TRC	7.50 m	17.75 m	
Lining	PCC M-15 A-40 for bed & sides	RCC M-20 for bed & sides	
Bed slope	1 in 200	1 in 200	
POWER AND ENERGY			
Average Gross Annual Energy	0.085 Mu	0.095 Mu	
Average plant load factor (PLF)	65.06%	71.96%	
POWER EVACUATION			
Substation	Nil, supplied to local loads (off-grid)	Nil, supplied to local loads (off-grid)	
Transmission voltage	415 V	415 V	
ELECTRIFIED OVEN			
Type	Budget type batch oven	Standard type batch oven	Budget type baych oven
CONSTRUCTION PERIOD			
12 months (including monsoon months)	12 months (including monsoon months)		

6. PROBLEMS AND ISSUES FACED

1. Dentam, West Sikkim 2. Rongli, East Sikkim	1. Unavailabity of materials such as Penstock.2 Unavailabity of labours throughout the year 3. Site location such cannot be worked during monsoon season. 4. Site location far away from the road to use excavator or any other machinery. 5. River bed full of hard rock which took lengthy time to excavate by labours as the explosive was not used due to presence of local houses nearby.

e. Summery

Civil work for Nano Hydro Power project is completed. Housing of electrified oven is yet to be done as will be completed when ovens will be delivered to the site. The Electro-Mechanical components including Electrified oven is said to be installed within next month or two.

2. Diffusion of grassroots innovations and documentation of innovations and outstanding traditional knowledge from Sikkim

a. Background:

The state of Sikkim, country's first organic state, is very rich in biodiversity and associated knowledge. Though traditional knowledge has been documented from the state, focus on grassroots innovations has not been much in the state. The Department and NIF have had a long association and have worked together on many occasions. Understanding the potential of grassroots innovations, the Department believes if systematic scouting and documentation of grassroots innovations from the state of Sikkim is undertaken, not only it will help unearth and promote local ingenuity but also may result in establishment of grassroots enterprises. NIF has had a long experience in promotion of grassroots innovations and valorisation of outstanding traditional knowledge and a partnership between the two institutions is expected to benefit the people of Sikkim.

Since NIF already has a pool of a number of grassroots innovations, it is requested NIF to provide to the Department, innovations that could be included in a proposed Innovation Demonstration cum Training Centre so that people can visit, see and even get trained on the available innovations.

Area:

The state of Sikkim with focus on district(s) enlisted in Inspirational district list of NITI Aayog. The Innovation Demonstration cum Training Centre (proposed) will be setup in Gangtok.

b. Activities:

The following activities will be undertaken :

a. Identification of needs of the people in the districts and solution

b. Dissemination of low cost useful solutions based on need assessment

c. Diffusion of useful grassroots innovations in the districts and setting up of Innovation Demonstration cum Training Centre

e Scouting of green grassroots innovations from the districts including from farmers, artisans, mechanics, school and ITI students for scaling up

f. Organising of ideation camps in schools for INSPIRE and Dr APJ Abdul Kalam IGNITE Awards

c. Output Indicators:

a. List of technological gaps/needs from the villages

b. Dissemination of useful information (booklets/posters) in villages *

c. Diffusion of innovations in the villages based on need assessment**

Table: 1.1

November – March (2018-19)				
Sl. No	**Activity/ Task**	**Actual Data (in Numbers)**		**Remarks**
		Submitted	**Pending**	
1	New Ideas scouted and documented	0		If scouted jointly along with other colleague(s), one person should report OR Divide the total number by the number of colleagues scouting jointly and report here So that numbers are not duplicate
2	New Innovations scouted and documentation	8		
3	New Plant variety scouted and documented	0		
4	New Agriculture practices scouted and documented	5		
5	New Traditional Knowledge Practices scouted and documented	167		
6	Number of villages visited	40		Do NOT count a village again if visited more than once
7	Number of schools visited	0		Do NOT count a school again if visited more than once
8	Number of districts visited along with name	3 (East, West & South Sikkim)		Do NOT count a village again if visited more than once
9	Number of herbarium samples prepared	20		
10	Number of bulk herbal samples collected	0		If one plant more than once, then count/include again

d. Future Scope

- The unexplored Grassroots Traditional knowledge and innovators hidden under traditional healers and farmers and students from remote areas if documented properly could be cure for many diseases.
- The recognition and respect should be given to such Traditional healers and innovators with patent or copyright.
- If more manpower with good emoluments is considered to this project, it can grow to a whole new level. More data on healers and other traditional knowledge could be explored.

Glimpses of Scouting and Documentation:

Pic:Herbal healer at Site at Namthang, South Sikkim

3. India SkillPedia/ TechPedia

Objectives

The indiaskillpedia / indiatechpedia portal envisages engagement of technology aspirants, enthusiasts, experts, resource persons, community leaders, researchers and students in strategic sectors, academic institutions and R&D institutions, who are desirous of contributing to promote and provide inputs to the manufacturing industries that are aimed at;

i. disseminating awareness and encourage industries to pursue/patent acquisition, develop technologies,
ii. prospecting, sourcing technologies, exploring and leveraging opportunities for development of technologies or pursuing innovations for manufacture and marketing of products and solutions,
iii. facilitating technology acquisition, transfer, negotiation of terms, understanding and positioning in the market, evolving strategies / approaches for exploitation of opportunities,
iv. supporting the augmentation of capacities of industries to manufacture products and services which can meet the demands in the Indian and Global Market
v. Facilitating effective management of operations and risks.

The portal will serve as an institutional mechanism that would disseminate ideas, designs and requirements for products and services in the manufacturing sector, - which can be seen and responded to by manufacturing companies with capacities for production of such product components and value added services

The portal is a modest effort that attempts to facilitate the community of entrepreneurs, technology enthusiasts, skill aspirants and start ups to collaborate and contribute in a manner that ensures that knowledge is created, developed and shared with contributions being made through crowd sourcing, compiling, repurposing and reusing contributions of resource persons, experts, techno-preneurs, developers, consultants, state agencies and institutions engaged in training and development of skills, technologies, products and systems.

Preliminary Investigations done by organization.

The Portal is already developed to engage the community to harness the potential of youngsters and transform them into a vibrant workforce with industry oriented Skills as also to counsel and guide them in their professional career, to enable them join the Industrial mainstreams in the production or service sectors. IndiaSkillPedia Foundation Society comprise of nominated members of Sikkim State Council of Science & Technology and Skill Mission Teams from Sikkim State Agencies**. Indiaskillpedia Portal** used an approved graphic theme and a consistent navigation format, the development team created a dynamic, interactive and easily navigable portal, which will include all general requirements identified in the compliance matrix;

I. Front end interface for each SMT/State agency is an independent application. similarly for industries, training providers and sector skill councils Application Portal Interface [API] developed with details of logic, rules, pre-requisites, exit-termination for making and regulating connections with SYI CORE:
   i. State government agencies,
   ii. Industries,
   iii. Training partners,
   iv. Skill sector councils.

II. Indiaskillpedia Portal is the knowledge repository portal also connects to SYI CORE.
III. The systems rely on distributed data uploads and crowd sourcing approach.
IV. Black board architecture is the broad guiding framework with an inbuilt embedded logic for data validation.
V. Content validation process flows for editorial reviews prior to publishing in public domain.
VI. Geo- location sensitive for adaptive profile based info & link layout display with GIS based schematic mapping.
VII. Intelligent system cues, messaging, presentation of links, cross referencing & context help for users and virtual one-on-one onboarding experience.
VIII. Evidence & context based data capture, drill down traceability, tool tips, navigation aids, bread crumbs etc., with dynamic analytics, system responses and feedback.
IX. Hyper dimensional –configuration module with an intelligent algorithm for Meta data capture, invocations and management & association of context and also inbuilt data retirement rules for archival of past data.
X. Engaging the stakeholder community to share information, knowledge is a challenge. Automated processes and authoring systems have been deployed coupled with editorial review mechanisms for validation and authentication for quality and acceptability.
XI. However, incentivizing knowledge sharing evolves progressively through engagement, active messaging, face to face interactions, creating awareness on purpose, functionality and features of the portal and encouraging/ motivating the contributors.

An alternative form of crowd sourcing approach has also been adopted. This involves, constituting a close group of motivated researchers associated with the management of the portal, and entrusting them with the task of identifying and sourcing contents which are already in public domain. The content from its original source is anchored and reproduced/ repurposed with anchor images and key paragraphs and providing links to the original source.

XII. The research group also proactively contacts the potential sources of knowledge, familiarizing them with the manner in which content can be uploaded and revised.
XIII. The other challenge is of Intellectual property rights. Giving credit to the contributors, authors, resource persons and acknowledging the source is done with due diligence.
XIV. Sometimes, authors and contributors are not very keen on identifying themselves or filling up forms or even loathe logging in before making any relevant changes to content using the authoring mechanisms provided to improve their quality.
XV. Hence, in evolving the solution, even the requirement for logging in, before uploading or revising/ reviewing a knowledge resource or contribution has been dispensed with. Instead the system merely captures the IP address and maintains logs to keep track of changes done.

S&T component in the project:

The Portal has been deployed in Amazon Cloud to ensure reliable, robust, real time, online experience with minimal latency and 24/7 availability. The infrastructure encompasses storage, computational resources scalability, security features and analytics which can be added seamlessly on the basis of transactional volumes, load balancing and demands for improved responses.

Messaging and solicitation of feedback form based user inputs and content upload/changes features are made available extensively, adapted to the context with functionality and features that are easy to use.

Extensive online help, tool tips, mouse over dynamics enable ease of navigation and access to specific resources being searched. The layout structure, link labels are themselves intuitively organized and are provided under various labelled sections providing an insight to the underlying knowledge structure and organization of content, in order to facilitate cognition, ease of comprehension and access.

The contents are also extensively cross referenced and indexed for navigation and ease of access, as also to give the user a comprehensive contextual understanding of the knowledge which is presented.
Both shelf view which enables views of files and knowledge resources in standard formats such as pdf/ jpeg etc, as also hyper media views with inbuilt hyper links, crosslinking other knowledge resources and content, are made available in the portal.

Methodology detailing stepwise activities and sub-activities.

1. Hiring of project staffs and Project lunch (officially)
2. Purchase / carry the required equipments and Components.
3. Development of Knowledge Resources uploaded from multiple sources on Portal and their dissemination to promote accelerated learning, skill acquisition, development of competencies, technologies.
4. Validating the uploaded Knowledge Resources by the group of experts before making it available for public view on India SkillPedia/ TechPedia.
5. Establishing, managing and maintaining a Knowledge Repository to support competency development, collaboration and engagement of stakeholders as also researching, analysing knowledge acquisition, methods for learning and acquiring professional competencies required for development and management of technology.
6. Disseminate awareness programmes and encourage the skill aspirants, potential entrepreneurs, startups, skilled workers, technology enthusiasts, IP practitioners and innovators with a view to empower, build proficiency and competencies of workforce both existing and potential
7. Facilitating the technologies and consultation to the manufacturer to explore their Good and Services.
8. Collaboration and engaged with stakeholder communities to share ideas, information and knowledge and provide effective management and consultancy to the manufacturer
9. Supporting the augmentation of capacities of manufacturing industries to meet the demand of global market and facilitate the establishment of entrepreneurs/ start ups to the aspiring communities in rural areas.
10. Provide Technology development frameworks, methods, mechanisms, practices associated with skill development initiatives, technologies, learning pathways, assessment of prior competencies, with a view to empower, build proficiency and competencies of workforce both existing and potential.
11. Evaluation and Submission of report of the Project completion

Output of the Project

As part of an evolving paradigm, the India techpedia/Skillpedia portal will progressively embrace a design to implement manufacturing focused (Enterprise resource planning) ERP Solution on the Web which will serve as a mechanism to;

- As the portal is in public domain and hosted in the Cloud Infrastructure, it is accessible by any user who has an internet enabled computing system or device.
- Pose and address technology related problems and challenges that presents opportunities for manufacturing in various domains, Evolve strategies, solutions, approaches, methodologies and pathways for development of technologies.
- Engage R&D organisations, strategic sector, industries & academic institutions.
- The critical success factor is the extent of on-boarding, involvement, participation and contribution by the community of knowledge workers, researchers, industries, government agencies, consultancy establishments, training providers and technology enthusiasts to

upload contents and be committed to improve the quality of content that is deployed to benefit the community of entrepreneurs, skill aspirants, start ups, industries, village communities and professionals

- Facilitate buyers to meet sellers of manufactured goods and services, o Avail consultancy/ advisory services related to patent evaluation, technology profiling, technology acquisition or legal assistance.
- Partner with other firms in system assisted, mediated negotiation and facilitation to reach agreement on sale or purchase of technology, technical / management services or support to build capacity for manufacturing.
- Whenever required, industries can search the portal, locate a suitable technology/an ideal R&D partner and forge a relationship. Companies can also keep feeding their current research focus areas and requirements for specific research resource from the Universities/Public Funded Research Institutions. Interested experts when coming across any specific industry requirement that matches their area of expertise and interest will then be able to contact the company directly and build the relationship.
- Such a measure is expected to benefit the Universities/Public Funded Research Institutions tremendously as existing IPs can be readily licensed to the industry, thus avoiding additional investment in time and associated risk.
- Mobile applications being developed to interface with the **indiaskillpedia** is another initiative being taken up along with the extensive use of social media like face book, twitter etc to ensure better outreach, access, reliability in terms of on boarding and usage.
- The network of Sikkim State Council of Science and Technology and Skill Mission Teams in the state are actively partner to uploading and updating contents that will be increasingly useful to large communities.

