ANNUAL REORT 2024-2025

ARUNACHAL PRADESH STATE COUCIL FOR SCIENCE &TECHNOLOGY (APSCS&T)

DEPARTMENT OF SCIENCE & TECHNOLOGY
GOVT. OF ARUNACHAL PRADESH

Table of Content

ANNUAL REPORT-2024-2025(April 2024-March2025)
ARUNACHAL PRADESH STATE COUNCIL FOR SCIENCE & TECHNOLOGY
DEPARTMENT OF SCIENCE AND TECHNOLOGY, GOVT. ARUNACHAL PRADESH

About the Council:

To establish the importance of encouraging and promoting scientific and technological activities in the states and union territories for the over also socio-economic development of the country, the Government of India's Department of Science &Technology (DST) initiated a scheme called "Assistance for Development of State Council for Science &Technology" during the Sixth Five Year Plan. Its main objectives were to assist the states and union territories to set up State Councils for Science &Technology to act as focal forums in the formulation, planning, coordination, and promoting scientific and technological activities within their respective states. The DST has performed a catalytic role to sensitize almost all the states and union territories in the country and helped establish state science &technology councils. Accordingly, the Government of Arunachal Pradesh considered the necessity to set up an organization to identify the areas in which science & technology can be applied for the development of the state in particular, to properly utilize natural resources through perspective planning for rural development and improvement of the socio-economic status of the state. To promote scientific and technological services in the state, the Arunachal Pradesh State Council for Science and Technology (APSCS&T) was established in 1992 as an autonomous organization under the state government's Department of Education and registered under the Societies Registration Act,1860 (Extension to Arunachal Pradesh, 1978) and later brought under the Department of Science and Technology, Government of Arunachal Pradesh in1998 with the prime objectives of playing a catalytic role in the application of science and technology to address local issues for development purposes and popularize science and technology in the state. The APSCS&T is also the nodal agency for the implementation of the program of the Government of India's Department of Science &Technology. Its administration and management are conducted by its Executive Committee comprising of a Chairperson, Secretary, and Commissioners to the state government. Its daily affairs and administration are looked after by the Chief Executive, i.e., Director/Member Secretary. Additionally, the Department of Science and Technology (DST) was created in 1998 to provide scientific and technological services and guide the overall development strategy for achieving sustainable development in the state.

Objectives of APSCS&T

a) To indicate optimum development of untapped new and renewable sources of energy in Arunachal Pradesh by applying contemporary scientific research and appropriate technology.

b) To plan research and development programme for academic research and development in existing institutions of the state.

c) To assist the State government in developing suitable Science & Technology structures to ensure and promote the application of proper scientific method and technology in rural area that will assist the administration in all matters relevant to application of science and Technology in the regional development and preparation of perspective planning.

d) To liaise with national organizations in facilitating collaboration and transfer of scientific and technological know-how.

e) To recommend means of popularizing the use of Science and Technology amongst the people of the State and utilization of mass media, participation in and organization of seminars, exhibitions and other such related activities and also development of application centres, Museum etc.

f) To evolve a long-term science & technology policy and programme keeping in view the natural resources/geographical features and socio-economic conditions available in the state.

g) To ensure that Science & Technology is harnessed meaningfully for the development of the state.

h) To evolve strong and workable mechanism for the transfer of indigenous technology

i) To identify projects and programmes to improve the conditions of the rural population and improve the quality of the health and hygiene.

j) To promote and fully involve the various departments connected with development schemes as well as the people.

k) To promote all activities which are necessary or conducive to the attainment of the objectives of the society.

Arunachal Pradesh Science Centre was established under the aegis of Arunachal Pradesh State Council for Science and Technology and inaugurated on 3rd December 2005, the then Chief Minister, Shri GegongApang at the Indira Gandhi Park in Itanagar. Since its establishment, it has become a centre for exhibitions and expositions that explores the knowledge unknown.

The Centre for Bio resources and Sustainable Development in Arunachal Pradesh was taken up by Arunachal Pradesh State Council for Science & Technology (APSCS&T), Department of Science & Technology, Govt. of Arunachal Pradesh with Department of Biotechnology (DBT), Ministry of Science & Technology, Government of India during December, 2016 with the mission for Development of Bio-Resources and their sustainable utilization through biotechnological interventions for socio-economic growth in Arunachal Pradesh.

The centre was operating from the makeshift temporary infrastructure developed in the permanent campus at Kimin with effect from 1st October, 2018. It was on 9thNovember 2021, Dr. Jitendra Singh, Hon'ble Union Minister of State (Independent Charge), Science and Technology, Earth Sciences, PMO, DoPT, DoS, DoAE, Govt. of India, inaugurated the Centre for Bio resources and Sustainable Development at Kimin, in Papumpare district of Arunachal Pradesh followed by inauguration of Rural Technology Demonstration Centre and Launch Skill Vigyan programme at Kimin, Papumpare in the presence of Shri Chowna Mein, Deputy Chief Minister, Govt. of Arunachal Pradesh, Shri Tapir Gao, Hon’ble Member of Parliament (Lok Sabha), Shri HonchumNgadam, Hon’ble Minister Science and Technology, RWD, Govt. of Arunachal Pradesh, Shri Nabam Rebia, Hon’ble Member of Parliament (Rajya Sabha) and Shri Bamang Mangha, Former Chairman, APSCS&T and several other delegates. Now APSCS&T have three administrative divisions functioning under the Department of Science and Technology, Govt. of Arunachal Pradesh.

1. **REGULAR PROGRAMME UNDER SCIENCE & TECHNOLOGY DEVELOPMENT ACTIVITIES DURING 2024-25 IN ARUNACHAL PRADESH**

I. Activities on Science popularisation and Research and Development activities taken up during the year 2024- 25

A. Programmes on science popularisation:

During the year 2024-25, Arunachal Pradesh State Council for Science and Technology undertook numerous programmes and activities to promote and popularise the objectives of the Department of Science and Technology.

Activity 1:Celebration of MathematicsDay 2024

TheArunachal Pradesh State Council for Science & Technology (APSCS&T)celebratedNational Mathematics Day (NMD) 2024 with great enthusiasm on **22nd December** at the Arunachal Pradesh Science Centre (APSC), Itanagar**.** The event aimed to foster scientific temperament and cultivate a passion for mathematics among the youth of the state.Approximately **140 participants**, including staff from APSCS&T and APSC, teachers, parents, and students from various institutions - VKV Itanagar**,** VKV Nirjuli**,** GHSS Ganga**,** GHSS Arunodaya**,** Green Mount School**,** GUPS Itanagar**,** KV 2 Itanagar**,** and Guardian Angel Schooltook part in the celebration.

The event was graced by **Shri. Joram Muthu**, Joint Director, Higher & Technical Education, Govt. of Arunachal Pradesh, as Chief Guest**,** and featured **Shri Arun Joram**, Lecturer at Rajiv Gandhi Government Polytechnic College, Itanagar, as Resource Person. In his talk titled *"Importance of Mathematics in Solving Real-World Problems,"* Shri Arun Joram reflected on **Srinivasa Ramanujan's legacy** and the significance of National Mathematics Day. Chief Guest Dr. Muthu emphasized the foundational role of mathematics in innovation, scientific advancement, and societal development, urging students to adopt mathematical thinking for both academic and real-world success.

The event concluded with a prize distribution ceremony honoring winners of mathematics competitions held on 20th December 2024. The celebration was **live-streamed on YouTube (**https://youtube.com/CIF1BxzQotg), extending its reach to a broader audience.

This celebration reaffirmed APSCS&T's commitment to nurturing scientific curiosity and promoting mathematics as a key driver of innovation and progress.

Activity 2: Celebration of National Science Day 2025

To commemorate National Science Day 2025, theArunachal Pradesh State Council for Science & Technology (APSCS&T) organized a series of interactive and educational programs across multiple venues. These initiatives were designed to promote scientific literacy**,** foster inquiry-based learning**,** and ignitecuriosity among students, while celebrating the enduring contributions of **Dr. C.V. Raman** to the field of science.

- Astudent-scientist interaction session **(*Know Your Scientist*)** focusing on **biodiversity and conservation** was held on 14th February 2024at Vivekananda Kendra Vidyalaya (VKV), Itanagar. A total of119 studentsbenefitted from the session, which emphasized the importance of sustainable wildlife management and local ecological knowledge.
- A hands-on workshop on**Artificial Intelligence and Robotics**was conducted on14th February 2024at VKV, Itanagar**.** Students engaged in practical exercises involving coding and robotics, equipping them with skills in emerging technologies through interactive learning.
- A series of science competitions culminated on 25th February 2025at theArunachal Pradesh Science Centre**,** with active participation from 113 students**.** The events aimed to encourage creativity**,** sustainability**,** and scientific thinking**,** and included the following categories: Drawing **(32 participants),** Eco Earth**(3 participants),** Waste to Wealth **(17 participants),** Science Model Exhibition**(28 participants),** Science Writing**(33 participants)**
- An outreach session themed***"It's Not Magic, It's Science"***was conducted on28th February 2025at Little Rose School, Naharlagun**,** for160 studentsof Classes 6 and 7**.** The program showcased illusion-based scientific experiments to explain key concepts in an engaging and accessible manner, reinforcing scientific curiosity through fun, interactive demonstrations.

The main National Science Day celebrationwas held on28th February2025at the Arunachal Pradesh Science Centre, Itanagar**,** with **150 participants**, including students, teachers, and government officials.Shri Chau Dhania Mungyak, Director-cum-Member Secretary of APSCS&T, graced the occasion as Chief Guest.The keynote address**,** titled *"A Journey Through the Evolution of Scientific Thought"*, was delivered by Dr. Hage Doley (Assistant Professor, Department of Physics, Dera Natung Government College), providing insights into the historical and modern relevance of scientific reasoning.

These initiatives reflect APSCS&T's steadfast dedication to nurturing a culture of scientific inquiry, enhancing student participation, and commemorating the legacy of Dr. C.V. Raman through wide-ranging and inclusive science outreach programs throughout Arunachal Pradesh.

Activity 3:Documentation of Natural and Intangible Heritage- Indigenous Belief Systems and Ethnic Traditional Rituals Among the Adi, Galo, Nyshiand Apatani Tribes in Arunachal Pradesh

The Arunachal Pradesh State Council for Science & Technology (APSCST) undertook an important research project aimed at documenting the natural and intangible cultural heritage linked with the indigenous belief systems and ethnic traditional rituals of the Adi, Galo, Nyishi, and Apatani tribes in Arunachal Pradesh. Intangible cultural heritage includes the traditions, practices, knowledge, and belief systems that define a community's culture, while natural heritage involves culturally significant landscapes and biodiversity. This project focused on capturing how these elements are intertwined within tribal rituals and practices to preserve and scientifically document these valuable cultural assets.

Objective of the project:

1. Documentation of the natural and intangible heritage of the tribes of Adi, Galo, Nyshi and Apatanis.
2. Identification and documentation of the species of plants and animals used in different traditional belief systems and rituals.

3. To validate the science behind the use of particular species of plants and animals in specific traditional practices.
4. Documentation of the specific verses and mantras or hyms used by the priests in specific traditional rituals.
5. Preservation of the intangible heritage by creating a digital data bank.
6. To organize awareness workshops for SHGs, entrepreneurs on cultivation of specific plant species.

The project team organized one State-level Awareness Workshop in collaboration with the Donyi Polo Indigenous Nyijik-Nyikok (SAMMAN) Cultural and Training Forum and extensive field visits to major tribal festivals such as Mopin (Galo), Myoko (Apatanis), and Nyokum (Nyishis) to document rituals and gather data. They focused on translating ritual chants and scientifically identifying the plants used during these ceremonies. The translation and identification the different species of plants used during the festival rituals is going on, aiming to create a detailed repository that safeguards and promotes awareness of the rich cultural heritage of Arunachal Pradesh.

This research is funded and supported by the Science and Heritage Research Initiative under the Ministry of Science & Technology, Department of Science & Technology, Government of India. Through this project, APSCS&T demonstrated its commitment to integrating scientific methods with cultural preservation, ensuring the sustainable management of Arunachal Pradesh's unique indigenous knowledge and **heritage.**

Plant species in major tribal festivals such as Mopin, Myoko, and Nyokum used by Galo, Apatanis and Nyishi community in traditional belief system:

Sl. No.	Scientific name	Local name	Parts used	Uses
1.	***Castanopsis indica***	Kora	Leaves	In the prayer structure
2.	***Phyllostachys bambusoides Gamble***	Bije	The entire stem	As post for the main structure of the prayer structure.
3.	***Zingiber officinalis***	Taki/Taki yanii	Rhyzome and leaves	For protection from evil eye and evade evil spirits
4.	***Saccharum arundinaceum Retzius***,	Peji-Pelo	upper branches and leaves	used by the Nyibu (Priest) during chanting of rituals in Dree festival. It is also used as Nago piiding for decorating the Nago (small house like structure used as sacred altar) where the main rituals are performed by the nyibus during Myoko
5.	***Prunus persica (L.) Batsch;***	Takung sanii	Entire Plant	is honored as a sacred tree, since it symbolizes the Myoko Yugyang (main sacred altar),

				where the important rituals, chanting and sacrifices of the animals takes place to mark the celebration of Myoko etc
6.	***Phyllostachys manii***	Tabu	Stem	For making the various decoration in the prayer structure to please the deity.
7.	***Neomicrocalamus franii***	Tajir	Stem	Used in the prayer structure, used for praying like incense and the rope made out of the stem is tied around the wrist for protection.
8.	***Chephalostachyum manii***		The entire stem	As post for the main structure of the prayer structure.
9.	***Calamus acanthospathus***	Rome	Leaves	In the prayer structure
10.	***Phrynium pubinerve***	Ekkam	Leaves	In making the prayer structures, also used for wrapping foods (acts as plates) during festivals and rituals. The leaves are also used to wrapped raw foods for steaming and cooking in bamboos.
11.	***Cannabis sativa***	Tapyo	Leaves, Flowers	Considered sacred, believed to ward off evil spirits Used a ritual offering to the deities.
12.	***Cinnamomum tamala***	Tajir	Leaves, Barks	Believed to possess spiritual and medicinal properties. Used in ritual offerings and healing purposes
13.	***Zanthoxylum alatum***	Thikro	Fruits, Seeds	Believed to possess spiritual and medicinal properties Used in ritual offerings and medicinal purposes
14.	***Dendrocalamushamiltonii***	Tajir	Stem	Symbolizes sacredness and spiritual connection Used for creating the main altar stucture
15.	***Bambusa tulda***	Tali	Leaves, stems	Represents fertility and prosperity Used for crafting decorative items, such as flowers for the

				altar
16.	***Dendrocalamusstrictus***	Tama	Stem, leaves	Signifies strength and resilience. Used for crafting intricate bamboo designs and patterns in the altar.
17.	***Bambusa balcooa***	Mopi	stems	Used for crafting ritual utensils.

Activity-4: Bioprospecting and translational product development research on medicinal,aromatic, wild edible and foam forming, plant resources of Arunachal Pradesh:

A. Ongoing Exploration, Documentation, and Ex-Situ Conservation of RET MAP Species

DBT-APSCS&T CoE for BRSD continues its efforts in the exploration, documentation, and ex-situ conservation of economically important Rare, Endangered, and Threatened (RET) Medicinal and Aromatic Plant (MAP) species of Arunachal Pradesh. The established MAP garden at the CoEatKimin is being regularly maintained and expanded, currently housing over 100 plant varieties. Plantation activities are ongoing in a phased manner, with new species being added to enrich the collection and promote long-term conservation and utilization efforts.

The following species of medicinal and aromatic plants are being planted as a part of the first phase of the plantation.

Sl.No.	**Commonname**	**Scientific Name**	**Family**
1.	Arjun	*Terminaliaarjuna*	Combretaceae
2.	Shatavari	*Asparagusracemosus*	Asparagaceae
3.	Aparajita	*Clitoriaternatea*	Fabaceae
4.	Jamun	*Syzygiumcurranii*	Myrtaceae
5.	Agarwood,Aloeswood	*Aquilariaagallocha*	Thymelaeaceae
6.	IndianOlive	*E.floribundus*	Elaeocarpaceae
7.	Sukloti	*P.benghalensis*	Lamiaceae
8.	Putranjiva	*Putranjivaroxburghii*	Putranjivaceae
9.	Bogabahak	*Adhatodavasica*	Acanthaceae
10.	Indianspurgetree	*Euphorbianeriifolia*	Euphorbiaceae
11.	Bael	*Aeglemarmelos*	Rutaceae
12.	Tulsi	*Ocimumgratissimum*	Lamiaceae
13.	Sarpagandha	*Rauvolfiaserpentina*	Apocynaceae
14.	Bhomora	*Terminaliabellirica*	Combretaceae
15.	Madhuri	*Psidiumguajava*	Myrtaceae
16.	Pategoja	*Bryophyllumpinnatum*	Crassulaceae
17.	Tulsi	*Ocimumsanctum,*	Lamiaceae

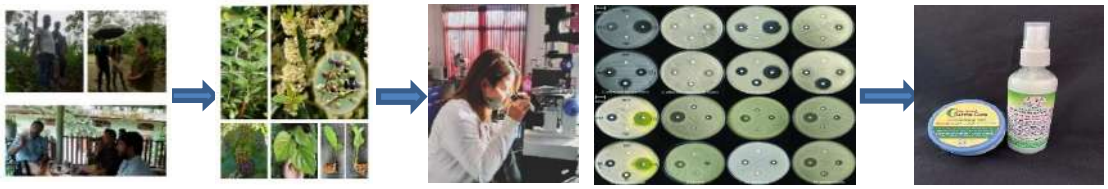
18.	Reetha	*Sapindusmukoross*	Sapindaceae
19.	KadiPatta	*Murrayakoenigii,*	Rutaceae
20.	Emli	*Tamarindusindica*	Leguminosae
21.	Dhuna	*Canariumstrictum*	Burseraceae
22.	Pasutia	*Vitex negundo*	Lamiaceae
23.	Sarpagandha	*Rauvolfiaserpentina*	Apocynaceae
24.	Bhomra	*Terminaliabellirica*	Combretaceae
25.	Madhuri	*Psidiumguajava*	Myrtaceae
26.	Pategaja	*Bryophyllumpinnatum*	Crassulaceae
27.	Tulsi	*Ocimumsanctum*	Lamiaceae
28.	Reetha	*Sapindusmukoross*	Sapindaceae
29.	Kalmegh	*Murrayakoenigii*	Rutaceae
30.	Shewali	*Nyctanthesarbor-tristis*	Oleaceae
31.	Hill Pepper	*Pipermullesua*	Piperaceae
32.	Giloi	*Tinosporacordifolia*	Menispermaceae
33.	Kalmegh	*A. paniculate*	Acanthaceae
34.	Bakul	*Mimusopselengi*	Sapotaceae
35.	Kordoi-tenga	*Averrhoacarambola,*	Oxalidaceae
36.	Bhatghila	*Oroxylumindicum*	Bignoniaceae
37.	Amla	*Phyllanthusemblica,*	Phyllanthaceae
38.	Neem	*Azadirachtaindica*	Meliaceae
39.	Kunchmoni	*Abrusprecatorius*	Fabaceae
40.	Sonalu	*Cassiafistula*	Caesalpiniaceae
41.	Gallnut	*Terminaliachebula*	Combretaceae
42.	Keechige	*Erythrinastricta*	Fabaceae
43.	Jamalghota	*Jatrophacurcas*	Euphorbiaceae
44.	Aloevera	*Aloebarbadensis*	Liliaceae
45.	Boss	*Acoruscalmus*	Acoraceae
46.	Blackpepper	*Pipernigrum*	Piperaceae
47.	Harjora-lata	*Cissusquadrangularis*:	Vitaceae
48.	Sweetleaf	*Steviarebaudiana*	Asteraceae
49.	Broad-leavedplantain	*Plantagoerosa*	Plantaginaceae
50.	Ashwagandha	*Withaniasomnifera*	Solanaceae
51.	Tejpatta	*Cinnamomumtamala*	Lauraceae
52.	Dalchini	*Cinnamomumverum*	Lauraceae

53.	Crepe & wild ginger	*Costusspeciosus*	Costaceae
54.	Nephafu	*C. colebrookianum*	Verbenaceae
55.	Orange	*Citrussinensis*	Rutaceae
56.	Mejankeri	*Litsea cubeba*	Lauraceae
57.	Kunchmoni,Latumoni	*Abrusprecatorius*	Fabaceae
58.	Mosondari	*Houttuyniacordata*	Saururaceae
59.	Menangmanba-shi (MonpaTribe)	*G.assamicus,*	Leguminosae
60.	Tapir/Tapil(Adi), Sangcher/Jishir (Nyishi), Samper(Apatani),Hisir (Galo), Educhi (IduMishmi)	*Phoebecooperiana*	Lauraceae
61.	Borthekera	*Garciniapedunculata*	Clusiaceae
62.	Rupahithekera	*Garcinialanceifolia*	Clusiaceae
63.	Ambra	*Spondiasaxillaris*	Anacardiaceae
64.	Dhuna	*Canariumstrictum*	Burseraceae
65.	Himalayanmango	*Mangiferasylvatica*	Anacardiaceae
66.	Assam apple	*Docyniaindica*	Rosaceae

Translational R&D based on traditional knowledge of Medicinal and Foam forming Plants:

Field surveys were conducted to document the rich Traditional Knowledge and 56 numbers of ethnobotanically important plant species have been recorded, collected, and scientifically documented. The translational R&D is in various stages of development in pursuit of the following outcomes:

- Poly-herbal formulations for dermatophytic infections, metabolic disorders, and resistant bacterial infections.
- Development of SLS and Paraben-free plant-based surfactants for cosmeceutical applications.



Field Exploration | **Documentation & Collection ofMAP** | ***In Vitro, In Vivo & Pre-Clinical Validation*** | **Prospective Product Prototype**

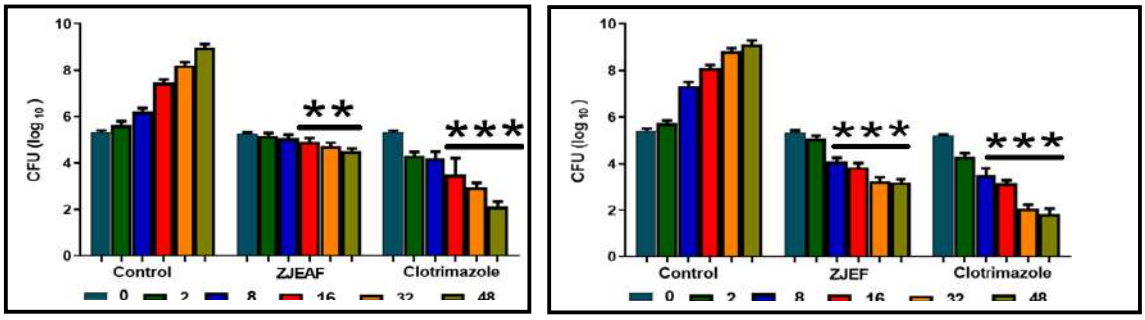
Development of an Anti-dermatophytic Poly-herbal Ointment Formulation for Human and Veterinary Applications

The need for development of anti-fungal agents leads to the quest for exploring alternative new herbal based agents to cope with non-resistant and resistant fungal infections. In the same line, based on traditional

knowledge of the herbal medicine practitioner of the state; we have screened nineteen (19) numbers of plant extracts and their fractions (hexane, chloroform, ethyl acetate, methanol, water) against prominent dermatophyte ATCC strains viz. *Trichophyton rubrum*, *Trichophyton interdigitale*. Out of all the plant fractions tested, different fractions of four plants demonstrated considerable activity against the tested dermatophyte in both *in vitro* zone of Inhibition and Minimum inhibitory concentration (MIC) and in *ex vivo* nail plate model of infection. A polyherbal formulation has also been formulated by mixing all four active fractions with standard ointment's excipients. Physico-chemical parameters for quality assurance of the ointment formulation are in progress. Detailed *in vivo* investigations of the formulation are warranted for successful translational development of the ointment.

ZoneofInhibitionexperimentsdoneagainst*T.rubrum*A)ZJEAF,B)Clotrimazole and C) Control plate

The rate at which the ZJEAF and ZJHF can kill the tested dermatophyte (*T. rubrum* and *T. interdigitale* were determined through a time-kill assay (Kalita et al., 2018). ZJEAF at MIC concentration (312 µg/ml) exhibited promising killing activity against *T. rubrum* and *T. interdigitale* at 2, 8, 16, 32, and 48 h time points. The killing rate demonstrated by ZJEAF is comparable with the standard antifungal drug Clotrimazole at 31.2 µg/ml concentration.