Impact

i. The project initiative leverages a Research focus to make continuous improvements in mechanisms/ methods for- knowledge Capture/ Representation, Intelligent systems and Cognitive approaches for enriching learning experiences for skill promotion, entrepreneurship development and hand-holding with start-ups
ii. Embedded mechanisms, automated processes for content compilation, indexing & cross referencing knowledge elements, organization and structuring knowledge, characterizing content and extracting metadata.
iii. Evolutionary Algorithms to capture nuances and parameters which depict human-system dynamics
iv. Developing paradigms, mechanisms, algorithms with self-learning/ adaptation properties along transient temporal/spatial dimensions, - and evolve cognitive models of knowledge exploration habits of users for enriched presentation of contents
v. Conceptualizing Contraptions for Embedding trigger events at various points of human engagement of the system during their interaction sessions and leveraging them for enriched learning experience in users

Parameters for monitoring effectiveness of project

I. Access to Knowledge& Sharing Expertise
   - Sharing Knowledge and Domain Expertise
   - Access to Learning Resources, Course Structure,
   - Support for learning progression
   - Features and facilities for Knowledge Dissemination
   - Metadata specification
   - Search services to locate, access and preview, read or download knowledge resources

II. Training &Assessment of Competencies
- Training Design
- Lesson Plan & Outcomes
- Training Partners
- Tools and Techniques for Assessment of Knowledge and Competencies

III. Networking and Collaboration
- Connecting with other experts and resource persons

IV. Consultancy & Directory Services
- Opportunity to Promote consultancy services
- Directory Services, Catalogs, Product & Service Guides
- Offering Mentoring or Apprenticeship Services
- Location aware services to connect with mentors, resource persons
- Analytics and Decision support services

V. Products and Services
- Online Sale of Products and Services

VI. Professional Development
- Membership Application in Professional Bodies
- Resume Building and References
- Job References
- Tools and facilities for practicing a profession
- Know How to produce goods, manufacture products and deliver services
- Consultancy for Career options, Pathways and proficiency upgradation

VII. Production, Processes, Product Design / Development& Manufacturing
- Ideas, Incubation & Innovation
- Iterative Product Design , Evolving specifications
- Standardization of products and services
- Methods for production, packaging, componentizing, modularity of design and packaging
- Material specification, use of alternative materials,
- Tests for meeting structural or functional specification
- Standardization of Design, Products and Services
- Drawings of parts, components, products, assemblies
- Assembly or Dis-assembly of tools, fixtures, product assemblies
- Working or operating principles of machinery, processes
- Standard Operation Procedures for production/ manufacturing, testing, assembly,

VIII. IPR & IP Management
- Processes for Patenting, TM, GeoIndication and Designs
- Consultancy for IPR and IP Management

IX. Operation Management & Service Delivery
- Lean and flexible Operations

X. Systems Design and ERP for Decision Support
- Business Process Modelling

- ERP Solution Architecture
- Process Automation
- Decision Support
- Configuration Management
- Interoperability
- Manageability, Sustainability

Suggested Post Project Activities

i. Emphasizing focus on Open knowledge
ii. Need for empowering and handholding skill aspirants, potential entrepreneurs and start-Ups
iii. Clarity in Principles/ Policies for Operation and Management of the Knowledge Repository
iv. Continuous Innovation and Updation of features, content and behavior of the application
v. Leveraging Promotional Events

4. Innovation Demonstration cum Training Centre:
4.1 Egg incubator and Hatchery at Village level

Poultry farming is quite popular among rural youth and one of their sources of employment and income. They often buy young chicks and feed them till they grow to a certain age for resale. However, if they install an egg incubator, they can produce the chicks in their farm itself. This will work out very economical for them. The incubators available in the market are very expensive and run on electricity. But in rural areas, there are frequent power cuts. The egg incubator developed by Milan Jyoti Das solves these problems. It is cheaper in comparison with the ones available in the market and its power source is both electricity and kerosene lamp.

Product Technical Details Salient Features

The incubator is made up of plywood in the exterior and plain sheet in the interior. Its wall is about 10 cm thick and thermocole is used to insulate it. The whole device is divided into two chambers, upper and lower. The upper chamber houses the main component of the incubator i.e. the egg tray and source of humidity, while the lower chamber houses the thermal source, a speaker for alarm in case of abrupt change and switches.

Innovator uses electric lamp as the source of heat when current is available and in case of power failure a kerosene lamp. Both the light and the lamp heat up the floor of the upper chamber (ceiling of the lower chamber). There is a regulator (same as one used for fan) by which the intensity of light can be altered. This chamber partition is made up of two plain sheets, so the heat can easily be transferred. For warming, a plate is placed below the egg tray. From the tray water gets evaporated due to heat and makes the chamber warm. In this incubator air is fed by tubes from four holes from the bottom to the upper chamber.

Weight: The weight of the incubator is about 125 kg.
Dimension: Length is 1.5 m, breadth 0.80m and height 1m
Source of temperature: Electric bulb and kerosene lamp.
Capacity: Regular model - 500 eggs.
Success rate: 85%.
It produces alarm in various emergency situations like opening of door, current failure, high / low temperature, high / low humidity.
Can be operated by using kerosene oil lamp in case of power

Activity details

These initiatives require hand holding of the target group in addition to providing working shed, civil works, electrical connection and training along with seed money to start the enterprise. In order to initiate these scientific diffusion of technology at the village level, there is requirement of fund to provide alternate source of livelihood and make it sustainable.

4.2 Sanitary Napkin Production Machine and training to be given to educated unemployed women SHG for production and sale in remote villages

Sanitary napkin, a universally needed product, has very low penetration in India and other developing countries, partly due to its high price and partly due to the tradition of using cheaper but unhygienic old cloth piece. As a result they become the host of many infectious diseases. This is due to lack of awareness and economic inability for adopting better precautions like use of good sanitary napkins during menstruation period. Usually different varieties of sanitary napkins are found available in the market but they are very expensive and are not affordable for rural & under-privileged women and girls.

Product:

1.Pulverizer

It is used for Pulverizing Pulp or Cotton. It can pulverize 100 kg per hour operated on a 0.5 HP motor. Total manpower for this machine is only 1 single person. It has added advantage over the grinder. There is a difference between pulverizing and grinding. If we pulverize the pulp then it becomes soft but retains its shape in napkin but if we grind it then it cannot retain its shape in a napkin

2. Napkin Press Machine:

The napkin pressing machines are available with three powders coated or steel plated dyes that ensure easy operation. These Napkin Pressing machines are easy to fix on the floor or on the table and sufficiently produce minimum 2,500 napkins in 8 hours or 75,000 napkins in 30 days.

3. Napkin Sealing Machine:

This machine is used to seal the pulp in a fabric. It takes 20 seconds to seal one

4. Gumming Set:

This Gumming Set is a type manual screen printing this designing of screen is only used for Sanitary Napkin back side Gumming. Total manpower for this machine is only 2 single persons. This gumming manual machine production capacity is 500 Napkins in 40 minutes

5. UV Treated Sterilizer

This UV Treated Sterilizer is of 18 gauge virgin steel with plastic coated in white color with red LED indicator on the top. There are three UV treated ultra-tubes of 12 inches with 12/24 inches mirror inside of the sterilizer so that the reflection the UV tube should reflect in the full sterilizer inner side. The size of the sterilizer length 35 inches & breadth 24 inches & depth is 25 inches.

Expenditure estimate for Sanitary Napkin Making Machine

1. Permanent Equipments, Transport, Training & TA			
	Particulars	**Cost**	**Remarks**
i.	Low Cost Sanitary Napkin Making Machine	Rs. 3,52,111/- X 5 units = Rs. 17,60,555/-	To be borne by National Innovation Foundation, Govt. of India
ii.	Training Cost		
iii.	Travelling Charges		
2. Recurring Raw Materials			
	Raw Materisals	Rs. 89,491/- X 5 units Rs. 44,74,55/	To be borne by NIF, GoI for first batch of 50,000/- pieces of final product
	3. Working Shed		
i.	Working shed measuring 500 sq. ft. for training and establishment of production centre (05 nos)	Rs. 1,00,000/- X 5 units = Rs. 5,00,000/-	To be borne by Sikkim State Council of Science & Technology
	Total Project Cost	**Rs. 27,08010/-**	
	4. Activity details		
i. ii. iii.	Identificaton of Self Help Group Construction of Training / Production Training to identified SHG by innovator Production of commercial materials by SHG Handing over of facility to the SHG Hand holding of SHG for post production activities & sale	All cost after the handing over to be borne by identified SHG in the Urban & Rural areas.	Initiate the activity as a business model by SHG

3. Selection of SHG: In Consultation with Municipal Corporation/ Panchayat

i. ii. iii.	Identificaton of Self Help Group Construction of Training / Production Training to identified SHG by innovator Production of commercial materials by SHG Handing over of facility to the SHG Hand holding of SHG for post production activities & sale	All cost after the handing over to be borne by identified SHG in the Urban & Rural areas.	Initiate the activity as a business model by SHG

5. ENVIS Centre Sikkim on Ecotourism

Introduction

Environmental Information System (ENVIS) is a plan programme of the Ministry of Environment and Forest, Government of India. ENVIS is a decentralised system using the distributed network of databases to ensure integration of national efforts in environmental information collection, storage, retrieval and dissemination to all concerned including policy planners, decision makers, research workers and the public.

OBJECTIVES

1. Long-term objectives

- To build up a repository and dissemination Centre in Environment Science and Engineering;
- To gear up the modern technologies of information acquisition, processing, storage, retrieval and dissemination of environmental information;
- To support and promote research, development and innovation in environmental information technology.

2. Short-term objective

- To provide national environmental information service relevant to present needs and capable of development to meet the future needs of the users, originators, processors and disseminators of information;
- To build up storage, retrieval and dissemination capabilities, with the ultimate objectives of disseminating information speedily to the users;
- To promote national and international co-operation and liaison for exchange of environment related information;
- To promote, support and assist education and personal training programmes designed to enhance environmental information processing and utilization capabilities;
- To promote exchange of information amongst developing countries

Activities undertaken by ENVIS Resource Partner on ecotourism are collection and dissemination of secondary news through our website. Uploading of daily news materials and other data for public use and perusal.