Killing Kinetics: ZJEAF (MIC) against A) T. rubrum, along with Positive and Negative Control.
B) T. interdigitale, along with Positive and Negative Control. All the results were expressed in mean ± S.D (n=3). ***p<0.001, **p<0.01

To further evaluate the ZJEAF in the ex vivo nail plate infection model; the fractionated plant extract was formulated with excipients for the feasibility of application into the snail plate. The formulations were tested for their quality, stability, and Physicochemical attributes, which were found suitable for dermal applications.

Ingredients	Quantity in gm/ml
ZJEAF	2 gm
Carbopol	1 gm
Poly Ethelene Glycol	5 ml
Methyl paraben	0.5 ml
Propyl paraben	0.05 ml
Triethanolamine	1.5 ml
Water	Q.S.

Representative images of formulation developed and *Ex vivo* nail plate assay

Future Plan:

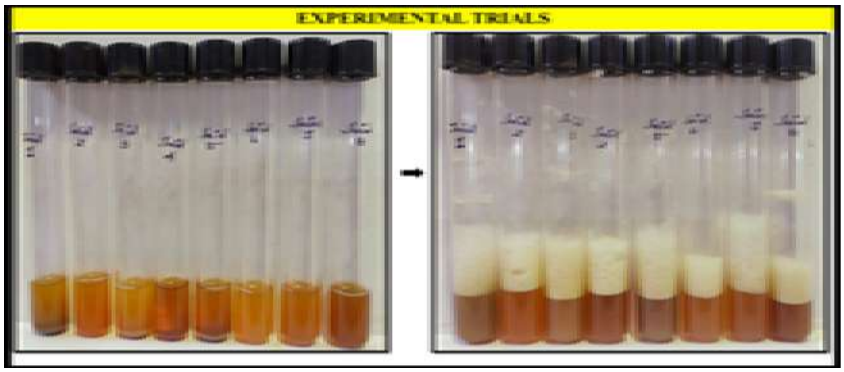
1. The CoE is aimed to develop various polyherbal formulations-based products for diverse applications ranging from topical therapeutics/toiletries for dermatophytic infections in humans, veterinary, fish, etc. This platform technology will be useful for developing products for fungal diseases of high-valued ornamental and crop plants. Robust translational research is warranted for the successful development of the products.
2. The CoE is aimed at developing polyherbal formulations as phytopharmaceutical and Nutraceuticals for metabolic syndrome and its associated complications.

Patent applied/granted:

1. A poly herbal formulation for the treatment of dermatophytic infections (Indian Patent application Number 201931008545).
2. A Polyherbal formulation for the treatment of Painful Diabetic Neuropathy, Indian Patent Grant Number: 39344

Development of SLS and Paraben-free plant-based surfactants for cosmeceutical applications.

Upon process optimization, two saponin-rich extract combinations were identified based on foam stability and wettability parameters. Combination 1 exhibited high foam stability, while Combination 2 demonstrated superior wetting ability. Both combinations, prepared using optimized concentrations of plant-based extracts, showed performance metrics comparable to synthetic surfactant standards such as SLS (57–59°), highlighting their potential as effective natural alternatives in formulation applications.



Activity5: Bioprospecting of microbial resources of Arunachal Pradesh:

Vision: To serve as the pivotal laboratory of DBT-APSCS&T Centre of Excellence for Bioresources and Sustainable Development, spearheading innovative microbial biotechnology interventions to address the unique unmet challenges of Arunachal Pradesh, while promoting sustainable development and improving the livelihoods of indigenous communities.

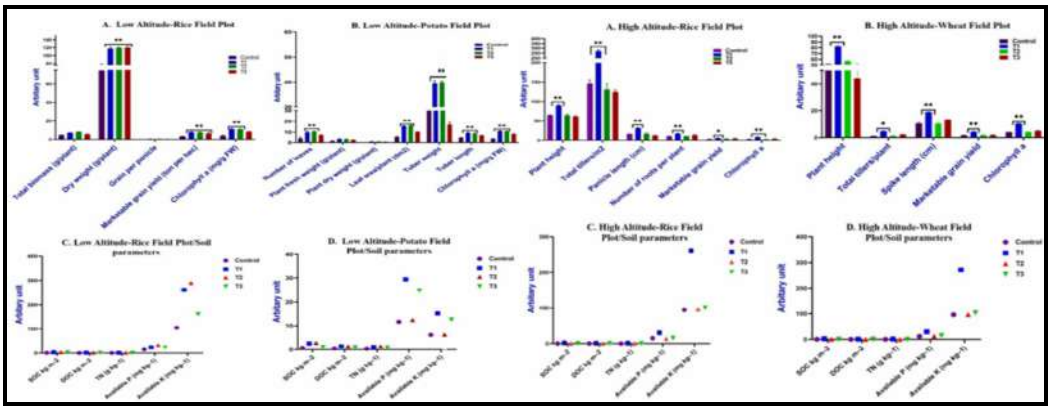
Mission:

- ❖ Conduct cutting-edge research and development in microbial biotechnology for developing innovative solutions for climate-resilient agriculture in Arunachal Pradesh.
- ❖ Validate fermented foods for their nutritional and nutraceutical properties, harnessing the potential of microbial fermentation for enhanced food security and health outcomes.
- ❖ Explore bioresource-based biomanufacturing techniques to produce sustainable products with high nutraceutical value and minimal environmental impact.
- ❖ Develop a comprehensive microbial database to catalogue and analyse indigenous microbial strains, facilitating future research and innovation in microbial biotechnology.
- ❖ Engage in various livelihood generation avenues based on bioresources, empowering indigenous populations with socio-techno-economic opportunities and fostering inclusive growth.

A. Developing efficient sustainable customized biofertilizer formulation considering the Agro-climatic condition of Arunachal Pradesh.

Biofertilizer Product prototypes were developed utilizing beneficial microbial consortium formulation based on extensive bioprospecting of the rich microbial bioresources of Arunachal Pradesh and detailed scientific validation. As per the recommendation from the PMC, a study was conducted to investigate the impacts of customized biofertilizer formulation (CBF) and commercially available liquid formulation (CLF) on the plant growth, nutrient content, and yield responses in the different Agro-climatic conditions of Arunachal Pradesh.

- In the high-altitude region, a significant increase in the growth, nutrient, and yield of rice crops had been observed with the plants inoculated with the native tolerant microbial consortium compared to the control and commercially available biofertilizer. Whereas in the low-altitude region, both the formulation demonstrated at-par results.



Field evaluation of the Microbial Consortium

Table: CAT, SOD, and POD activities in the leaves of rice-wheat crops of the high-altitude plots

Antioxidant enzymes (U mg prot min-1)	Rice-High altitude plot				Wheat-High altitude plot			
	Control	T1	T2	T3	Control	T1	T2	T3
SOD	47.65±2	11.35±	39.28±1.	46.56±1	62.79±2	13.41±2	64.51±1	62.09±0

	.25	1.05	33	.33	.60	.11	.06	.33
CAT	17.44±1.54	4.55±1.15	17.49±0.62	16.15±1.64	22.77±1.21	8.34±1.07	23.27±1.09	22.24±2.26
POD	36.72±0.83	9.72±1.83	37.89±1.09	32.33±0.55	46.86±1.02	9.73±0.84	44.45±1.89	44.07±0.82

Representative photograph for efficient customizable and scalable, bio-input and prebiotic enriched solid and liquid biofertilizer formulations tailored for all major Agri Horti crops for Arunachal Pradesh.

B. Development of an improved/ commercially viable method of brewing and/or Processing of Alcoholic beverages of Arunachal Pradesh and evaluation of its Physicochemical, Organoleptic, Antioxidant, and Quality parameters.

- The traditional method of brewing was documented scientifically for finger millet, a fruit-based (orange) alcoholic beverage of Arunachal Pradesh. The brewing method and the processing steps were optimized and improved in contrast to the traditional method for preparing the beer/wine samples for possible up-scaling avenues.

- Here we have standardized the starter culture (co-cultured of *W. anomalus* and *S. cerevisiae*) for brewing and processing purposes based on different testing parameters.

- Some steps in contrast to the traditional method are modified or added for the development of a commercially scalable improved process: 1) Addition of optimum level of extracellular enzymes, 2) Addition

of some food grade or non-harmful chemicals i.e. bentonite, pectin, sorbate, etc. at the time of maturity, 3) Hot and cold filtration steps, 4) Filtration with the help of activated charcoal and Whatman filter paper (pore size 0.22 µm).

- Findings from Physiochemical evaluation: 1) In the case of beer, the alcohol content improved from 3.8 % (v/v) to 5.2 % (v/v) and the pH of the improved method of beer remains stable up to 180 days i.e., 4.27- 4.18. Lesser turbidity was observed in the improved method of finger millet beer than in the traditional brewing method. 2) In the case, of orange wine, the alcohol content improved from 8.2 % (v/v) to 11 % (v/v), and the pH of 4.34 of the improved method in wine remain stable for 180 days.

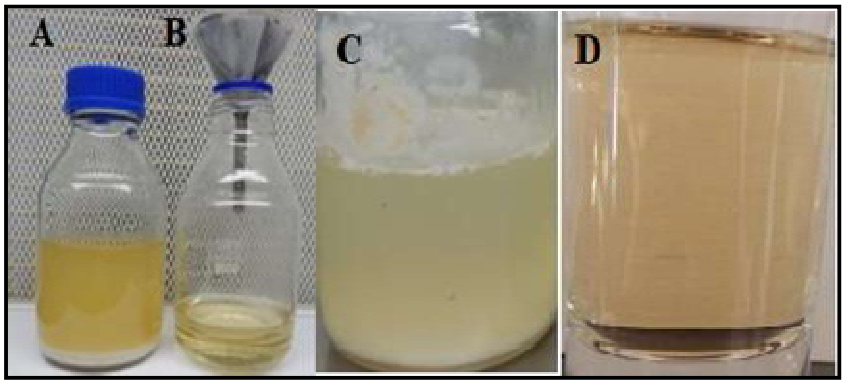
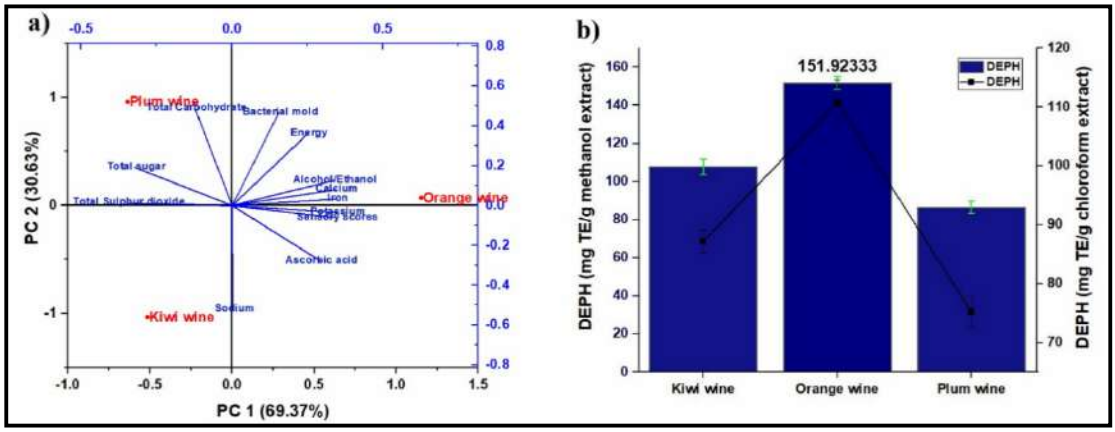


Fig A, B: Representativeimagesofreductionofturbidityinimprovisedprocessofbrewing(Finger millet-based beer: Traditional and improved brewing process, respectively. D: Orange-based wine: Without filtration and improved metho of preparation, respectively



Result of evaluation of Quality Fruit wines from organically cultivated Orange, Kiwi, and Plum of Arunachal Pradesh, India

- Organoleptic and Antioxidant activity: Sensory evaluation of both traditional and improved process-based alcoholic beverages was taken into consideration viz., taste, color, flavor, acidity, mouthfulness, strength, and overall acceptability. Nine points hedonic scale from 1-9 with a scale 1- dislike extremely, 2- dislike very much, 3- dislike moderately, 4- dislike slightly, 5- neither like or dislike, 6- like slightly, 7- like moderately, 8- like very much and 9- like extremely was used for sensory evaluation. A trained panel of 35 judges conducted the sensory evaluation. The panel had given the highest points in the improved method of alcoholic beverages as compared to the traditional method of preparation.

The antioxidant activity of the finger millet beer samples obtained from both methods was evaluated, which revealed; the highest DPPH inhibition (74.99%) obtained from the improved method compared to the traditional method (54.16%) of the finger millet beer. Similarly, in the case of orange wine, the DPPH free radical scavenging activity of the traditional method was 72.98%, whereas the improved method showed increased 88.78% activity.

- **Quality parameters:** Quality parameters (Pesticide content, Heavy metal, a toxic compound, mineral content, etc.) of Finger millet beer and orange wine prepared by the improved method were analyzed as per USFDA norms by following FSSAI Manual – 2016.

DNA extraction through using CTAB and SDS protocols Liquor products

Technology Developed: (Final Indian Patent filled; Application no. 2023-31-086447)

Temperature independent Revivable formulation and Methodology for long term preservation, storage, and transport of live Bacteria, Yeast and, filamentous fungus

- This referred invention of technology deals with a hydrogel formulation based on long-term preservation, storage, and transport of live bacteria and fungus. This system is not temperature dependent and thus how adds lots of advantages compared to available options.
- Feasibility, cost-effectiveness, and scalability are the three major advantages of this developed technology. Apart from that, the system is efficient in a temperature range of -196°C to 50°C, which is unachievable in conventional systems. This invention has tremendous applicability in healthcare, agriculture, and R&D-related applications.
- We are confirmed that there is no prior art closely or distantly related to this invention

FOR SUSTAINABLY PURSUE THE *R&D @ APPLIED MOLECULAR MICROBIAL BIOTECHNOLOGY: Challenges and Vision has been formulated*

Challenges:

- No improved technology for the production and application of high-quality microbial inoculants. Molecular approaches needed for a better understanding of root-microbiome interactions
- Engineering the rhizosphere and formulation of consortium to encourage beneficial microbe establishment is a great challenge for the future
- Increases in population and climate change pose a challenge to worldwide crop production. There is a need to intensify agricultural production in a sustainable manner and to find solutions to combat abiotic stress, pathogens, and pests
- The problem associated with fermented food products and beverages is traditional method of products, low quality, shelf life, non-reproducible.
- No standard methodand regulation for the composition of the substrate used for the fermentation.
- Lack of scientific intervention, process technology, contamination with known toxigenic microorganisms which can proliferate and elaborate toxins during the fermentation process

A. Basic Science, Climate resilient and Next Generation Agriculture

- Holistic inclusive strategy to conserve the indigenous beneficial soil microbiome and to develop whole soil microbiome as next generation biofertilizer/biopesticides
- Mass production of efficient biofertilizer, biopesticides and other bio-inputs based of agro-geo climatic need towards developing organic Arunachal brand.
- Raising of high value Horticulture crops and providing services for the following aspects: Soil testing, consultancy services, developing improved varieties, low-cost technology, QA/QC, conservation of indigenous land races, and post-harvest technologies
- Integration and implementation of Digital, precision and next generation agriculture practices towards achieving higher productivity.

B. Ethnic & Fermented food and beverages hub of Arunachal Pradesh:

- Scientific documentation, and exploring metataxonomic and metagenomic diversity of microorganism in the ethnic food and beverages products of Arunachal Pradesh to develop functional food.
- Preclinical and clinical validation of the fermented food produced through improvised process for improved quality and fortified ethnic fermented food.
- Metabolic engineering of beneficial microbes for production of novel bio-functional compounds.
- Formulation, Validation and preservation of scientifically optimized approach for production of high Quality hygienic and safe ethnic fermented food and beverages products as developed functional food with improved shelf-life and maximum consumer acceptability.
- Targeting life-style diseases and/or deficiencies through the fortified functional ethnic fermented food products.

C. Comprehensive Exploration, Database Development and Conservation of Economically Important Microbial Biodiversity of Arunachal Pradesh

- **Evaluation of key beneficial characteristics** corresponding to a) PGPR (soil fertility), b) Probiotics attributes (fermented foods) c) Antimicrobial activities (drug discovery) d) Enzymes and stresses molecules (drug discovery/ bio-pesticides)
- **Development of database and sustainable utilization:**The envisaged database is poised to function as a repository teeming with microbial riches, offering a trove of opportunities for the bioprospecting of advantageous microbial traits that hold the key to advancing both scientific knowledge and the betterment of humanity
- **Capacity Building:**The initiative aims to orchestrate impactful workshops, symposia, and training programs centred around the intricate domains of microbial identification, preservation, and the advanced facets of microbial taxonomy and phylogeny

D. Bio-manufacturing: Bio-production of industrially valuable compounds and enzymes from lignocellulosic biomass hydrolysates with a modular metabolic engineering system in *Saccharomyces sp/Lactobacillus sp*

The growth of the circular bioeconomy, or the commercial and industrial application of sustainable bio-based products and services, has long been an ambition for many governments, public and private stakeholders. The benefits of that economic system are manifold, especially for energy use reduction, increased innovation and sustainability.

Transitioning towards a system of production firmly rooted in biotechnological innovation, and away from traditional petroleum-based manufacturing practices, is dependent on the enabling research from fields such as synthetic biology, information technology, and industrial biotechnology.

Approaches:

- Increasing the robustness, performance and metabolic versatility of industrial microbial chassis. Developing genome engineering tools and strategies
- Generating sustainable and safe-by-design products from alternative feedstocks and valorizable wastes
- Bioproduction: using *Pseudomonas putida* as our main microbial chassis, but with research projects on *Escherichia coli, Rhodobactersphaeroides, Bacillus subtilis, Saccharomyces cerevisiae etc.*

E. Entrepreneurship Development through Mushroom Cultivation and fortification Avenue in Arunachal Pradesh with Special Reference to Cordyceps Mushroom Cultivation and Its Value Addition

- Scientifically validation of wild edible mushrooms boasting superior nutritional and nutraceutical properties.
- Fortified edible mushroom with superior human health benefits.

  Alternative nutrient-enriched substrate materials designed to enhance growth and yield, complemented by innovative production methods.

Different plant species used by different tribesDifferent plant species used by different tribesMushroom culture set-up at DBT-APSCS&T Centre of Excellence (CoE) for Bioresources and Sustainable Development, Kimin, Papum Pare district, Arunachal

Activity-6: Exploration, Collection, Documentation of Indigenous Rice Landraces for Phenotypic and Genotypic Study for Germplasm Conservation:

- The Department of Biotechnology (DBT), Government of India (GOI), in collaboration with the DBT-APSCS&T Centre of Excellence (CoE) for Bioresource and Sustainable Development in Kimin, has initiated a project focused on the conservation of indigenous rice cultivars. This project, driven by the recommendations of the Project Monitoring Community of the DBT, aims to preserve the diverse range of rice (*Oryza sativa*) varieties native to various parts of the state, particularly in valleys and plains where rice is a major crop.

- The state boasts a wide variety of rice cultivars that are adapted to local agro-climatic conditions. However, there is a challenge of duplicity arising from different nomenclature used for the same landrace in different regions. To address this anomaly, the project emphasizes the need for accurate identification of rice landraces using modern biotechnological tools, enabling differentiation on both phenotypic and genotypic levels. This accurate identification will facilitate proper information dissemination and the generation of unique accession numbers for each landrace.
- In pursuit of this goal, the Germplasm Conservation project focuses on the exploration, collection, and documentation of indigenous rice cultivars. So far, 117 landraces have been registered from districts such as Upper Subansiri, Changlang, Lower Subansiri, Tirap, Longding, Kamle, West Siang, Lepa Rada, East Siang, and Siang. However, it is worth noting that four landraces from Lower Subansiri have been discarded by local Sowers in favor of hybrid varieties and are on the verge of extinction.
- The Centre's objective is not only to develop a repository of indigenous rice germplasms but also to analyze their qualitative and quantitative properties. As part of this effort, the qualitative analysis and quantification of chemical components have been conducted for 15 indigenous rice varieties from Ziro, belonging to the Apatani community of Arunachal Pradesh. This comprehensive approach aims to ensure the conservation and sustainable development of the state's rich rice biodiversity.

Districts covered:

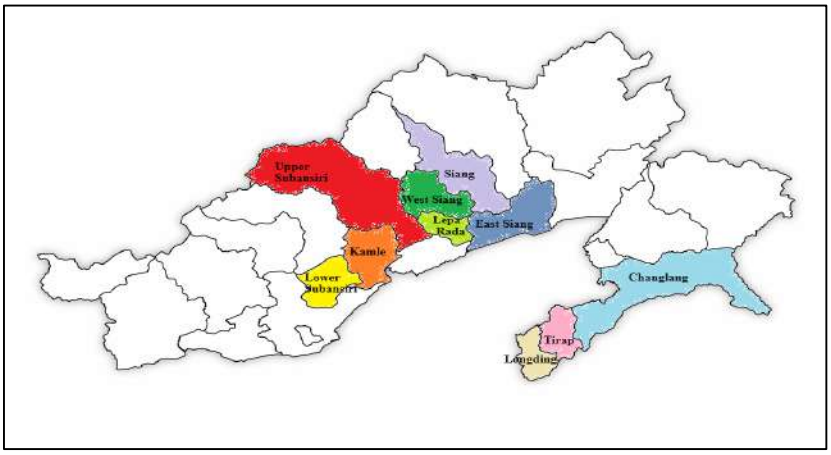


Fig: Representative images of different varieties of indigenous rice landraces harvested form the trial plots. 1. Jih Pyaapin, 2. Ampuhaath, 3. Missang Pyaapin jih, 4. Neli Aemo, 5. Radhe Ralang, 6. Sobo Aemo)

Research and Development:

- The R&D work was done on the selective varieties of 15 cultivars of Ziro rice, targeting the Apatani community's local varieties. The aim of this study was to fulfill preliminary research on indigenous rice to obtain a project on germplasm conservation and genetic population study through markers and DNA barcoding studies.

Proximate analysis of the selected rice samples for parameters like Nitrogen, Carbohydrate content, Crude fiber, Protein content, Ash, etc. have been completed. Similarly, mineral content for calcium, phosphorous, potassium, etc. have also been completed.

-

Table 4.1: Showing Cultivars with highest Proximate composition

Sl. No	Test	Cultivars
1	Carbohydrate Content %	Sobo Aemo
2	Protein Content (%)	Ellang Meepya
3	Ash Content (%)	Radhe Rapu
4	Crude Fat Content (%)	AempuHaatii
5	Crude Fiber Content (%)	Ellang Meepya
6	Moisture Content (%)	Jih Pyakhe Pyat

Table 4.2: Showing cultivars with highest Mineral content

Sl. No	Test	Cultivars
1	Nitrogen content (%)	NyiboPyaat
2	Phosphorous content (%)	PyaatMeepya
3	Sodium content (%)	Jih Pyaat
4	Potassium content (%)	AempuHaatii
5	Calcium content (%)	NyiboPyaat, Pyanyi

- Antioxidant studies for the methanolic extracts have been completed through DPPH assay and ABTS assay. The assay has been analyzed using standard ascorbic acid and gallic acid for DPPH and ABTS assay respectively