Other Activities of ENVIS Centre:

- Envis RP has also celebrated World Wetlands Day on the 2nd of February 2018 which was done at Kendra Vidyalaya School.
- The Envis Staff has also covered Okharey Ecotourism festival 2018 and brought back resource material from the event.
- The center has successfully completed a two month long capacity building course for 20 candidates known as Green Skill Development Programme for the year 2018-19 which is a government of India (MoEF&CC) initiative.
- Envis is also selected as one of the lead centers for GRIDSS which is a Remote Sensing based project proposed by Government of India. The districts selected for GRIDSS for ENVIS ecotourism are West and South Sikkim.
- ENVIS is also responsible for publication of quarterly newsletters and other resource materials.

- **World Tourism Day – 2018**

The World Tourism Day was celebrated by ENVIS Resource Partner on Ecotourism, Sikkim State Council of Science and Technology in collaboration with Department of Tourism, Sikkim University, at Vigyan Bhawan. on the theme of World Tourism Day 2018, "Tourism and the Digital Transformation". The programme also included a lively debate on pros and cons of digitalization, exhibition of digital video shoots and photos of ecotourism spots of Sikkim.

- **ENVIS - National Review Meet – 2nd April, 2019**
  ENVIS Centre participated in the National Review Meet of ENVIS Scheme MoEF&CC for Evaluation of ENVIS Scheme, Green Skill Development Programme, NES-GRIDSS in Ministry of Environment, Forest and Climate Change, New Delhi.

Pic: Shri. C.K. Mishra, Secretary, MoEF&CC, GoI. (left) visiting Sikkim S&T Council gallery

Video Documentation of Council's GSDP displayed in Big Screen in MoEF&CC.office

Functions of ENVIS Resource Partner Sikkim on Ecotourism

- Building up a good collection of books, reports and journals in the particular subjects area of environment.
- Establishment of linkages with all information sources in the particular subject area of environment.
- Responding to user queries.
- Establishment of a Data Bank on some selected parameters relating to the subjects area.
- Co-ordination with the Focal Point for supplying relevant, adequate and timely information to the users.
- Helping the Focal Point in gradually building up an inventory of information material available at the Centres.
- Identification of gaps in the specified subject area and action to fill these gaps.
- Bringing out newsletter /publications in their subjects area for wide dissemination.

6. GREEN SKILL DEVELOPMENT PROGRAMME
NATURE CONSERVATION AND LIVELIHOOD: ECOTOURISM (NSQF - 4)

- Two months Certificate Course in Nature Conservation and Livelihood: Ecotourism under GSDP kicked off with Inaugural function on 9th August, 2018 which was attended by Dr. Anandi Subramanian, Senior Economic Adviser, MoEF&CC GOI

Dr. Anandi Subramanian, Principal Adviser MoEFCC, Dr. K Jayakumar IAS, Additional Chief Secretary, Govt. of Sikkim | addressing the inaugural function.

GSDP training included

- 7 major field trips included trip to IHCAE (Indian Himalayan Centre for Adventure and Ecotourism)
- Field trip to Namgyal Institute of Technology was organized where participants learnt about culture, history of Sikkim,
- Field trip to Himalayan Zoological Park was also organized where participants of GSDP were trained about wildlife and ecosystem, flora and fauna
- Short trek was also arranged where participants learnt about trekking, guides, wildlife, equipments, trails etc.
- Training on garbage management,
- Hotel management, heritage and tourism
- Field visit of Homestay management, village tourism was organized in Pelling, West Sikkim
- Exposure to financial institutions
- 150 hours of theory classes on ecotourism and related areas

Field Visits & Skilling Classes of Green Skill Development Programme

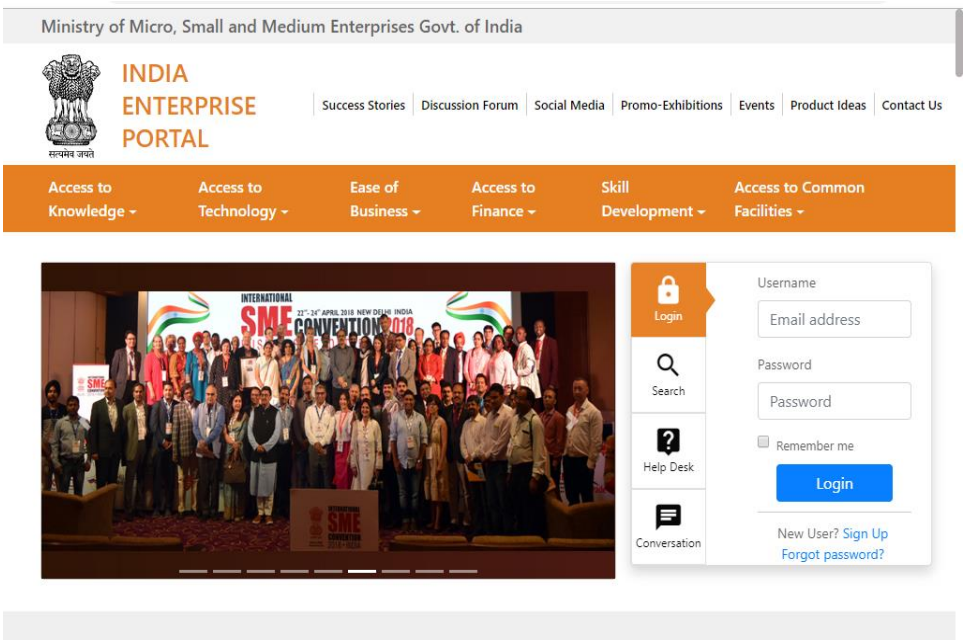
All the trainees now have been skilled and trained on Ecotourism National School Qualification Framework (NSQF) level IV. Out of 20 participants 10 trainees are already employed in the respective trade

6. Enterprise India

Cyber Eco-System enabling Convergence, Collaboration & Transactional Mode Custom Delivery of KNOW-HOW, Designs, Technologies and Technical Assistance – With Authoring Systems, Blackboard Architecture and AI based Assist Mode Capabilities

The *India Enterprise Portal*has been deployed for access using the URLs as under

http://enterpriseindia.co.in
http://www.enterpriseindia.net



Key Objectives:

- Evolving Systems to Source Knowledge in Public Domain to pass on to inspire younger generation with promotion of habits for DIY – entrepreneurship culture, assimilating know-hows, self-learning, experimenting, innovating, demonstrating, prototyping and scaleUp
- Structuring the Portal Solution framework and Underlying Knowledge/ Service Delivery Architecture and Automated Authoring Systems to facilitate Cognition
- Enabling & Enhancing understanding of informed choices for (i) Establishing and Promoting Enterprise Activity (ii) Building Capacity & Confidence in relevant Roles, Professional Responsibilities
- Promotion of habits for Knowledge Exploration, Collaboration & Networking seeking Services of Partners and reinforcing capabilities
- Mobilizing and Leveraging a wide spectrum of Community involvement / Participation to Inspire entrepreneurial and enterprise pursuits Instituting Systems & Machine Intelligence to support human activities and pursuits

Benefits and Improvements

1. Develop a National Enterprise portal that has been envisaged for MSME and is being developed by the Foundation
2. Create common facilities for supporting entrepreneurs in developing digital media content, print publications, proposals, designs etc. and make it possible to convert their ideas to products, prototypes and designs for production and marketing which can be used by the North Eastern State Agencies, Entrepreneurs and Start-Ups
3. Develop and package content for the National Enterprise Portal developed by the Foundation for the Ministry of MSME

Deliverables:

- Develop the NEP
- The portal needs to be developed to deliver its envisaged services and capabilities
- NEP is envisaged to serve and address the gap in the existing websites and information dissemination paradigms for customized user profile based information and service delivery
- serve as an institutional mechanism that would disseminate ideas, designs, challenges/solutions, requirements/ pre-requisites, methods, mechanisms and systems for products and services in various development and manufacturing sectors, - which can be seen and harnessed by other individuals, industrial establishments and organisations to leverage such inputs and scale up their capacities for production of such products, components and value added services
- eMarket Place, conversational facilities with peer groups, blogs, continuously updated knowledge resources through crowd sourcing etc.
- A team of programmers will work under the guidance of senior stakeholders to deliver the portal

Recent Achievements

- Excess of ~7500 registered users who are skill aspirants, 41 training providers, 62 training courses, 1176 placements and 796 persons undergoing counselling. About 24 start-ups have commenced operations in Sikkim over the last two years in different sectors like Agro-based, Tourism, Travel and Trade and Hospitality Sectors
- Indiaskillpedia Foundation with the objective to support and promote the micro, small and medium enterprises (MSME) in NER and Sikkim, has been offering its services for past three years to the various stakeholders associated with MSMEs through two online portals - **http://www.skillyoungindia.com and http://www.indiatechpedia.com.**

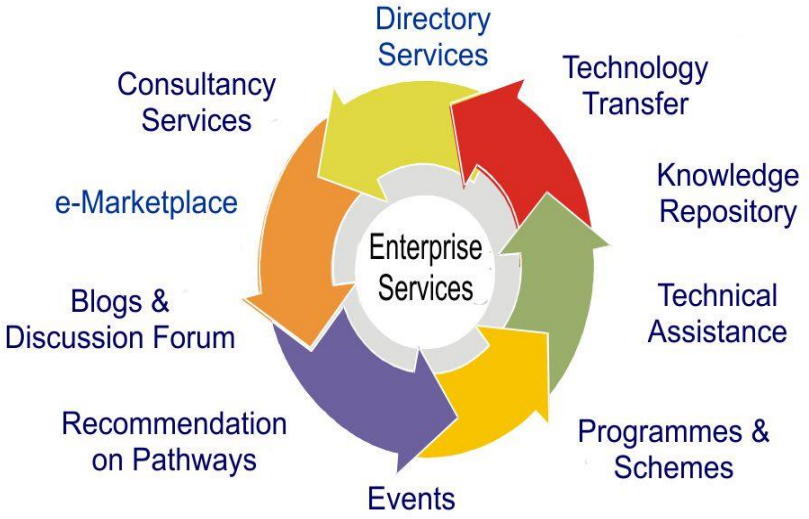


Fig 3 The wide spectrum of transactional mode knowledge exchange and Service Delivery that are Offered

Description Of Services On The India Enterprise Portal
Access to Common Facilities and Technical Assistance

Access to Common Infrastructure: There is availability of plots and industrial sheds across India created through public investments by the state governments, as well as common facility centres by Government of India. Such information would be available to MSMEs at one place at IEP as follows:

a. *List of cluster and common facilities*: Information and details of MSE Cluster Development Programme and other related promotional interventions.

b. *Plots and sheds in industrial estates*: All state governments and UTs are being encouraged to make such information available on the IEP platform or at least provide a link for the available infrastructure at their end. Efforts would be made to provide augmented services at the enterprise facility centres, common facility centres, industrial estates with plug and play utilities and readymade factory set ups for the entrepreneurs and startups.

Technical Assistance Services that are delivered on IEP are being customized to the needs, requirement and profile of the users based on their interactions, inputs, as also discerned and input by the operations team manually and progressively in an autonomous manner by the system, in accordance with embedded rules and system intelligence to ensure customized delivery.

Contributors/ Service Agencies / Facilitator Profile Tags

Knowledge Resources are also identified in terms of their ownership/ contributors or authors identity – the individual or entity uploading the resource.

The system also captures and presents details of profiles of these individuals or entitites for reference by the users.