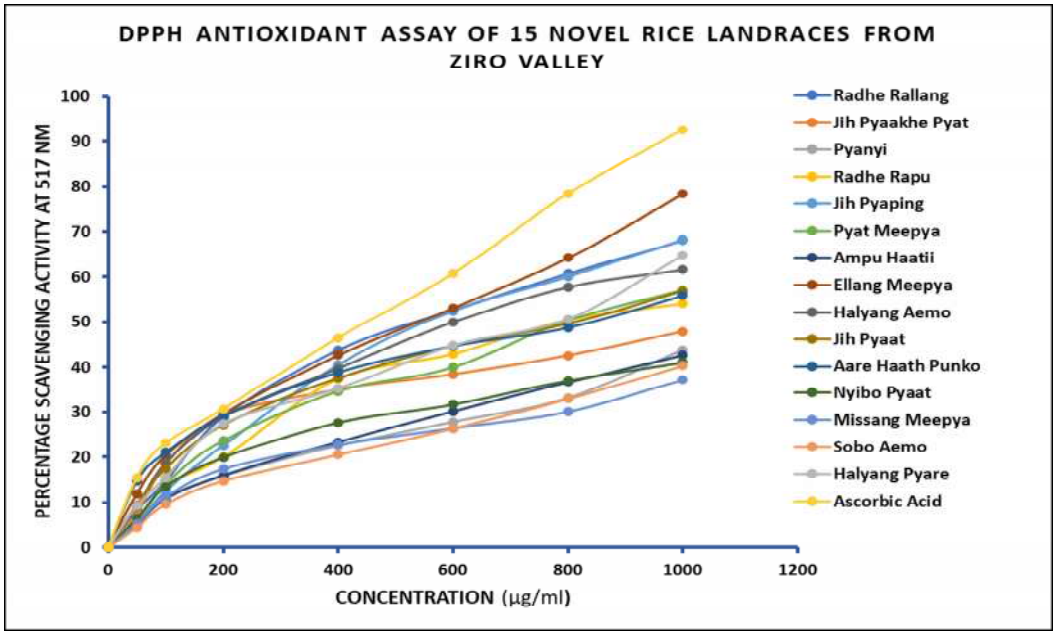


Fig:DPPH Assay of 15 novel rice cultivars from Ziro Valley

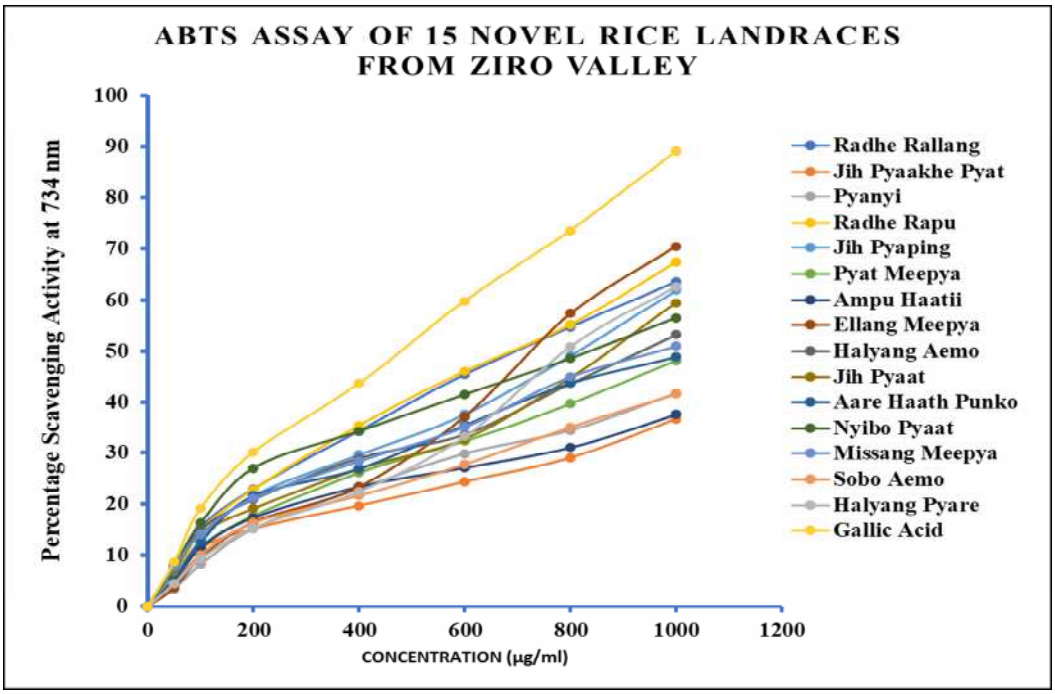


Fig:ABTS assay of 15 novel rice cultivars from Ziro Valley.

- Bioactive components from the selected rice cultivars have been identified through GCMS at IIT Bombay.
- Phenotypic study including morphological features have been recorded during field survey and verified through in-house germination studies conducted in the Centre.

Table 4.3: Phenotypic study of 15 novel rice varieties from Ziro Valley

Accession no.	Rice cultivar	F.L.L (cm)	F.L.W (cm)	H (m)	N. T	C.D (cm)	S. P	G. P	S.S (cm)	D.S	S.C
IC-0641394	Ellang Meepya	57.45	0.8	4.3	5	4	6	205	0.7	Pigmented	Pigmented
IC-0641395	Pyanyi	49.56	1.7	4.1	4	3	4	180	0.6	Slightly Pigmented	White
IC-0641396	Jih Pyaat	51.27	0.95	5.2	4	3.5	6	200	0.8	Pigmented	White
IC-0641397	Jih Pyaping	48.97	0.87	4.9	5	3	5	190	0.9	Pigmented	White
IC-0641398	Radhe Rapu	56.33	1.3	4.8	7	3	11	220	0.7	Yellowish	White
IC-0641399	Radhe Rallang	52.66	1.1	4.5	8	3	10	225	0.8	Yellowish	White
IC-0641400	Pyat Meepya	63.54	1.2	4.2	5	4	6	195	0.6	Pigmented	White
IC-0641401	Aare Haath Punko	67.28	1.25	4.1	6	2.5	8	220	0.6	Yellowish	White
IC-0641402	Missang Meepya	58.3	0.83	4.3	5	3	6	180	0.7	Pigmented	White
IC-0641404	NyiboPyaat	43.55	1.93	4.1	4	3.5	4	180	0.6	Slightly Pigmented	White
IC-0641405	Jih Pyaakhe Pyat	45.36	0.75	4.7	4	2.5	5	200	0.8	Pigmented	White
IC-0641406	HalyangAemo	38.57	0.7	3.8	5	1.5	6	160	0.5	Yellowish	Pigmented
IC-0641407	AmpuHaatii	55.68	1.1	4.6	8	2	7	205	0.5	Yellowish	White
IC0641408	Sobo Aemo	57.61	0.92	3.9	5	2.4	6	230	0.6	Yellowish	White
IC-0641409	Halyang Pyare	39.87	2.1	4.5	4	2.5	4	170	0.7	Slightly Pigmented	White

* Flag leaf length (F.L.L), Flag leaf width (F.L.W), Height (H), Number of tillers (N.T), culm diameter (C.D), spikes per plant (S.P), grains per panicle (G.P), seed size (S.S), dehusk seed (D.S), seed colour (S.C)

- Work on DNA barcoding is being initiated and is under nascent stage as the protocols for DNA extraction are being standardized at the present.

DNA extraction through using CTAB and SDS protocols.

Activity-7: Bioinformatics-based Intervention for Drug Discovery and Development of Database on Medicinal, Aromatic, Orchid and Wild edible plants

The Bioinformatics and Computational Biology Centre have been established in DBT-APSCS&T CoE for BRSD, Kimin having installed high-performance servers along with the leased line internet connectivity.

a. Documentation of medicinally important plants.

Arunachal Pradesh is known as the hotspot of biodiversity. The local populace of Arunachal Pradesh is extensively relying on medicinal plant based traditional remedies for the management of diverse ailments. However, an interactive database for all important medicinal plants and their uses needs to be developed for the extensive research of these plants. The comprehensive data mining of 200 such important medicinal plants encompassing their respective applications, modes of action, and chemical constituents have been completed. Arunachal Pradesh also recognized as the 'Orchid Paradise', consists of approximately 650 orchid species which represents nearly half of the total orchid species documented throughout the rest of India. Information regarding 80 Rare, Endangered, and Threatened (RET) orchid species of Arunachal Pradesh have been collected.

b. Co-expression network analysis of secondary metabolite gene clusters.

Gene Regulatory Network (GRN) is a directed edge connects two genes, denoting a biochemical process such as a reaction, transformation, interaction, activation or inhibition. The ongoing gene Co-expression network research spans various domains including the investigation of gene clusters implicated in flower development in Rhododendron, orchids species and secondary metabolite clusters of immunomodulatory plants etc. In this process, De novo assembly and functional annotation of known genes were completed. However, there are several unannotated genes were identified. To address this issue, we are working on integration of different databases and webtools for annotation of unknown genes.

Furthermore, we conducted transcriptome sequencing in duplicate for two important medicinal plants: leaf & seed of *Nyctanthesarbor-tristis*, and leaf & flower of *Lucas aspera*. The primary objective of this transcriptome sequencing is to elucidate the genes involved in secondary metabolite biosynthesis pathway within these plants. Raw sequencing data for both plant species have been acquired, and the process of De novo assembly of these sequences is currently underway.

c. Computer Aided Drug Designing (CADD)

The advent of CADD approach brings novel avenues towards successful design of lead molecules with high binding affinity and specificity against target protein. In the present study, we have employed CADD approach to design lead molecule against Type 2 Diabetes Mellitus (T2DM). An enzyme called alpha glucosidase, found on the surface membrane of small intestine helps in the digestion and absorption of carbohydrates. The blockage of this enzyme helps in the reduction of glucose absorption in small intestine that proves to be beneficial to reduce postprandial blood glucose level. Hence, alpha glucosidase enzyme was considered as the target.

A total of 17,528 phytochemical compounds were downloaded from Indian Medicinal Plants, Phytochemistry and Therapeutics (IMPPAT) database. Subsequently, Lipinski rule of five and ADMET screening method was followed for initial screening and 26 lead molecules were retained for further process. Then 26 molecules were subjected for virtual screening against alpha glucosidase enzyme and based on highest binding energy and active site binding residues, 9 lead molecules were selected for Molecular Dynamics Simulation (MDS). Then MDS was performed in different time intervals i.e. at 50ns, 100ns and 200ns for investigating the dynamic behavior of lead molecules. Finally, one compound, named as Spathulin (IMPHY011094) from *Gaillardia aristate* found to be the best lead molecule that shows high binding affinity and showed stable binding orientation with alpha glucosidase enzyme.

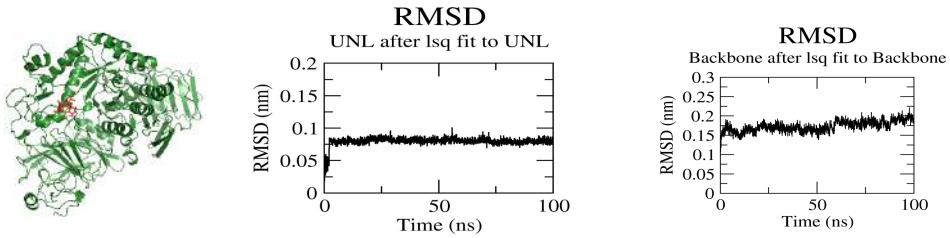


Fig. showing docked ligand Spathulin (IMPHY011094) with alpha glucosidase (left) followed by Molecular Dynamics Simulation showing the RMSD of protein (middle) and complex (right)

Activity-8: Exploration and Documentation of wild edible plant species of Arunachal Pradesh

Arunachal Pradesh, located in the eastern Himalayas, is one of India's richest biodiversity zones with vast forest cover and numerous endemic species. It harbours over **5000 flowering plants, 400 ferns, 600 orchids, 48 gymnosperms** and several species of algae, lichens, fungi, and bryophytes. Wild Edible Plants (WEPs) form a crucial part of the local dietary system and are important for sustaining tribal livelihoods, particularly during lean seasons. However, traditional knowledge of WEPs is gradually declining due to modernization and cultural shifts.

Rationale for the Study

- Herbal teas (Tisanes) are caffeine-free infusions made from a variety of herbs, flowers, fruits, and spices.
- Folklore in Arunachal Pradesh has long credited these tisanes with medicinal and therapeutic benefits.
- Six traditionally important wild edible plant species were selected based on indigenous knowledge for tisane formulation.
- In response to suggestions from Project Monitoring Committee (PMC) members, the study aimed to develop infused tisane formulations through systematic bioprospecting and translational research.

Aim of the Study

- To document traditional knowledge of herbal tisanes used by various communities in Arunachal Pradesh.
- To assess the traditional healthcare functions and safety of these herbal drinks.
- To formulate caffeine-free herbal infusions (tisanes) using indigenous herbs and spices.
- To perform sensory evaluation of five tisane formulations for taste, aroma, and acceptability.
- To analyze the biochemical, antioxidant, and nutritional properties of the tisanes.

Plant selection and formulation of Tisane:

Litsea seeds

Rhus Sps.

Magnolia fruit

Cinnamon bark

Wild Litsea flowers

Pyrus pashia

Ginger Root

- Selected herbs and spices for the formulation of six different varieties of Tisanes
-

Sensory evaluation of the formulated Tisanes:

In the present study, the detailed sensory and organoleptic evaluation was carried on these tisanes to find out the acceptance level from Tocklai Tea Research Institute, Jorhat by an expert Tea Tester. The sample infusions were coded A, B C, D, E and F.

Table: Sensory evaluation of six number of formulated tisanes (Mean score of tisanes sensory attributes)

Infusions	**Taste**	**Colour**	**Aroma**	**Acceptability**
Code A	8	8	8	7.2
Code B	9	7	8	6
Code C	7	7	6	5.8
Code D	6	6	7	6.5
Code E	5	6	6	8.2

The radicle scavenging activity of the Tisanes after boiling was also evaluated. The prospective product prototypes were designed.