(a) State Agency
(b) Enterprise Development Centres
(c) Industry
(d) Financial Institutions
(e) Business Consultancy Service Providers
(f) Accounting & Audit Service providers
(g) Legal Service Providers
(h) Training Institutions

Domain Areas/ Sectors

(a) Agro-Farming
(b) Textiles/Apparels
(c) Leather & Footwear
(d) Renewable Energy
(e) Green Economy, Ecology, Environment
(f) Waste to Wealth/ Swatch Bharath
(g) Automobiles & Electric Vehicles
(h) Construction Engineering & Infrastructure
(i) Smart Cities
(j) Rural Economy
(k) Media and Entertainment
(l) Information & Communication Technology

A Resource Development Centre has been established at Vigyan Bhavan, Gangtok Sikkim with plans to set up another satellite Resource Centre at Shristi Nagar, Guwahati to cater to NE States

- It is a virtual Office Establishment, with functionaries performing their roles and responsibilities through
- The portal solution architecture encompasses – automated processes, workflows and functions as a cloud based enterprise application
- Allocation of credentials /tasks through configuration management are performed by the core op & management team and volunteers
- Entrepreneurs can pose service requests, queries for responses, input details in forms that can be invoked to present detailed information of their requirement for information and services
- Requests are acknowledged by system and relevant partner and service agencies are notified in their profile pages
- Responses from consultants, partner agencies, consultants, industries and govt agencies are notified back on the profile pages of the user in addition to alerts on sms/ emails
- Appropriate escalation mechanisms, dashboards onscreen status updates on process progression and acknowledgements present enriched cognitive feedback and enable progression of enterprise

As concerns Activities for Engagement, Advocacy, Promotion and Training of various Stakeholders, Government Institutions and infrastructure facilities would be made use of.

COMMUNICATION
&
PUPULARISATION OF SCIENCE

Operation & Activities:

1. Establishment of Sikkim Science Centre, Marchak

Sikkim Science Centre

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.

Visit to Sikkim Science Centre by Students.

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**

2. 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:

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

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

Communication and Popularization 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:

a. Organization of series of workshop in supported by Vigyan Prasar/DST/State Government:

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, 2018 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.

Series of Science Awareness Programme during 2018-19

b. Workshop on Ham Radio (Natural Disaster Communication tool): A week long workshop on Amateur (Ham Radio) was organized from 9th to 14th May 2017 in Sikkim Science Centre, Marchak, Sikkim .40 participants for various organizations, departments, volunteers, media personal had attended the work shop. Out of these 23 had appeared for Amateur Station Operators Certificate (ASOC) Examination and 11 have already received the license for operation of Amateur (Ham) Radio .

Procurement of the accessory items like Antennas for HF (2 Unit), VHF and UHF (l Unit), Coaxial Cables for antennas, VHFruHF antenna, DC Power Supply for the main Station, VHF & VHF+UHF dual trand handheld Walkie-Talkies (2+1 unit), Antenna Change-Over Switch etc. is being initiated

As at present S&T Council you have eleven (11) license holders, to run a local network on VHF for disaster preparedness and mock drills who can work during natural disaster after activating the station This would be the first hrst if its kind in a Science Centre in India.

c. "Sci- Connect" Science quiz competition supported by Vigyan Prasar.

(Nurturing young talents of North East in Science)

"Sci- Connect" Connecting Science with Young Talent is a program devised by Vigyan Prasar especially for the children in North Eastern States of India, i.e Assam, Mizoram, Nagaland, Tripura, Manipur, Sikkim, Meghalaya and Arunachal Pradesh.

Objective:

- To sensitize the young children of upper primary and secondary level towards the science in day to day life.
- To help them practice the method of science from their childhood.
- The programme will also help children in remote areas to showcase their talent and innovative ideas.

The program has two components:

- Screening of science films in schools, science clubs in all the North East states.
- Organization of Quiz Competition on the basis of content devised through screening of films and selection of best young minds of the North- East.

With this approach all innovative resource material in the form of video program will be made accessible to the young children of the remote areas.

Activities undertaken:

The program was organised in 4 stages:

- Screening of films
- District level Science Quiz
- State level Quiz
- Regional Level Quiz

Stage I: Screening of Science films produced by Vigyan Prasar was organised at all the registered schools.

Stage II: From the content of the screened film, a selection test in written format was organised at all the participating/registered schools. 15 participants was selected from participating States for the next level.

Stage III: The selected 15 participants for the Stage II was invited for State level. Five teams of three students each was formed where. One best team from the comprising three students was selected for the regional level from each State.

Stage IV: One team from each Sate was invited for the final round.

A total of 1334 students from Sikkim participated for Sci-Conncet 2018-19. Sikkim was host for conducting the Sci-Connect level II where students from Tripura, Nagaland, Manipur and Sikkim were the participants.

d. Workshop Science Awareness Programmes supported by State Government:

One day awareness programme on Traditional Knowledge with respect to Medicinal Plants of Sikkim for College Students.

Workshop on low cost teaching aid in Science For three days for the graduate teachers of State.

e. Mathematics Orientation And Exposure Programme For Students During 2018-19.

Sikkim State Council of Science & Technology organized "**Mathematics Orientation and Exposure programme for students"** of Sikkim on 17/09/2018 at Sikkim Science Centre, Marchak, East Sikkim. The main objective for organizing the programme was to encourage the students to take up mathematics in senior secondary level and focus on tackling the fear among students in Mathematics. 200 students from Class VII & VIII participated in the programme

Pic: Resource person during the inaugural function of Mathematics Orientation and Exposure programme.

Sikkim State Council of Science & Technology organized State Level Mathematics Olympiad at Sikkim Science Centre, Marchak on 30/09/2018

In the Mathematical Olympiad held on 30th September2018, 400 students from all over the state comprisind of al, four districts of the state covering 20 Government Secondary and Senior secondary schools participated in the programme.

The main objective of the programme was to prepare the students for regional and national Mathematics Olympaid. Different questions of different standards were prepared and were discussed with participants during the programme. Also mode of preparation for Regional and National level Olympaids was highlighted by the resource persons during the programme.

f. SCIENCE AWARENESS PROGRAMMES – NSD 2018:

National Science Day is celebrated every year on February 28. National Science Day is celebrated to commemorate discovery of the 'Raman Effect', which led to Indian scientist Dr. C.V.Raman winning the Noble Prize in Physics in 1930. Raman Effect is a phenomenon in spectroscopy discovered by the eminent physicist while working in the laboratory of the Indian Association for the Cultivation of Science, Kolkata.

The basic objective of celebration of National Science Day is to propagate the message of importance of science and its application among the people. National Council for Science & Technology Communication (NCSTC) of Department of Science & Technology (DST) is nodal agency to support catalyze and coordinate celebration of the National Science Day throughout the country, particularly in scientific institutions & research laboratories.

During the National Science Day 2018 programme which started on 28th February 2018 organised by Sikkim State Council of Science and Technology, a series of programmes comprising of following activities were organized during the first phase:

1. Popular Science Lectures,
2. Quiz competition
3. Essay Competitions
4. Painting Competitions

These competitions were organised in different venues and in different dates of state covering all four districts which covered twenty schools comprising of Junior High School, Secondary Schools and Senior Secondary Schools.The painting competition were organised for primary level student based on Theme of National Science Day 2018 – "Science & Technology for a Sustainable future". This competitions were attended by more the one hundred students. Each venue had winners and reunners up who were given certificates and award.Essay writing competitions for Junior High School level was organized based on theme of NSD 2018. Two hundred students participated in total hailing from remote schools from all four districts. Winners were presented certificated and awards.

Simiarly, Quiz competitions were orgainsed on basic science for secondary level in all the venues. Twenty Schools participated in the final rounds of Quiz Competitions. Winners were presented with certificates and awards / prizes.Popular Science Lectures were delivered on the theme and also on

Biodiversity and Weather & Climate Change in all the venues for creating awareness among the students which covered more than 2000 students including teachers. The students were made awareness on the objective of organizing National Science Day every year with different themes.

National Science Day Programme in different Districts of Sikkim during 2018-19.

Pic: Exposure visit of students to Biotechnology Lab at Vigyan Bhawan, Sikkim.

g. INSPIRE 2018-19:

Department of Science & Technology (DST), Government of India flagship programme 'Innovation in Science Pursuit for Inspired Research (INSPIRE) is being implemented continuously since 2010. The scheme covers students in the age group of 10-32 years and has five components. The first component, INSPIRE Award aims to motivate students, in the age group of 10-15 years and studying in classes 6 to 10, to pursue Science and a career in Research.

Under the INSPIRE AWARDS - MANAK Scheme, students are invited from all government or private schools throughout the state irrespective of their educational boards (national and state) to send original and creative technological ideas/innovations focusing on common problems and come up with solutions on their own., be it household or for porters, labourers, society or the likes. Once the student has thought of an idea, he/she can submit their ideas to the Principal/Headmaster of their schools.

Sikkim State Council of Science & Technology, Sikkim has organized the combined Districts and State level exhibition cum projects competition on 28th and 29th December 2018 at Sikkim Science Center, Marchak, Ranipool. There are 97 Students has been selected from the four districts of Sikkim during the financial 2018-19 out of 96 students 60 along with escort teachers has been participated during the combined Districts and State programme.

Objective Of Programme:

INSPIRE aims to identify, sustain and strengthen human capacity for Research and Development base of the country. Inspired research achieved by means of an innovative scientific pursuit is the objective of this flagship scheme of the DST. INSPIRE Program covers students in the age group 10-32 years. It has five components spread over in three major schemes. These are:

INSPIRE Award MANAK (Million Minds Augmenting National Aspiration and Knowledge) scheme, previously known as INSPIRE Award Scheme, is being implemented through State and UT governments with objectives (i) to attract young students to study science and pursue research career (ii) to promote creative thinking and foster a culture of innovation among them.


Combined Districts Level Exhibition cum Project Competition held during December 2018

The Name of selected Students /Projects is for the financial year 2018-19.

1. Abishek Kumar, Singtam Sr. Sec. School,East Sikkim : **Path Producing Electricity.**
2. Ayush Ranjan, Rangpo Sr. Sec. School, East Sikkim, **Digital Smart Dusbin.**
3. Abishek Chettri, Lower Sumin Sec. School, East Sikkim: **Solar Tracking System for maximum Consumption.**
4. Aditya Sharma, Namchi Sr. Sec. School, South Sikkim: **Automatic Curtain Dryer.**
5. Ashis Dangal, Rangpo, Sr. Sec. School: **Phone Charging Booth.**

The selected four students have been participating in the National Level INSPIRE programme.

National Level programme at Delhi 2019

News paper clips:

NEWS

Sikkim students to participate in INSPIRE programme at Japan

SE Report

Rs 7.33 crore cash seized in NE since March 10

SC to EC: You have woken up to take action

h. New Facilities: Various new facilities have been added up which are all due for inauguration.

(i) 8m dia Planetarium - Planetarium is a facility for presenting educational and entertaining shows on celestial wonders and the magic of night sky, capturing the beauty and magnificence of celestial objects and phenomena. A dominant feature of most planetariums is a dome shaped projection screen onto which scenes of stars, planets and other celestial objects can be made to appear and move realistically to simulate the complex motions of the heavens. The celestial scenes can be created using a wide variety of technologies. The 8m dia planetarium has a seating capacity of 53 and daily 4 shows can be held.

(ii) 3D- Theatre - A 3D/three-dimensional film is a motion picture that enhances the illusion of depth perception. In Science Centre ambience, short length scientific documentaries produce an immersive experience for the visitors and this element of surprise helps communicate science in a better way. Many modern science centres are now equipped with the 3D theatre facility. It creates immense curiosity among the visitors and simultaneously generates revenue.

(iii)Innovation Hub -The 'Innovation Hub' is a Science laboratory for high school (classes VI to XII) and College students where they are engaged in creative and innovative activities. The underlying ideas is to promote critical thinking and problem solving ability through hands on activity. The broad sections of Innovation Hub are 'Hall of Fame: Innovators and Inventors', 'Innovative Resource Centre', 'Innovation Laboratory' and 'Tech Lab: Robotics and Microprocessor Programming Facility'.