Qualitative Phytochemical Analysis & Nutritional Study

- For the initial screening of bioactive substances, various extracts were used. These included alkaloids, carbohydrates (Fehling's test), Phenolic compounds, proteins and amino acids.
- Antioxidant activity (DPPH assay): Highest radical scavenging activity recorded at **80.99%**, notably in *Pyrus pashia*, traditionally valued in indigenous medicine.
- Solvent extract variation: Antioxidant activity differed between methanol and ethanol extracts.
- The tisane extracts are rich in primary antioxidants and bioactive compounds.

Quality parameters (Pesticide content, Heavy metal, a toxic compound, mineral content, etc.) of tisane prepared by the improved method were analyzed as per USFDA norms by following FSSAI Manual – 2016.

Nutritionalanalysis:
Confirmed the presence of crude proteins, crude fibre, crude fats, and carbohydrates in significant quantities, indicating good nutritional value.

Foodsafetyconsiderations:
Addressed risks of contamination, foodborne illnesses, and adhered to strict regulatory standards for safety and quality assurance.

Challenges & Constraints

- Difficult access to remote locations for field studies and plant collection.
- Lack of industrial infrastructure for processing, R&D, and product development in the state.
- Food safety concerns due to risks of contamination, foodborne illnesses, and strict regulatory standards.
- Limited opportunities to study food values, therapeutic properties, market demand, and consumer preferences for wild edible plants.
- Absence of structured linkages with women's self-help groups (SHGs) for marketing, value addition, and conservation of the plant species.

Conclusion & Future Prospects

- Formulated tisanes showed promising attributes in terms of sensory qualities (taste, colour, aroma) and antioxidant potential.
- Identified as a potential non-caffeinated alternative to conventional tea varieties.
- High antioxidant activity confirmed through DPPH assay, notably in key indigenous ingredients.
- Certain ingredients traditionally believed to have immunomodulatory effects — planned for scientific validation.
- Future work will involve:

  - Detailed quantitative phytochemical and nutritional analysis.
  - Assessment of quality parameters and food safety standards.
  - Translational research for product development and commercialization.
  - Exploring market linkages and community-based value chains for sustainable use and conservation.

Activity 9:Capacity Building of Rural Women on Processing and Value Addition of Millets /Underutilized Crops through Technology Adoption and Awareness for Nutritional Security in Dadam Village of Tirap District, Arunachal Pradesh

Output: Under the significant progress has been made in empowering the local community, particularly rural women. As part of the initiative, millet processing machinery was successfully installed in the village to facilitate small-scale processing and value addition of locally grown millets and underutilized crops.

To ensure optimal use of this infrastructure, two comprehensive training programs were conducted, focusing on technology adoption, hygienic processing methods, and techniques for developing value-added products such as millet-based snacks, flours, and ready-to-cook mixes. The trainings also included sessions on the nutritional benefits of millets and underutilized crops, helping raise awareness among the participants about their importance in achieving food and nutritional security.

This initiative has laid the foundation for sustainable livelihood opportunities by equipping women with practical skills and resources to process, package, and potentially market their products, thus promoting self-reliance and improved health outcomes in the region.

Activity 10: Establishment of Bioinformatics and Computational Biology Centre in Arunachal Pradesh – BIC at Centre for Bioresources and Sustainable Development, Kimin

The Bioinformatics and Computational Biology Centre have been established inDBT-APSCS&T CoE for BRSD, Kimin having installed high-performance servers along with the leased line internet connectivity. As per the defined objectives, information about medicinal plants and Orchids have been collected from available literatures, books and through interaction with indigenous local knowledgeable people. These data are stored in a digital database prepared using HTML, PhP, CSS and Java Script. *Setaria italica* transcriptome data have been collected for carrying out the Gene Co-expression Network analysis. High-throughput transcriptome sequencing of four important medicinal plants (*Nyctanthesarbor-tristis, Clerodendrum colebrookianum, Costus speciosus*and *Leucas aspera)* was carried out by the Centre. The Centre has also established scientific collaboration with different institutions for pursuing joint collaborative research. During the financial year 2024-25, a total number of 139 students and researchers received training in advanced fields of Bioinformatics through various workshops organized by BIC, DBT-APSCS&T CoE for BRSD, Kimin.

Awareness programmes for students and researchers in the field of Bioinformatics.

The Bioinformatics and Computational Biology Centre (BIC) continues to serve as a vital resource hub, offering training, facilities, and support to both in-house and external researchers engaged in Molecular Biology and Computational Biology teaching and research. During the first year of project implementation and the financial year 2024-25, BIC successfully organized two (2) hands-on workshops at the DBT-APSCS&T CoE for BRSD, Kimin, and one (1) symposium at Arunachal University of Studies (AUS), Namsai, Arunachal Pradesh. The symposium featured a total of 111 participants from AUS, Namsai and Indira Gandhi Government College, Tezu, Arunachal Pradesh, significantly contributing to regional capacity building and fostering collaborative scientific engagement. The details of the organized training programs are highlighted in the table below:

Advancing Agriculture with Bioinformatics and AI: Sustainable Solutions for Bioresource Management

The BIC, DBT-APSCS&T CoE for BRSD, Kimin, was successfully conducted a workshop titled "**Advancing Agriculture with Bioinformatics and AI: Sustainable Solutions for Bioresource Management**," during 26th -27th November, 2024. The event featured 14 participants and three expert speakers from CSIR-CSIO, including **Dr. Amol P. Bhondekar** (Senior Principal Scientist), **Dr. Ritesh Kumar** (Principal Scientist), and **Dr. Saurav Kumar** (Senior Scientist), who led sessions on precision

agriculture, AI, IoT systems, and sensor technologies. Day two included hands-on sessions on classification analysis using rice drought datasets, EDA and model development with lettuce data, and leaf disease classification. Coordinated by Dr. Debashis Panda (Scientist-B, DBT-APSCS&T CoE for BRSD), the workshop combined lectures and practical training, emphasizing the role of advanced technologies in sustainable agriculture and resource management in Arunachal Pradesh.

Snapshot of Workshop on "Advancing Agriculture with Bioinformatics and AI: *Sustainable Solutions for Bioresource Management*"

Advancements in Drug Discovery: A Comprehensive Hands-on Training on Network Pharmacology, QSAR and Virtual Screening

The workshop titled "**Advancements in Drug Discovery: A Comprehensive Hands-on Training on Network Pharmacology, QSAR and Virtual Screening**," was scheduled for 8th-9th January 2025, but due to some unavoidable circumstances the workshop was postponed and merged with workshop titled "**Multi-Disciplinary Approaches in Bioinformatics and Computational Biology: Network Pharmacology, QSAR Modelling, Virtual Screening, Role of AI in Drug Designing, and Transcriptome Data Analysis".**

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No. SC (DBT)/BC/60/2019-20(Vol-I)/571 Dated. 10th December, 2024

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Applications are invited from post-graduate students, researchers and faculty members working in Life Sciences sector for attending in the two-days' Workshop entitled ***"Advancements in Drug Discovery: A Comprehensive Hands-on Training on Network Pharmacology, QSAR and Virtual Screening"*** conducted by the Bioinformatics and Computational Biology Centre (BIC), DBT-APSCS&T Centre of Excellence for Bioresources & Sustainable Development, Kimin, Arunachal Pradesh under the Department of Biotechnology, Government of India, New Delhi, sanctioned project on **8th & 9th January, 2025.**

Only limited seats are available, which will be filled on first come first basis. Lodging and boarding on twin sharing basis would be provided to the outstation participants, subject to the availability of vacancy in the guest house. To register, please use the following link: **https://forms.gle/yweK4zG6o6dbWsWj6.** Participants will be selected based on their research interest, as outlined in the registration form and will be notified through email.

Last Date of Registration: **2nd January, 2025.**

Sd/-
(Project Director)
DBT-APSCS&T Centre of Excellence for Bioresources and Sustainable Development
Kimin-791121, Arunachal Pradesh

DIPR/ARN/001865/2024

Snapshot of advertisement of postponed Workshop on "Advancements in Drug Discovery: A Comprehensive Hands-on Training on Network Pharmacology, QSAR and Virtual Screening"

Multi-Disciplinary Approaches in Bioinformatics and Computational Biology: Network Pharmacology, QSAR Modelling, Virtual Screening, Role of AI in Drug Designing, and Transcriptome Data Analysis

The BIC, DBT-APSCS&T CoE for BRSD, Kimin, was successfully organized a workshop on "**Multi-Disciplinary Approaches in Bioinformatics and Computational Biology: Network Pharmacology, QSAR Modelling, Virtual Screening, Role of AI in Drug Designing, and Transcriptome Data Analysis**." The event featured 14 participants and four experts from different institutions, aimed to build capacity in integrated drug discovery approaches and modern computational tools in Life Sciences.


DBT-APSCS&T CENTRE OF EXCELLENCE
FOR BIORESOURCES AND SUSTAINABLE DEVELOPMENT
DEPARTMENT OF SCIENCE & TECHNOLOGY
GOVERNMENT OF ARUNACHAL PRADESH
KOMASAKI, KIMIN-791121, ARUNACHAL PRADESH
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Workshop on multi-disciplinary approaches in Bioinformatics & Computational Biology concludes

Dr. Hridoy Jyoti Mahanta (Scientist, CSIR-NEIST, Jorhat) introduced participants to Machine Learning and Deep Learning in drug discovery. **Dr. Sanjib Kumar** (Assistant Professor, NEMCARE Group of Institutes, Guwahati) covered key concepts in Computer-Aided Drug Designing (CADD). **Dr. Sanchaita Rajkhowa** (Assistant Professor, Centre for Biotechnology and Bioinformatics, Dibrugarh University) delivered a lecture on Network Pharmacology and conducted a hands-on session on QSAR modelling. Additionally, **Dr. Debashis Panda** (Scientist-B, DBT-APSCS&T CoE for BRSD) led sessions on High-Throughput Data Analysis and CADD. The workshop provided a balanced mix of theory and practical training, equipping participants with essential skills for cutting-edge research in Bioinformatics and Computational Biology.

Symposium on Applications of Bioinformatics & Computational Biology in Biopharmaceuticals, Bioeconomy and Biomanufacturing

The BIC, DBT-APSCS&T CoE for BRSD, Kimin, organized a Symposium on "**Applications of Bioinformatics & Computational Biology in Biopharmaceuticals, Bioeconomy and Biomanufacturing**" at Arunachal University of Studies (AUS), Namsai, Arunachal Pradesh to highlight the diverse and interdisciplinary roles of computational tools in Life Sciences and Biotechnology for 111 participants.


Need for integrating computational biology tools with biotechnology to advance India's bioeconomy stressed


Symposium on 'Applications of Bioinformatics & Computational Biology'

Dr. Ajeya Jha, Professor at Arunachal University of Studies, Namsai, delivered insights into the applications of Biopharmaceuticals, while **Dr. Rashmi**

Rekha Boruah, Associate Professor at the same university, presented on advancements in Molecular Biotechnology**. Dr. Sanjeeb Kalita** (Scientist-B, DBT-APSCS&T CoE for BRSD) shared expertise on Translational Biotechnology, and **Dr. Debashis Panda** (Scientist-B, DBT-APSCS&T CoE for BRSD) spoke on High-Throughput Data Analysis and Computer-Aided Drug Designing.

The symposium served as a knowledge-sharing platform that brought together researchers and academicians to discuss the latest trends and practical applications of Bioinformatics in addressing biological and biomedical challenges.

II. SCIENCE AND TECHNICAL PROGRESS RESEARCH AND DEVELOPMENT

1. ESTABLISHMENT OF STATE-OF-THE-ART ORCHIDARIUM FOR CONSERVATION AND MULTIPLICATION OF PRIORITY ORCHIDS SPECIES ALONG WITH ESTABLISHING STATELLITE UNITS IN SELECTED VILLAGES WITH VIEW TO PROMOTE ORCHIDS- BASED ENTREPRENEURSHIP IN RURAL VILLAGES OF ARUNACHAL PRADESH.

A. State-of-the-Art Orchidarium at DBT-APSCS&T CoE for BRSD

State of the Art Orchidarium at DBT-APSCS&T CoE for BRSD, Kimin

The state-of-the-art Orchidarium at DBT-APSCS&T CoE for BRSD, Kimin, continues to be actively maintained and operated as a hub for conservation, propagation, and commercialization of commercially important and indigenous orchid species. Housing around 600 hybrid varieties, the facility supports ongoing training, awareness programs, and entrepreneurial initiatives in orchid-based floriculture. It also functions as a conservatory for rare native orchids, promoting sustainable floriculture practices and economic opportunities for local growers and entrepreneurs in Arunachal Pradesh.