(iv)Biodiversity gallery – Different exhibits related to Sikkim Biodiversity has been displayed in this section which mostly aims in providing the information on biodiversity among the mass and thus helping the students in conserving the biodiversity of Himalayas by creating awareness at a glance.

i. India Skillpedia

The Sikkim State Council of Science and Technology has been making efforts to popularize science among students, youth, women, farmers and community at large, and binging to their attention technologies which can be harnessed for livelihood, setting up of enterprises and growth of business, and for community development.

The advocacy and promotion has largely focused on know-how, technologies, innovative approaches, methods, protocols and knowledge sharing. Online discussion forums, sci-tech query support, knowledge repository, blogs and services for delivery of technical support customized to the needs of users have been implemented on the IndiaSkillPedia Portal.

The state council of S&T has also functioned actively to promote entrepreneurs, facilitate growth of enterprises, encourage startups and disseminate ideas and innovations for harnessing technologies for development of products, boost industrial growth and access markets offering their products and services.

Following the development and deployment of the IndiaSkillPedia/ Techpedia Portal, augmented efforts are being made to institutionalize and build a network of centres which would:

a. Document knowhow, develop digital knowledge resources which would serve as a reference for the following

   (i) **Adoption of science in everyday life** in the households, rural community assets, common amenities area, public parks, educational institutions to demonstrate water harvesting, waste management, augmenting water resources, use of renewable energy, installation of micro-hydel plants, use of bamboo and local materials, improved farming practices, reuse of bio-waste and composting, enhancing bio-diversity and so on

   (ii) **Advocating operations, taking up activities related to production, manufacturing and service delivery** with the infusion of Do-It-Yourself Culture, encouraging production of goods and services and moving away from consumerism

   (iii) **Encourage ideas, innovations incubating technologies for product development** and commercialization

b. **Train and groom** students, youth, volunteers and women as knowledge workers, mentors and practitioners for the purpose undertaking the following tasks:-

   (i) Promoting application of science, adoption of technologies
   (ii) Creating demonstration centres and public utility services such as nurseries, sales and service of gadgets, equipment, devices and tools / kits for practitioners
   (iii) sourcing, capture, compilation of knowledge resources
   (iv) repurposing/reuse of public domain knowledge
   (v) collaborating with R&D Establishments and Industries to obtain and present knowledge of available technologies,
   (vi) make cognitive presentation for ease of understanding of information and knowledge relating to setting up an enterprise, installation of equipment and machinery, plant layout and production, product development, quality aspects, packaging and logistic supply chain management etc.

c. **Assist in the capture of tacit knowhow, indigenous knowledge, techniques, methods and approaches** used by practitioners, experts in various sectors in the ground of their demonstrated capability which is proved to successful.

Establishment Of Science Clubs And Resource Development Centres

A network of Resource Development Centres are being established as part of (i) educational institutions – Schools, Colleges & Universities, (ii) Departmental Field Offices (iii) facilitating and counselling centres' or single window service delivery units of Government agencies, organizations.

The **Re**source **N**etwork for **D**issemination of Ideas, **T**echnologies, **I**nnovati**on**, (RENDITION) units would be a part of the science clubs. They would comprise of a media production team with a camera person, interviewer and researcher-cum editor for science application, documentation of know , practices and technologies.

To start with 5 such Science Clubs & Rendition centres are being set up in 5 Universities/Colleges/Schools development as under:-

(i) Sikkim University, Mass Media Communication Development
(ii) Sikkim Manipal Institute of Technology, Department of Computer Science
(iii)Advance Technology Training Centre Bardang(Polytechnique)
(iv) Nar Bahadur Degree College, Department of Tourism
(v) Deorali Girls Senior Secondary School.

Each of the Centres to be set up in the above 5 institutions will be guided in the establishment of the centre, training of the persons who will undertake various operations and activities and be monitored for the documentation, compilation, development of resources, advocacy &field activities and community involvement. There would be training imparted for undertaking field research, technology exploration, development, dissemination, development of digital resources, interviewing of experts, development of protocols, use of knowledge capture technologies and such other related activities.

The experiment has proved to be successful. A group of 12 students have been trained and have produced about 36 digital resources over a period of two months. The digital media production kit has been given to Science Club with assistance from the Sikkim University, Mass Media Communication Development considering the success of the experimentation it is proposed to expand the network of Science Club in the other Educational Institutions mentioned above. NITI Aayog may consider providing financial support for the rendition centres that are proposed to be made functional in Sikkim.

The Digital Resources developed will be uploaded and populate in the India SkillPedia/TechPedia Portal and the users attention will be drawn for access of such knowledge resources and delivery of services through SMS and emails.

Features Of Indiaskillpedia/ Techpedia Portal

The indiaskillpedia.com / indiatechpedia.com portal serves as a collaboration and transactional platform/ ecosystem, for science enthusiasts, innovators, community development practitioners, social enterprises promoting livelihoods, skill aspirants, entrepreneurs, start-ups and budding, ambitious professionals,

(i) providing access to knowledge and facilitating authoring system for sharing and upgrading know-hows, skills & competencies, for applying science and leveraging technology for human welfare, improving quality of life in communities and for sustainable development
(ii) engaging them by providing adaptive, automated delivery of information and services for their empowerment and handholding
(iii) linking them to sources of knowledge, professionals, state agencies and enabling pursuits for sustainable livelihoods, pursuits to establish startups/ enterprises to engage in production, manufacturing or service delivery, sustain such entrepreneurial ventures and
(iv) keep updated and enriched to enhance their capacities for innovations, building capacities and confidence for rapid execution of ideas and scale ups

Such outcomes as those above would be achieved through the sharing and harnessing knowledge and innovation through collaboration, building individual and organizational competencies and capacities and ushering in technological and industrial competitiveness of the Indian industries

As an online Knowledge Repository, the Portal serves the purpose of accessing, exchanging, sharing resources that can help in pursuits for augmenting capacities, competencies, acquiring know-hows, assimilating an understanding for planning/ performing tasks, producing, manufacturing, building, assembling, installing, setting up or managing processes.

Embedded features and functionality in the portal enables authoring of contents/ contributions, invoking process automation for review and approval for authentication, acknowledgement, validation of uploaded/ reviewed or modified contents for quality and acceptability, as also for the required organization, annotation, cross referencing and presentation of such knowledge resources intuitively adapted to the profile of the user.

The portal subscribes to the paradigm of Open innovation, which is becoming increasingly relevant in the current scenario where collaboration, networking and partnerships play significant roles to determine success and outcomes.

Building Capacity In Individuals, Enterprises And Communities For Knowledge Services Delivery

In developing an understanding the nature of knowledge that would benefit communities, and the manner in which they can be made available the following aspects could be considered;

a) Contents would need to be useful and focus on essentials – such as know-how, demonstration of how operations are done, technologies available for use, practices that will need to adopted for successful production and sustainability of operations, practitioners insights on dos and donts, standard protocols to be adopted, the nature and characteristics of inputs, value addition methods, management and mitigation of risks etc
b) Experts, volunteers, social enterprises will be involved in their roles as knowledge workers for the purpose of undertaking the following tasks
    i. Sourcing, capture, compilation of knowledge resources
    ii. repurposing/ reuse of public domain knowledge,
    iii. collaborating with R&D establishments and industries to obtain and present knowledge of available technologies,
    iv. make cognitive presentation for ease of understanding of information and knowledge relating to setting up an enterprise, installation of equipment and machinery, plant layout and production, product development, quality aspects, packaging and logistic supply chain management etc.
c) Structuring and organising knowledge resources classifying them under various areas, clusters, sub-clusters related to enterprise lifecycle, sourcing entities- such as state agencies, enterprise development centres, industry, R&D establishments, business consultancy service providers, training institutions, legal finance establishments etc , as also under sector or domain specific classifications– such as relating to agriculture, textiles, industry, food processing, environment and climate change, waste management, biotechnology etc and should be so represented in the knowledge repository to enable ease of search and retrieval, access and delivery, analysis of usage, authoring, validation, transacting and management of content.
d) In addition to sectoral and domain focus as above, it would also need to be thematically organised such as access to technology, access to finance, common facilities tor production, manufacturing and service delivery, ease of business – in setting up enterprises, management of enterprise, ensuring compliance etc., market access
e) Knowledge resources would require to be indexed, cross referenced and presented in context to the user adapted to his needs (*ascertained from his activity patterns, access behaviour, counselling and facilitation centre inputs on the basis of his visitations seeking assistance and system intelligence*) and in the course of his actions seeking to explore, discover, and make use of the knowledge to would provide actionable insights to the user
f) Knowledge workers will need to undertake research, analysis of user behaviour, engaging stakeholders, knowledge partners in the course of developing content and knowledge resources and instituting/ orchestrating services with appropriate strategies, mechanisms and collaboration with the knowledge delivery, facilitation and service centres

g) Engaging and consulting knowledge partners for accurate and succinct answers to the most pressing operations or business questions would require to be pursued with such answers being made available to the users
h) Knowledge Resources developed would require to provide insights on the basis of experience gained earlier, feedback on performance, dos and donts, aspects requiring attention that would contribute to successful completion of operation
i) Disseminating knowledge would be for the purpose of imparting understanding on how products are made in order that increased focus be given to production of goods and associated services locally rather than pursue a consumerist tendency to avail produced goods and services made available elsewhere (*such as sourcing from china or relying on trade channels which route goods produced abroad*)
j) Knowledge processing would involve intensive activities that are data driven and encompass the process of gathering, managing, analysing and delivering objective insights into operations related to production/manufacturing, service delivery or conduct of businesses.

Techniques For Knowledge Capture

The domain specific expertise knowledge is acquired from the domain specific experts. The knowledge captured must be validated and confirmed as accurate and reliable. A wide repertoire combination of rules, cases, models, or theories such as predicate logic, mimic human reasoning can be invoked for effective knowledge capture.

Crowd sourcing is a useful approach to source and gather knowledge. The India Enterprise Portal has an authoring system which enables contributors to register and upload contents in the form of

a) compiled pdf or word documents or such other multimedia content formats such as image sequence compilations, presentations or video
b) blog anchor presentation with anchor images, brief text and redirection links to blogs that are already available in public domain
c) hypertext media with content texts embedded with cross referencing hypermedia links linking to a network of structured bodies of texts with multimedia content

Interviewing is the method of asking questions to the domain expert about the domain interest and their task performance. The tools of interviewing can be unstructured, semi-structured, or structured.

The success of an interview session depends on how the questions are being asked. Difficulties may arise when the interviewer is not familiar with the domain of which questions to be asked. The ability of the expert to articulate their knowledge also plays a big role in the success of the interview. The expert may not remember exactly how they perform a task, especially the task being performed automatically.

Some interviews used to build a particular type of model of the task. Therefore, based on information obtained during the interview, model is built by the knowledge engineer and then reviewed with domain expert. In some cases, the models can be built interactively with the expert. Depending upon the context, either a structured or unstructured interview technique can be adopted.

7. REGISTRATION OF TRADEMARKS

The trademarks for **techpedia** under Class 35, 41, 42 & 45 and **technopreneur** under Class 45 has been registered with the TradeMark Authority of India.

The Domain URL for IndiaSkillPedia and IndiaTechPedia have been registered with the NET4 Domain Registration Agency.

The portal has been lauched in the Amazon Cloud infrastructure.

TRAINING WORKSHOP IN PROGRESS FOR SCIENCE CLUBS





Future Activity:

1. A proposal for Nano hydel Project in collaboration with SEED Division, DST, GOI has been proposed.
2. Discussed regarding Development of Rural Technology Park and Women Technology
3. Entrepreneurship Development on newer technology.
4. Extension of Science Centre:
   i) A structure as guest house
   ii)Development of bee park.

5. Dryer for Cardamom, ginger, mushroom and other herbs and vegetables energized by Nano Hydel Power generated by local water streams.

Proposed list of Projects for Technology Demonstration Centre:

Introduction:

Sikkim is predominately a rural state where 75% of the populations live in rural area. The total area of Sikkim is 7096 sq km out of which 80% of the land is covered with reserve forest, alpine zone, cold deserts and mountains and only remaining 20% of the area is available for settlement, agriculture/ Horticulture and allied activities. Per capita land holding in Sikkim is less than 0.5 acres hence not sufficient in food grains, vegetable and necessary goods and items. Hence most of the food materials are imported from outside state. The main cause of shortfall is low land availability, landless farmers, difficult terrain, water scarcity etc. Shift in state agriculture policy from chemical fertilizer to organic

Creation of rural infrastructure will facilitate adoption of farm and nonfarm (manufacturing) sectors related technologies for enhancing the efficiency and improving the socio economic condition of the rural population of the hill State.

Vision:

To serve as a centre for wider dissemination, provide functional exposure and demonstration and provide training on appropriate & affordable rural farm & nonfarm technologies to all the stakeholders including entrepreneurs/ rural poor for alternative livelihood options and improving quality of life, and thereby enabling sustainable rural development.

Objective:

1. To set up a Technology Demonstration Centre to demonstration and transfer of proven technology modules to grass root level and on dynamic replicable appropriate rural technologies based on the local needs.
2. Develop collaborative network with technology developers and scientific institutions and user group with market with both backward and forwards market linkages.
3. Facilitate transfer of technologies by entrepreneurs and experts to target group by display /demonstration and manufacture of high quality products and sale for alternative livelihood options.
4. Eventually, to establish units for transfer of all successful field tested technological options suited to various diverse social groups and suitable to all the geophysical conditions across the state.

Approach:

Tie up with premier institutions for trainers training and capacity building of the master trainers and resource persons of the project

1. Collaborative networking with technology developer's users, support organization, financial institution, local bodies, State Department, SHGs.

2. Selected Technology models are placed in display demonstration and production on marketing mode to serve as technology demonstration.
3. Dissemination of technologies for livelihood options through training to beneficiaries of rural areas identified through local bodies, PRIs and districts administration in batches.
4. Keep abreast with the innovations and provide a platform for periodic exchange of ideas between KVK, ICAR, GB Pant Instiute, Spices Board, Insect Pest Management Centre and technology generators/inventors, other scientific establishments, marketing agencies and financial institutions.
5. To support and hand hold the trainers after training for setting up their own units in their areas for alternative livelihood options.

Technologies proposed for the Technology Demonstration Centre:

1. Training And Setting Up of Apiary as business model for alternative livelihood
2. Technology Intervention For Sustainable Livelihood through Use Of Bamboo for the Rural Population Of Sikkim
3. Demonstration And Training On NADEP Organic Compost For Production Of Organic Farming
4. Technology Demonstration, Training and Installation of Water Mill Businees Model:
5. Training on mushroom spawn production, mushroom cultivation, packaging and marketing for unemployed youth of Sikkim.

Ongoing Activities:

0. National Mathematics Day – 2019 supported by NCSTC.
1. National Science Day – 2019 supported by NCSTC
2. Capacity Building and Awareness Workshop – supported by Vigyan Prasar
3. Workshop cum Camps on Understanding Nature including Climate Change – supported by Vigyan Prasar.

Key activities under taken:-

1. **Technology Development**:

a. Demonstration of Ice Stupa in Sikkim:

Himalaya is one of the vulnerable areas in terms of climate change. 'Ice Stupa' is an artificial glacier build in natural environment which resemble the Stupa, a cone shape structure named as 'Ice Stupa'. The massive melting of glacier and ice field throughout the world is one of the major impacts of climate change and global warming. This technique of artificial glaciations proves to be useful for re-glaciation if we put some more efforts in it.

Glaciers are one of the important sources of water for drinking and irrigation purpose in the Himalayas. The techniques can make water availability possible during dry for irrigation.

b. New Agro Technology for Hilly region of Sikkim introduced.

Integrated fish farming, vermicomposting and azolla cultivation has been developed. Multilayered cropping system of cardamom cultivation with passion fruit and other fruit trees developed

c. Developed two new Cymbidium hybrid:

Two new cymbidium hybrids developed. One is hardy and long lasting type and another large flowered. In both the cases the traits of original *Cymbidium lowenium* of the region is re-expressed. Sikkim is also known for orchids. There are very few indigenously developed orchid hybrid which will have the commercial importance.

d. Low cost technology to clean greenhouse plastic:

One of the biggest problems of greenhouse farming in the Himalayan region is the accumulation of algae, fungi and dust on the greenhouse plastic due to high humidity and rainfall. After few years of greenhouse cultivation, the plastic becomes opaque and blocks the sunlight due to which the crop grown inside will be greatly hampered. Further, the pests and disease incidence increases due to congenial environment. S&T Council of Sikkim has developed a simple and easy method of cleaning greenhouse plastic.

e. Development of drying of cardamom and other vegetables by using hydel power generation from local streams at final stage:

f. Successfully developed the protocol for tissue culture of large cardamom for propagation of elite quality planting material:

The protocol for tissue culture of large cardamom for propagation of elite quality planting material is successfully developed for all the popular cultivars. In the next phase, large scale production will be made and distributed to the farmers under a project funded by DBT, GOI.

2. Technology Demonstrations:

a. Demonstration of Ice Stupa for storage of water resources for lean season and reglaciation efforts in Sikkim
b. Demonstration of Tissue Culture techniques and transfer of technology
c. Demonstration of modified cultivation practices of large cardamom for shortening gestation for fruiting from three years to two years.
d. Rain Water Harvesting for drinking purpose at Suldung Kamling GPU funded by UNDP
e. Development of dryer for Cardamom, Ginger, Mushroom and ether herbs and vegetables energized by Nano Hydel Power generated by Local Water Streams of Sikkim
f. Micro Solar Dome for rural households for 24 x 7 solar lighting
g. Azolla is found to have multiple use such as cow feed, pig, chiken, fish feed. They are also used in rice field to control weed and enrich the soil. The use and method of azolla cultivation is demonstrated to the farmers of the locality.

3. Popularization of Science:

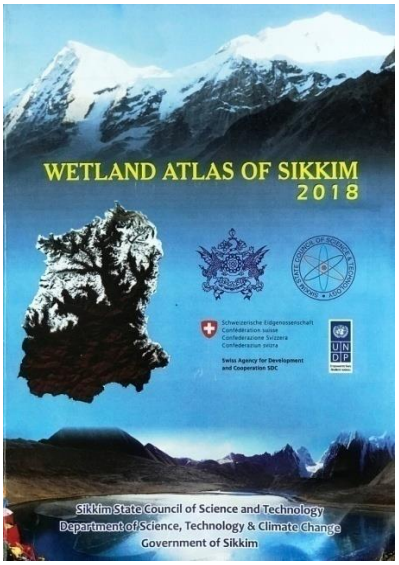
i. Awareness programme on Organic Farming to farmers / NGOS and Panchayat Members in all four districts of Sikkim
ii. Awareness workshop on Climate Change Adaptation in 15 senior Secondary Schools on all four districts of Sikkim
iii. Awareness programme on Biodiversity and its preservation and sustainable utilization
iv. Master Trainers Workshop on Low Cost Teaching Aid for teaching Physics and Chemistry to 100 science teachers at Sikkim Science Centre, Marchak
v. Training to the College student on the Remote Sensing and GIS application, Geoinformatics and Climate change.
vi. Awareness workshop on Traditional Knowledge with respect to medicinal plants of Sikkim to College Science Students and NGOs
vii. 15 days workshop on tools and techniques of Animation to students at Vigyan Bhawan
viii. Training on tools and techniques of Biotechnology to Research Scholars and College Students of Sikkim at Biotechnology laboratory at Vigyan Bhawan, Deorali, Gangtok
ix. Biotechnology outreach and awareness programmes in 30 school in all four districts of Sikkim
x. Awareness lecture series on Intellectual Property Rights in Colleges, University and students and public
xi. Training on Bioinformatics to Research Scholars and College faculty
xii. Laboratory exposure of science students of various schools of Sikkim.
xiii. National Science Day 2016-2017 at State Level
xiv. National Children Science Congress 2017: organisation of District and State level competitions
xv. INSPIRE scheme 2016-17: Organization of District and State level competition
xvi. Radio Serials in Science in collaboration with All India Radio and Vigyan Prasar
xvii. Innovatin Hub developed in collaboration with National Innovation Foundation and BITM, Kolkata
xiii. Patents: State PIC has filed for Patent in Agriculture Tool
Applied for GI in six item viz: Sikkim Mandarin, Sikkim Temi Tea, Lepcha Hat
Copyright filed for two film stories by PIC
Protection of Plant Variety and Farmers Right (PPV&FR) for one local rice variety

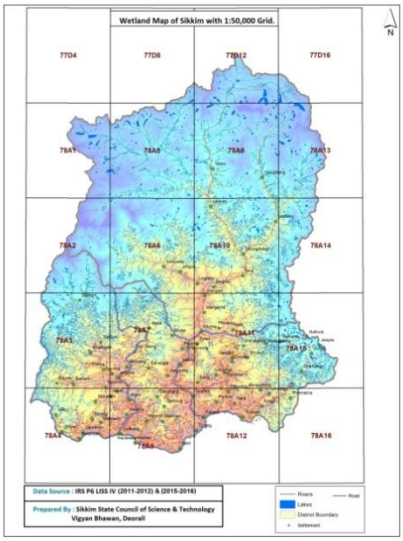
4. Any new innovative activities

- Siphoning of Excess lake water at high altitude South Lhonark lake to prevent Glacial Lake Outburst Flood
- Networking programme with Agriculture department on GIS and Remote Sensing for Micro planning on Agriculture sector.
- Netrworking with Water Resource and River Development Department for preparation of DPR on River Training Works
- Collaborative programme with Land Revenue & Disaster Management Department for GLOF mitigation of South Lhonark Lake
- Forest Environment and Wildlife Management Department for Integrated Watershed Development Programme,
- UNDP and Rural Management Development Department for Spring shed Development under National Adaptation Fund for Climate Change
- Networking with the GIZ for Technical cooperation on Climate Change Study
- Networking with UNDP on Climate Change Adaptation Programme and Wet land Mapping
- Collaborative pogrammes with Swiss Development Cooperation for CCA
- Networking with UNDP for Rain water Harvesting at Rain shadow Area in West Sikkim
- Collaboration with NB Institute of Rural Technology for Promoting Micro Solar Dome Technology in Tribal Pockets of Sikkim in Different Agro Climatic Condition and Varied Type of Housing.
- Innovatin Hub developed in collaboration with National Innovation Foundation and BITM, Kolkata
- Automatic real-time online monitoring of the flood levels of a specific area, based on such remote cyber surveillance systems and image processing methods, will help to obtain instant flooding and water level rising event alerts. The method can better meet the practical needs of disaster prevention and help evacuate human habitation areas that would to be affected on account of flooding.

  The system relies on dynamic detection of floods and overflow/ inundation is considered an intrusion object in the video surveillance image. A surveillance video from a small-scale field of view is used as the input source in order to monitor the water flow and water flow level trends in the image features are discerned. An image segmentation technique is used for removing the surrounding objects, such as building and the geographical background, and separating the intrusive objects for a subsequent risk analysis.
- A region- based image segmentation method and flood-level classifiers are used to identify the on-site variation of the rivers water levels in the identified flow terrain area to determine and calibrate the corresponding risk levels.

- **Development of Empirical equation for Glacial Lake Volume and area**
  Early Warning Flood Detection and Monitoring System
  Coordination with GIZ & UNDP Partners in different line Department
  Preparation of Wetland Atlas of Sikkim Using Remote Sensing and GIS





India Enterprise Portal

Brief Overview

The *India Enterprise Portal* has been architected for the Ministry of Micro, Small and Medium Enterprises under the Scheme for Promotion of MSME in the North East Region and Sikkim, on the basis of validated approaches in the earlier deployments of the skillyoungindia.com and indiaskillpedia/ techpedia portals.