Snapshot of Symposium on "Applications of Bioinformatics & Computational Biology in Biopharmaceuticals, Bioeconomy and Biomanufacturing"

Snapshot of Workshop on "Advancing Agriculture with Bioinformatics and AI: *Sustainable Solutions for Bioresource Management*"

B. Ongoing Technical Support and Handholding for Orchid Production Units across Arunachal Pradesh

During 2024–25, DBT-APSCS&T CoE for BRSD continued its technical support and capacity-building initiatives for orchid production units established in Namsai, Pasighat, Ziro, Deed, and Kimin. These satellite units, supported through Memoranda of Agreement with Self-Help Groups, are actively engaged in orchid propagation and commercialization. Regular monitoring, hands-on technical training, and guidance on market linkages have been provided to empower local farmers and entrepreneurs. Training collaborations with ICAR-NRC on Orchids, Sikkim, further strengthened local capacity in orchid conservation, cultivation, and value addition. The initiative is yielding results, with revenue generation reaching up to □50,000 annually per unit, promoting sustainable orchid-based livelihoods.

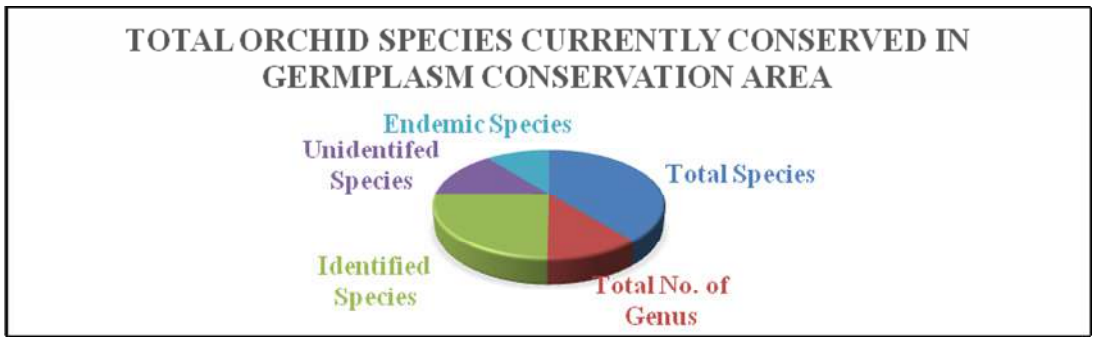
Pictures of the Orchid production unit at Pasighat, East Siang District

C. Establishment of orchid germplasm conservation areas in the centre

Orchid Germplasm Conservation Area has been established to conserve and propagate the rare,endangered and threatened orchids of the State. Field explorationwas conducted in different locations, agro-climatic zones of the state for the rescuing and collection of the orchids. Till the period under report, a total number of more than 110 species of orchids have been rescued, collected from the explored locationsand are being conserved in the germplasm conservation area. The orchid germplasm conservation area is also working as an orchid repository for the molecular, plant tissue culture and other research works.

The major objectives behind the establishment of the orchid germplasm conservation area were the following

1. Rescuing and conservation of the indigeneous orchids of the state.
2. *In situ* conservation of the indigeneous orchids of the state.
3. Orchid repository for the molecular, plant tissue culture and other research works.



Flowers of few Endemic Orchids being conserved Germplasm conservation area at theDBT-APSCS&T CoE for BRSD, Kimin, Arunachal Pradesh

Hand Pollination of Indigenous Orchids (*Phaelonopsismanii*) at the Germ plasm conservation

Standardizing methodologies for the vegetative propagation of the orchids.

Methodologies have been standardized towards increasing the propagation of the orchids through replication and improvement of the standard existing methodologies. Experiments have been conducted to obtain the best media, best choice of the explants and understanding other requirements for growth of the orchids. These methodologies are being disseminated to the farmers, entrepreneurs, SHGs for cultivation of orchids.

Vegetative propagation of Orchids through Stem cuttings, Keikis and

Potting media - Brick pieces, Charcoal, Paddy husk, Tree barks, Coconut chips and Sphagnum Mosses

Experiments conducted to choose the best combination of natural media for the growth of the *Dendrobium*spp

D. Mic **e** **n**

Vegetatively propagated commercial orchid plantlets of *Dendrobium* and *Oncidium* hybrid.

Plant Tissue Laboratory has been established in the centre with all the required facilities for micropropagation. Protocols have been developed, standardized for micro-propagating orchids having commercial value for mass

production of its quality planting materials for cultivation, conservation and making available to the orchid growers. Currently protocols have been successfully standardized for the following orchids.

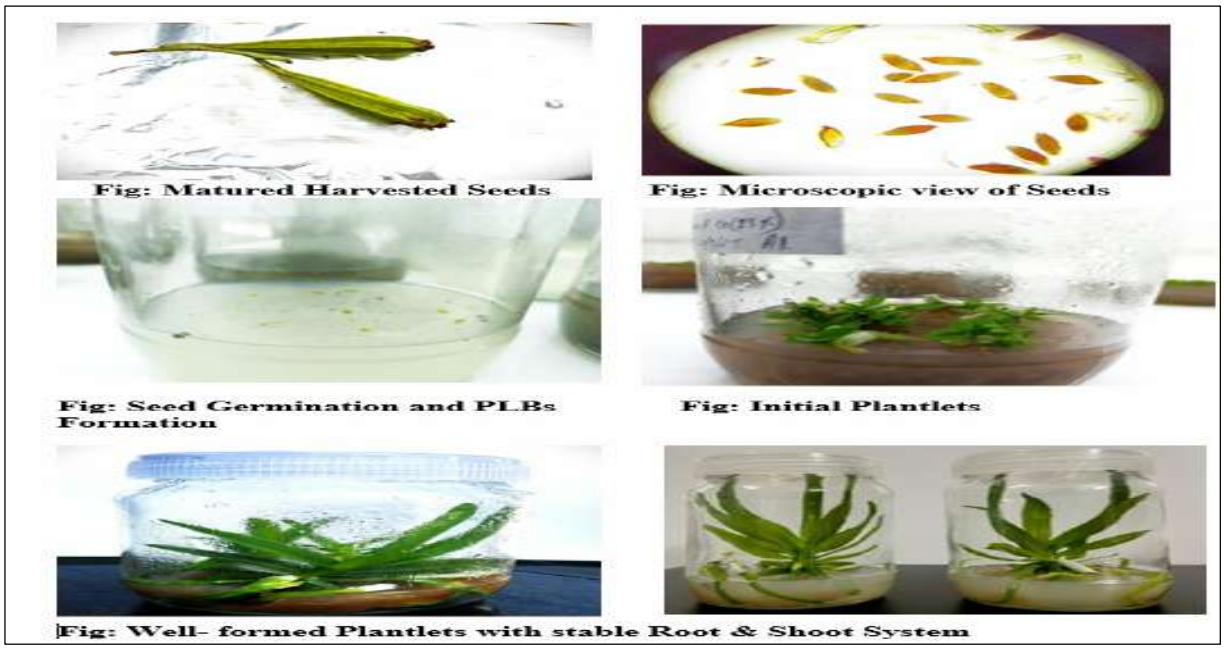
1. *Rhynchostylis retusa*
2. *Calanthe tankervilleae*
3. *Calanthe wallichi*
4. *Coelogyne nitida*
5. *Coelogyne viscosa*
6. *Epidendrum xanthinum*
7. *Cymbidium aloifolium*
8. *Coelogyne nitida*
9. *Cymbidium bicolor*
10. *Dendrobium chrysanthum*
11. *Vanda hybrid*
12. *Phalaenopsis hybrid*
13. *Vanda tessellate*
14. ♀*Vanda tessellate* X♂*Vandacoerulea*
15. *Cattleya* hybrid
16. *Dendrobium* hybrid
17. *Cymbidium* hybrid

E. Regeneration of ♀ *Vanda tessellata* X ♂ *Vanda coerulea*:

Regenerating hybrids from two intraspecific orchids involves several steps, mainly focused on the germination of seeds, culture media, and care of the seedlings post primary hardening. One such intraspecific cross was made in between *Vanda tessellata* (♀) X *Vanda coerulea* (♂). The hybrid seed was obtained through hand pollination. Once the seeds were matured, the capsule was collected and the seeds were cultured on different culture media out of which the earliest germination was observed in Basal KC Media. Post germination, the seeds at PLB stages were further sub-cultured in different growth media in controlled sterile conditions with proper monitoring. The fully grown seedlings were maintained in in-vitro condition until they developed robust shoot and root systems and were then moved out for primary hardening at the Greenhouse potted in a suitable orchid potting mix.

The hybridization between intraspecies of *Vanda tessellata* (♀) X *Vanda coerulea* (♂) is among first of its kind and the seedlings developed are of first-generation progeny. The seedlings are being taken care of at the Greenhouse of the CoE awaiting their flowering and further molecular works on these seedlings will be continued.

Results have been obtained for all the mentioned orchid through seed culture and tissue culture through meristematic tissues are also being initiated at the laboratory.



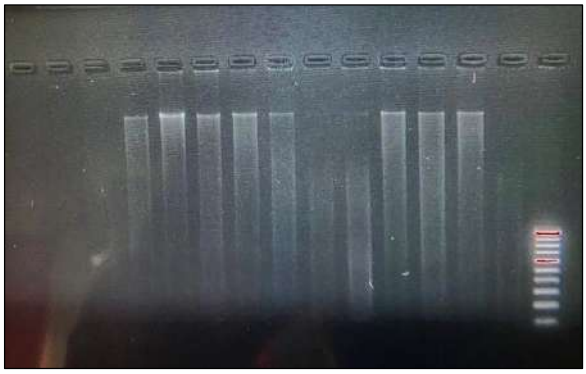
Primary hardening has also been successfully standardized for all the tissue cultured orchids. There are now more than 500 tissue cultured plantlets which are in the primary hardening. The centre will soon provide the benefit to the local orchid growers, entrepreneurs by making available the micro-propagated quality orchid plantlets of commercial value and also establish itself as a nodal training hub for micropropagation of orchids.

Primary hardening of the tissue cultured plantlets.

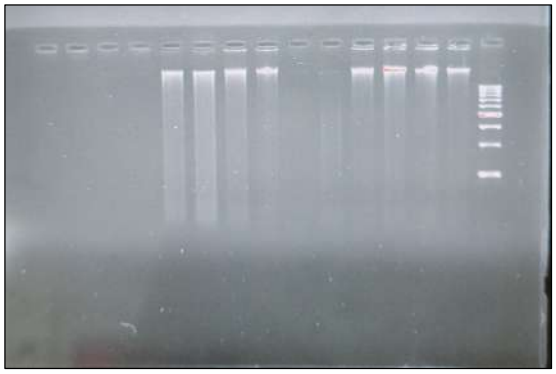
F. Molecular and other research activities

Arunachal Pradesh is bounded with the important endemic orchids which includes rare, endangered and threatened orchids with medicinal and other economic values. Identifying the need of molecular aspects towards the conservation of endemic orchids of the state, the Centre has initiated the process of DNA-Barcoding of the Orchids. Currently DNA isolation has been standardized for the following orchids through following methods.

Sl. No	SPECIES NAME	METHOD
1	*Dendrobium nobile*	CTAB
2	*Calanthe manii*	CTAB
3	*Dendrobium chrysotoxum*	CTAB
4	*Dendrobium devonianum*	SDS
5	*Arundinagraminifolia*	CTAB
6	*Phaphiopedilumspicerianum*	SDS
7	*Calanthe sylvatica*	CTAB/SDS
8	*Cymbidium tracyanum*	SDS
9	*Cymbidium bicolor*	SDS
10	*Paphiopedilum insigne*	SDS
11	*Paphiopedilum hirsutissimum*	SDS
12	*Paphiopedilum venustum*	SDS
13	*Calanthe tankervilleae*	SDS



Lane 1: 500bp ladder, Lane 2-12: *Paphiopedilum* sp.