The Strategic approach which guided the development and deployment of the Portal relies on presenting a unified blackboard architecture and collaboration platform, serving as a cyber eco-system, cutting across the boundaries of several Ministries, State Agencies, Industries and Institutions serving the cause of promotion and growth of entrepreneurship, start-Ups and MSME's in our nation.

The portal relies on distributed, decentralized content updating of operations, sharing of information/resources by the network of partners, state agencies as also the Enterprise Development Centers, which are proposed facilitation centers being set up across the nation on the lines of PHC/ ICDS centers and such other field Offices of the governments.

The India Enterprise Portal encompasses functionality and features for **online delivery of services- eServices**, to entrepreneurs/ start-Ups – aligned with

(a) their profile and requirements as discerned from their inputs, interactions during the use of the portal, as also from

(b) the posting of their needs by facilitators, on the basis of counseling and facilitation services offered by various field operatives and centers.

The Portal encompasses functionality features besides eServices, which includes;

(i) **Knowledge Repository** with authoring systems,
(ii) **e-Market Place**,
(iii) Unified view of information related to **programmes and schemes** for entrepreneurs notified and implemented by the Ministries of Govt. of India,
(iv) **R & D Solutions and Technologies** developed by various Institutions,
(v) **Directory Services and Profile pages** for each of the Registers Users, Industries, State Agencies and Institutions,
(vi) **Events** notification with mention of follow up action required
(vii) **Streaming blog/ YouTube anchors** and contents
(viiii) **Ideas and Opportunities in Focus Sectors** with blog contents and relevant resources to evoke interest and enthusiasm in entrepreneurs

The portal applies **cognitive methods** to enhance comprehension and ease of understanding with visual cues, tool tips, enriched GUI and interactive features and system intelligence for notifications, messages and onscreen alerts to users to draw their attention and engage them in the process of on-boarding them and promoting patronage in the use of the facilities offered on the portal.

The solution architecture for the portal subscribes to the **paradigm of Open innovation**, which is becoming increasingly relevant in the current scenario where collaboration, networking and partnerships play significant roles to determine success and outcomes.

System intelligence is built in to enable log the user activity on the basis of his consent in order to provide him customized links and recommendations adapted to his needs.

Organization of Knowledge Resources and E Services

The Knowledge and Service Clusters, Sub-Clusters and Thematic Nodal Clusters are structured and organized along

(a) the life cycle of the enterprises/start-Ups –such as inception; setting up infrastructure; planning for production & services; operation & management; sustainability, scale-up & value addition
(b) Across profiles of service agencies/ facilitators
(c) Across service clusters and categories and
(d) Across focus sectors.

Processes are built in, - to take service requests, register for redress of grievances, provide status updates, seek resolution on issues / technical assistance, view notifications seeking responses/ compliances, document uploads to enable process service requests.

Features and facilities for management of the knowledge resources, information on services and related contents, their representation and presentation under various links provided in the GUI layout are provided. Links are also presented for operations such as previews, downloads, archiving/ editing/deleting or managing metadata of contents.

5. SUCCESS STORIES:

1. Demonstration of Ice Stupa (Artificial glacier) in Sikkim

Background

Ice Stupa is an innovative technique for making artificial glacier which resembles the Stupa, a Buddhist monument in cone shape. In this technique the water from height bring down to a specific location through pipes and it makes sprinkles from the top of the cones, resembling the water fountain in temperature of -10 to -30 degree centigrade which usually reaches in winter season in high altitude areas. The water sprinkle when it come in contact with the freezing air it freezes and in the course of time it piles up to form giant Ice Stupa. The amount of stored water depends on the height and volume of the Stupa. Later in the lean season, the water starts melting and the melt water can be used for irrigation and drinking purposes. Usually in the months between March-May there will be crises of water in most of the Himalayan states including Sikkim due to the less or no rainfall during winter. Spring usually dries up or can fetch less water due to the less winter rainfall. So, Ice Stupa is a natural water conservation technique in high Himalayas in the air in the form of Ice for the use in water crises months. The proposed project site is located in near Kalapathar, North Sikkim, at the altitude of 3808 m meters above mean sea level.

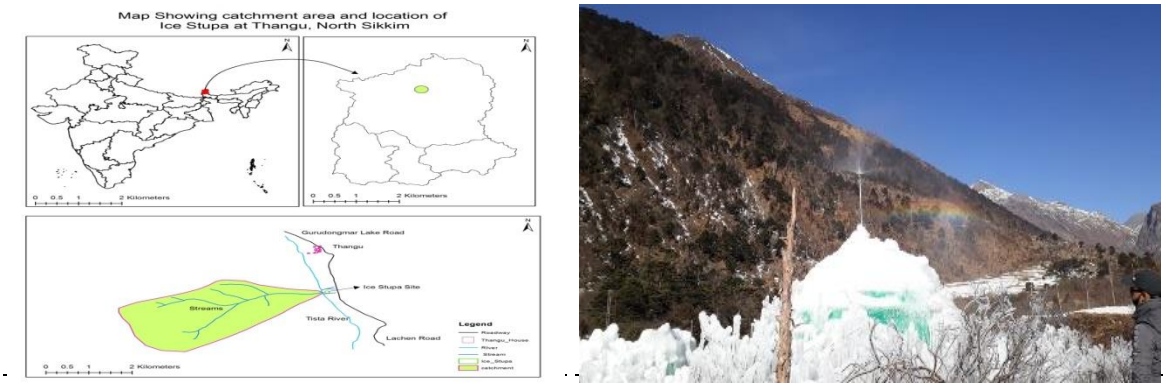


Fig. Photographs of location map & in making of Ice Stupa at the site

Methodology:

- Perennial stream has been identified so that the flow of water will be there in the stream even during the extreme winter. Water from the stream is piped to the location of Ice Stupa site from uphill area (roughly 250 meters) so that enough head can be achieved to attain the height of Stupa.
- Area with higher slope gradient is preferred so that the water inside the pipe may not be frozen while flowing down to the site from intake point. Higher gradient provides higher pressure of water inside the pipeline which prevents water from freezing.

- In addition, the exposed pipeline will be covered from outside by thin sheet of Insulator which maintains require heat within pipeline to combat the freezing.
- At the end of the pipeline, a pipe will be attached vertically and the height of the pipe will depend on available head of the pipeline. The vertical pipe will be installed properly in a leveled position so that outflow water passes from all the side equally.
- The outflow water when come in contact with freezing temperature outside tend to freeze slowly to form ice stupa. Sprinkle may be used to break the water into the small droplets to enhance/accelerate freezing.

Making of an Ice Stupa in Thangu Valley, Sikkim Himalaya

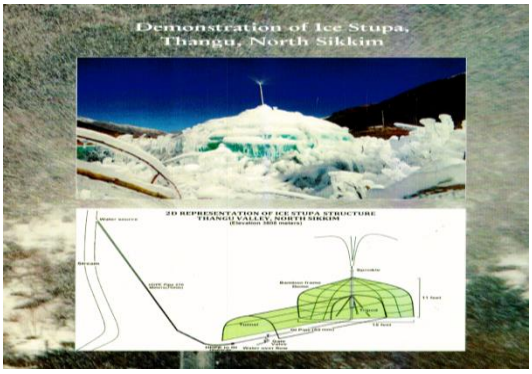
It was in November 2018, the team from Sikkim State Climate Change Cell attended 3 (three) days Hand on training on making of Ice stupa in Phyang Village, Leh Ladakh. After successful completion of training, the team has identified the suitable location to build Ice Stupa. The site is selected about 1 km below Thangu village, North Sikkim.

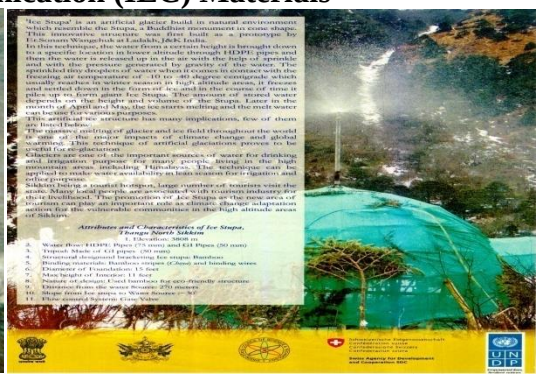
After receiving of HDPE pipes, the team started building the foundation and structural components at the selected site from Jan 05, 2019. The principle behind the formation of ice in the selected site is the breaking of water droplets from sprinkle system to small nuclei which gets frozen when it comes in contact with open freezing environment that accumulates to give structure of the cone.

Findings:

1. Successfully developed a prototype of Ice Stupa at Thangu, North Sikkim in the winter month of 2018-2019.

Development of Information Education Communication (IEC) Materials





Way forward:

Department of Science and Technology Government of Sikkim successfully developed a prototype of Ice Stupa at Thangu, North Sikkim in the winter month of 2018-2019 with the support of UNDP. The output of the project was quite successful and it encouraged going ahead with further deep into the project in Sikkim.

The success of this prototype in Sikkim will be upscaled to the next higher level with bigger mandate of reglaciation of glacier. Likewise in other areas, glacier retreat being a major issue in Sikkim Himalaya, an effort has been made to take the *ice stupa* to a next level for the reglaciation of some portion of the selected glacier which is a prime need of the present times.

(ii) Mitigation of GLOF at South Lhonak Glacial Lake through siphoning:

After the scientific interventions, Sikkim State Climate Change Cell together with the support of Disaster and land Revenue Department, Government of Sikkim initiated the second mitigation works for GLOF in during 2018 at South Lhonak Lake. Siphoning of lake was done by using High Density Polyethylene (HDPE) quick clamp pipes during the expedition. The diameter of the pipe was 8 inches. A total of 140 pipes were used for the siphoning of lake for siphoning of water from three sets of pipelines. The team first measured the discharge of lake (say discharge after the peak melting season) by area velocity method. The approximate discharge measured near the outlet was about 4.5 m^3/s(160 cusec). The discharge from single pipeline is measured approximately 50 litres/second which ultimately gives a total of 150 -180 lit/s in three sets of pipelines. It is expected that lake would be lowered by about 2 meters at the end of winter season. This is the first of its kind, that HDPE pipes were used for siphoning the glacial lake in India and first approach towards the siphoning of such glacial lake in Indian Himalayan region

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 within a span of 45 years. 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.

I. Photograph showing the stream draining to the South Lhonak lake & II.

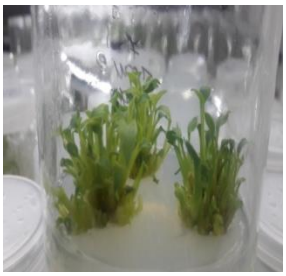
(iii) Biotechnology Research Application Centre,

<u>Implementation of Large cardamom project</u>:

The major work of large cardamom project is undertaken at Sajong centre which includes tissue culture of elite large cardamom, hardening, transfer to nursery, germlasm collection and maintenance, construction of shade houses, field plantation etc. The following works are undertaken:

a. Standardization of protocol for *in vitro* propagation and *in vitro* mass production:

Protocols for micropropagation of three important commercial cultivars of large cardamom, viz., *Seremna*, *Dzongu Golsai* and *Varlangey* have been standardized. The plants are being mass multiplied *in vitro* using the standardized protocols and hardening of *in vitro* plants.



b. Maintenance of Large Cardamom Germplasm

Maintained five to seven (5 to 7) cultivars of large cardamom germplasm in the field of Sikkim State Biotechnology Research and Application Centre under S&T Council, Sajong, Rumtek There are more than 15 cultivars of large cardamom are reported in Sikkim. Therefore, Survey and field tour was proposed at the department for the collection of large cardamom cultivars from farmers field and for maintenance of germplasm in the office field.



1. Developed two new cymbidium hybrid

Two new cymbidium hybrids developed. One is hardy and long lasting type and another large flowered. In both the cases the traits of original *Cymbidium lowenium* of the region is re-expressed. Sikkim is also known for orchids. Most of the hybrids are developed in advance countries like Australia, New Zealand. The parents are mostly collected from the Himalayan region of our state and its corridor. There are very few indigenously developed orchid hybrid which will have the commercial importance.



Newly developed cymbidium hybrids

c. Developed and demonstrated integrated method of azolla cultivation and System Rice Intensification(SRI):

In this method, low requirement of water and rice seedling is demonstrated during rice cultivation. The integration of azolla in the SRI method of rice cultivation helped in considerable weed control in the rice field and enrichment of nutrients.

d. Successfully developed the protocol for tissue culture of large cardamom for propagation of elite quality planting material:

The protocol for tissue culture of large cardamom for propagation of elite quality planting material is successfully developed for all the popular cultivars. In the next phase, large scale production will be made and distributed to the farmers under a project funded by DBT, GOI.

(IV) Study of Glacier Dynamics of East Rathong Glacier- Sikkim

Summary of Progress: The long term monitoring of " study on glacier dynamics of East Rathong Glacier" was sanctioned by SERB, DST-GoI with the approved objectives viz. temperature indexed modeling, geodetic mass balance using DEMs, glacier hydrology, ablation measurements and vertical thinning, glacier surface velocity, snout monitoring etc. In this context, the study team have visited East Rathong glacier since 2017.

The major objectives of the expedition included Stakes installation for the vertical melting studies and glacier velocity study, Initiation of Hydrological study comprising discharge measurement and suspended sediment study, Snout monitoring of the glacier, Retrieving of Automatic Weather Station Data. The discharge has been calculated and sediment data are in the processed in the lab and data analysis has completed and included in the progress report and monitoring report too. The post processing of data pertaining to DGPS measurements of stakes for glacial movement has been processed. The sanctioned instruments are procured.

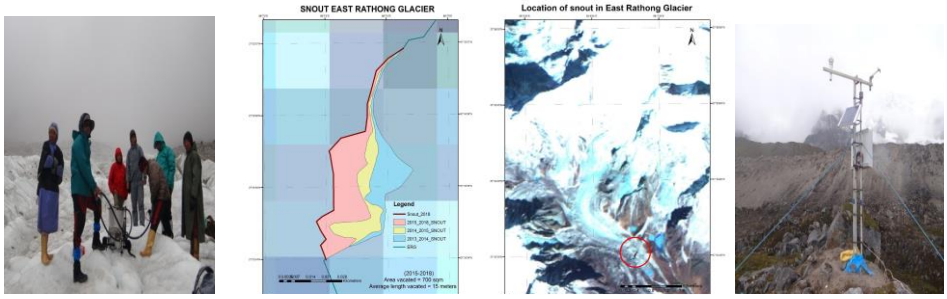
Installation of stakes for the vertical melting studies and glacier velocity study

Stakes were fixed in the glacier in order to measure the vertical melting of the glacier as well as to know the rate of movement or flow of the glacier. The bamboo stakes were installed in the glacier.

Overall vertical melting in 2017 was 3m, in debris covered glacier the vertical melting was 2.7 and in the clean ice it is 3.1m while in 2018 the vertical melting is relatively high as compare to 2017. The

overall vertical melting was 3.8m, in debris covered glacier the melting was 2.5m which is relatively low as compared to 2017 and in the clean ice it is 4.1m.
The maximum horizontal surface velocity during ablation season June 2018 to September 2018 in (my^{-1}), the maximum horizontal surface velocity 7.28 (elevation 4800m), minimum horizontal surface velocity is 0.6 (elevation 4644m), minimum vertical component of velocity is 14.28 (elevation 4644) and average surface velocity 4.16 m.

Snout Monitoring upto 2018
Area vacated in between 2015 and 2018 was 700sqm and average length vacated was 15 metre. The figure below represent the significant result of snout monitoring of glacier using DGPS



Meteorological assessment: The meteorological study is one of the important studies of East Rathong Glacier. The State Climate Change Cell has installed AWS system in East Rathong Glacier in September 2015. Due to technical problem in the system, the department has successfully installed AWS system in June 2018, and comprehensive weather data is generated and the scientific team successfully retrieving data at time to time.

The maximum rainfall occurred with an intensity of 35.5 and 37mm, whereas minimum rainfall occurred with an intensity of 0.5, and 1mm. The average rainfall during the season 2017 and 2018 were 9.50 and 11.77 mm respectively. The total rainfall (June-September) during the study period (2017-2018) is 876 and 1082 mm respectively with a total mean rainfall of 980 mm. Overall, 52% of rainfall occurred during the night time.

Mass balance through temperature index model (PDD)
During the ablation season of 2018, monitoring of daily ablation reading has been done through 5 daily stakes reading for 3 months for Ice and debris cover areas. Analysis on positive analysis on positive temperature and daily ablation record is in progress calculate the Positive degree day (PDD) for 2018.

Glacial Hydrological and Suspended Sediment Concentration (SSC)
The hydrological site (gauging site) was constructed 0.8 km below the snout. The discharge measurements were carried out for the ablation season of 2017-2018. The data were collected four times a day considering the timing of the minimum discharge and maximum discharge periods.
The average daily discharge of East Rathong glacier was 4.9 and $4.8 m^3 s^{-1}$ for the ablation season 2017-2018. The discharge magnitude showed that July and August contributed maximum runoff according for more than 70% of the total runoff and rest took place during June and September.

In the month of July and August contribute maximum sediments concentration in East Rathong melt water stream, the sediment rating curve has been established for the melt season of 2017-18.

New Observations:

1. In the month of July and August contribute maximum sediments concentration in East Rathong melt water stream.
2. The overall vertical melting of 3.8m recorded in the ablation season of 2018, in debris covered glacier the melting was 2.5m and in the clean ice it is 4.1m.

(V) Technology Transfers

Innovation Demonstration cum Training Centre:

a. Egg incubator and Hatchery at Village level

Poultry farming is quite popular among rural youth and one of their sources of employment and income. They often buy young chicks and feed them till they grow to a certain age for resale. However, if they install an egg incubator, they can produce the chicks in their farm itself. This will work out very economical for them. The incubators available in the market are very expensive and run on electricity. But in rural areas, there are frequent power cuts. The egg incubator developed by Milan Jyoti Das solves these problems. It is cheaper in comparison with the ones available in the market and its power source is both electricity and kerosene lamp.

Product Technical Details Salient Features

The incubator is made up of plywood in the exterior and plain sheet in the interior. Its wall is about 10 cm thick and thermocole is used to insulate it. The whole device is divided into two chambers, upper and lower. The upper chamber houses the main component of the incubator i.e. the egg tray and source of humidity, while the lower chamber houses the thermal source, a speaker for alarm in case of abrupt change and switches.

Innovator uses electric lamp as the source of heat when current is available and in case of power failure a kerosene lamp. Both the light and the lamp heat up the floor of the upper chamber (ceiling of the lower chamber). There is a regulator (same as one used for fan) by which the intensity of light can be altered. This chamber partition is made up of two plain sheets, so the heat can easily be transferred. For warming, a plate is placed below the egg tray. From the tray water gets evaporated due to heat and makes the chamber warm. In this incubator air is fed by tubes from four holes from the bottom to the upper chamber.

These initiatives require hand holding of the target group in addition to providing working shed, civil works, electrical connection and training along with seed money to start the enterprise. In order to initiate these scientific diffusion of technology at the village level, there is requirement of fund to provide alternate source of livelihood and make it sustainable.

b. Sanitary Napkin Production Machine and training to be given to educated unemployed women SHG for production and sale in remote villages

Sanitary napkin, a universally needed product, has very low penetration in India and other developing countries, partly due to its high price and partly due to the tradition of using cheaper but unhygienic old cloth piece. As a result they become the host of many infectious diseases. This is due to lack of awareness and economic inability for adopting better precautions like use of good sanitary napkins during menstruation period. Usually different varieties of sanitary napkins are found available

in the market but they are very expensive and are not affordable for rural & under-privileged women and girls.

Product:

Pulverizer

It is used for Pulverizing Pulp or Cotton. It can pulverize 100 kg per hour operated on a 0.5 HP motor. Total manpower for this machine is only 1 single person. It has added advantage over the grinder. There is a difference between pulverizing and grinding. If we pulverize the pulp then it becomes soft but retains its shape in napkin but if we grind it then it cannot retain its shape in a napkin

Napkin Press Machine:

The napkin pressing machines are available with three powders coated or steel plated dyes that ensure easy operation. These Napkin Pressing machines are easy to fix on the floor or on the table and sufficiently produce minimum 2,500 napkins in 8 hours or 75,000 napkins in 30 days.

Napkin Sealing Machine:

This machine is used to seal the pulp in a fabric. It takes 20 seconds to seal one

Gumming Set:

This Gumming Set is a type manual screen printing this designing of screen is only used for Sanitary Napkin back side Gumming. Total manpower for this machine is only 2 single persons. This gumming manual machine production capacity is 500 Napkins in 40 minutes

5. UV Treated Sterilizer

This UV Treated Sterilizer is of 18 gauge virgin steel with plastic coated in white color with red LED indicator on the top. There are three UV treated ultra-tubes of 12 inches with 12/24 inches mirror inside of the sterilizer so that the reflection the UV tube should reflect in the full sterilizer inner side. The size of the sterilizer length 35 inches & breadth 24 inches & depth is 25 inches.

Identified Area for implementation of Project:

i. Sombaray, West Sikkim
ii Tadong, East Sikkim
iii TDC, Marchak
iv Jorthang, South Sikkim

6. Has the council developed any specific state related S&T and innovation policy? If so the details to be provided.

NA

7. How strong are the links between other state government / departments if so provide details.

- Sikkim State council of Science & Technology works in close coordination with the line departments as well as the state government
- Sikkim State Council of Science & Technology is the Nodal Institution in the State for Climate Change initiatives. Second Phase of State Action Plan for Climate Change has been under preparation with the support of GIZ All government departments are involved as the member of the steering committee for Climate Change.
- Linkages with UNDP, Swiss Development Cooperation and GIZ on Climate Change adaptation programmes.
- INSPIRE Programme of DST; Govt. of India has been taken up in coordination with Human Resource Development Department. State Nodal Office is the Council while District Joint Directors of HRDD are the district Coordinators.

- **Support to the user departments/ agencies:** S&T Council being nodal for Remote Sensing and GIS applications in Sikkim, has contributed technical support to many user department and agencies in Sikkim. Some of the support includes-
- Preparation of various GIS map for General Election 2014 and 2018
- 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, Govt. of Sikkim.

(i) Council is responsible for all patent work related to intellectual property in the state.
(ii)

8. How strong are the links of the council with local industry units/associations?

Sikkim being a hilly landlocked state, there is not many local industries except for cottage industries and handicraft. The council is striving to have linkages with such local industries by formulating projects in the areas of handicraft.

S&T Council with the support of GIZ organized one training on weaving of fine handlooms during 2017-18

9. List 5 major technology area, where the council can play an important role by finding convergent technological solutions.

(i) Biotechnology and tissue culture
(ii) Climate Change Adaptation and Mitigation
(iii) Remote sensing
(iv) Non renewable energy
(v) Post harvest technology

10. Proposed Programmes:

1. **Establishment of Science Center in South Sikkim**
2. **Establishment of Technology Demonstration Centre at Marchak, East Sikkim**
3. **Establishment of Technology Incubation Centre in Sikkim**
4. **Development of INSAR based technique for high resolution surface topography and ice velocity under microwave and hyper spectral techniques for earth resources application and management.**
5. **Development of Firest Fire Spread Model using Satellite RS**
6. **Climate Change Risk reduction for potentially Dangerous Glacial Lakes In Sikkim**
7. **Sikkim State centre for Glaciology**
8. **Experimental Studies on Reglaciation of Deglaciated Valley in Sikkim through Artificial Glaciation**
9. **Study on Wild Edible fruits of Sikkim Himnalayas.**