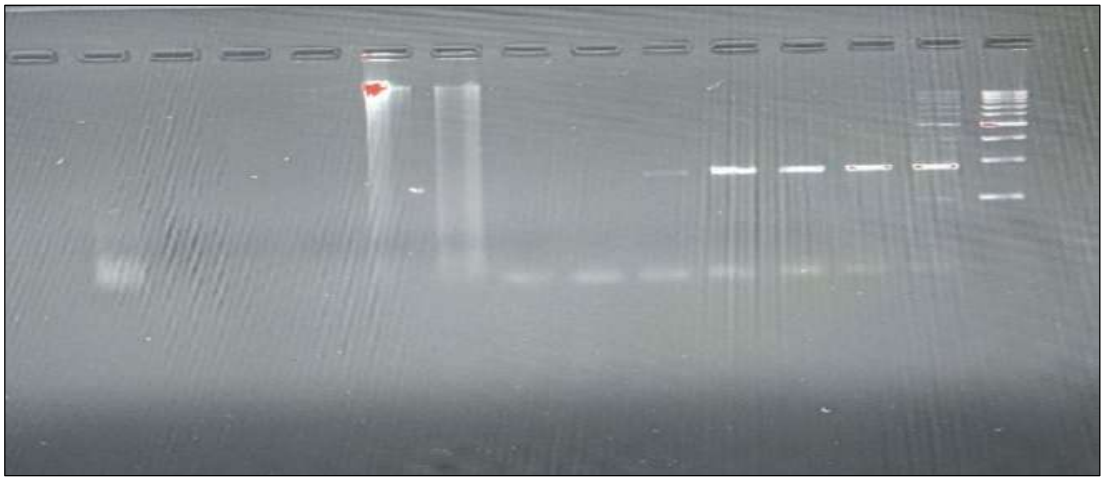


Lane 1: 500 bp ladder, Lane 2-5: *Phauistankervillae,* Lane7-10: *Phauis flavus*

Gel Documentation of the Isolated DNA samples

PCR amplification of MatK region of few orchids also have been successfully performed.

Sl. No.	Primer Name	Sequence direction 5'-3'
1	Mat k 1F	5'GAACTCGTCGGATGGAGTG3'
2	Mat K 1R	5'GAGAAATCTTTTTCATTACTAC3'



PCR Amplification of Mat K region of the plant (Orchid) DNALane 1: 500 bp ladder, Lane 2: *Cymbidium* bicolor, Lane 3: *Paphiopedilum* sp. Lane 4: *Dendrobium devonianum*, Lane 5: *Paphiopedilum* sp. Lane 6: *Dendrobium nobile.* Lane 7: *Arundinaaraminifolia.*

Further research work is being conducted on DNA sequencing and data base preparation for the identified species and its molecular characterization through DNA barcodes and molecular methodologies.

G. Value addition of orchids

Efforts are being made at the Centre to increase the economic avenues through value addition to the orchids. The revenue generations through the potted flowers and cut flowers have been initiated. DBT-APSCS&T CoE for BRSD has made attempts to capture the flower of orchids and bring value addition to it. Techniques have been developed, where the drying techniques have been standardized and embedded in resin where the vibrancy, colour and texture of the orchid flowers can be maintained till the eternity. This will help towards conservation, educational purpose and also towards development of orchid flower-based products. The prototypes have been already used as a memento and sold.

Standardization of Techniques for Value Addition of Orchids on Different Aspects; Optimization of Drying Techniques and Identification of Ideal

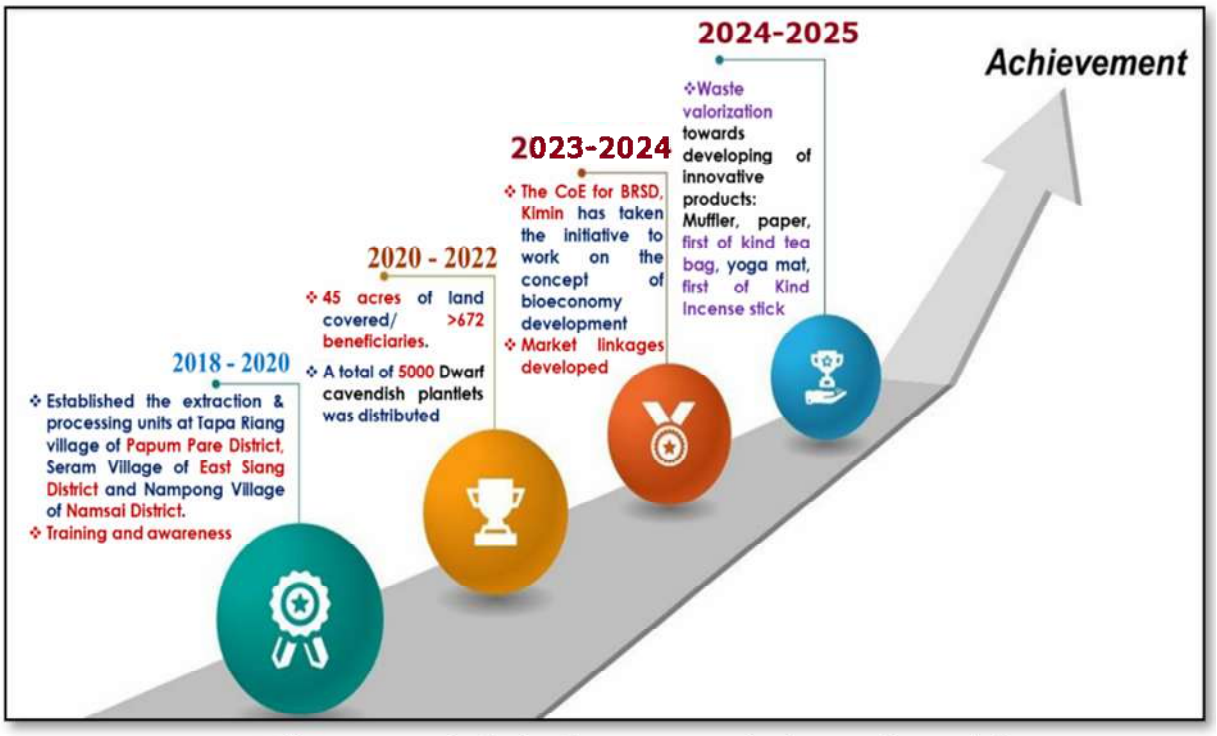
Orchid Flower Souveneirs with the Theme " Orchids for Eternity Bliss"

FUTURE PROSPECTS:

- ✓ Vast field exploration to the pristine region of the state for rescuing and documentation of the indigenous orchids of the state.
- ✓ Exploring orchid based floriculture avenues to increase the economic sustainability of the local populace.
- ✓ Development of Plant Tissue Culture laboratory into State-of-the-Art Plant Tissue Culture Laboratory.
- ✓ DNA Barcoding/Molecular Characterization of the indigenous endangered endemic orchids of the state.
- ✓ Developing Post Harvest methodologies for increasing profitability out of orchid based economic avenues
- ✓ Developing sustainable market for the orchid entrepreneurs/farmers.
- ✓ Increasing training and awareness program on orchid conservation, orchid cultivation and post-harvest methodology.

2.ESTABLISHMENT OF BANANA FIBRE EXTRACTION AND PROCESSING UNITS IN SELECTED DISTRICTS OF ARUNACHAL PRADESH.

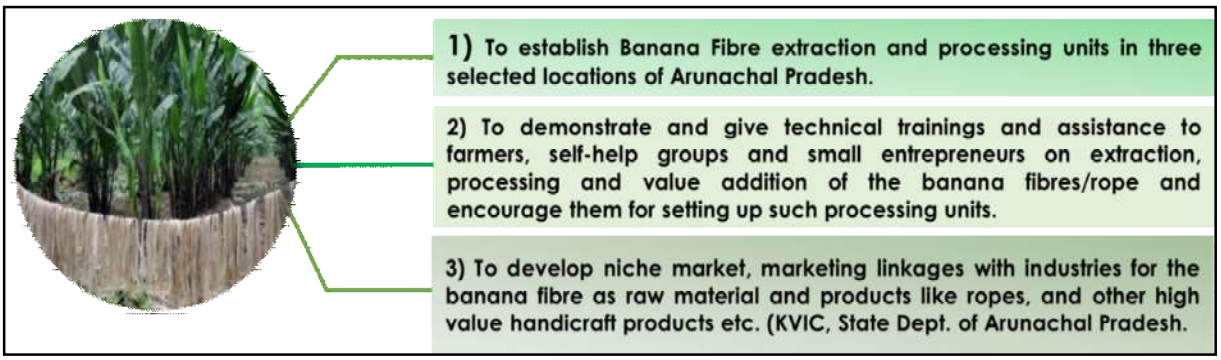
Under this DBT-PMC approved major activity, DBT-APSCS&T CoE for BRSD, Kimin has been focusing mainly on providing technical knowledge and training in value-added product development and promoting entrepreneurship development in banana fiber-based enterprises in the State with the active involvement of empowered youth, farmers, and other stakeholders. This programme being implemented will open up ample opportunities for the tribal populace of Arunachal Pradesh towards livelihood generation and upliftment of



Achievement made during the programme implementation period

their socio-economic status through banana fibre-based entrepreneurship development.

Objectives of the proposed project on Banana fibre:



Detail of Progress Made during the programme implementation period:

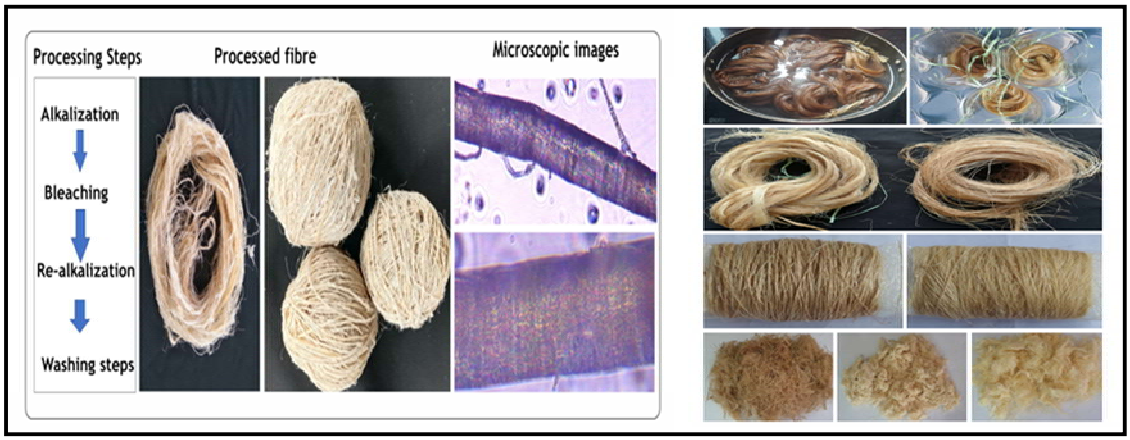
Under the PMC, Department of Biotechnology, Government of India approved programme, "*Establishment of Banana Fibre Extraction and Processing Units in Selected Districts of Arunachal Pradesh*"; the DBT-APSCS&T Centre of Excellence (CoE) for Bioresources and Sustainable Development, Kimin, has been focusing on providing technical knowledge and training in extraction, processing, value-added product development towards fostering banana fibre-based entrepreneurship in Arunachal Pradesh. This initiative actively engages youth, farmers, and other stakeholders to create sustainable livelihoods and uplift the socio-techno-economic status of the tribal populace.

Key objectives already achieved include the establishment of banana processing units, selection of banana species for high-quality fibre extraction, procurement, and installation of machinery, and conducting workshops and training programmes for capacity building. Further R&D efforts are underway to develop innovative products from banana Fibre, explore eco-friendly processing and dyeing techniques, standardize Fibre quality improvement processes, and promote product diversification into textiles, handicrafts, and composites. This programme aims to unlock the potential of banana Fibre as a valuable bioresource, driving entrepreneurship, employment, and economic growth in the region.

Representative photographs of processing units and facilities in the three selected districts (Namsai, East Siang, and Papumpare district) of Arunachal Pradesh

R & D, Technology development, and product prototypes

❖ **Development of an improved method of degumming banana fibre and sutcher materials:** The degumming process of banana fibre/ sutcher material had been standardized in the laboratory condition for utilizing the fibre in various industrial applications. The evaluation revealed that the processed banana fibre/ sutcher material improved their flexibility and strength by approximately 68.6- 74.06 % as compared to non-processed fibre.



Processing of fibre extracted from banana pseudo stem

❖ **Exploration of dye yielding plants of Arunachal Pradesh and optimization of the process of dyeing in banana fibre with natural dyes:**

Standardized the process of banana fibres dyeing by utilizing natural dye extracted from *Baccaureasapida, Bixa orellana, Melastomamalabathricum, Curcuma sp, Rubia cordifolia, etc*, and evaluated their antibacterial activity in terms of zone of inhibition.

Representative photographs of Dyed of Banana fibre

Table: Measurement of colour intensity in UV-VIS spectrophotometry

Sl. No	With natural dye	Mordant/Without mordant	At 566 nm	At 675 nm
1.	*Bixa Orellana*	-1	2.29±0.82	2.87±0.67
2.	*Bixa sp*	+1	3.96±1.23	3.56±0.93
3.	*Rubia cordiafolia*	-1	1.89 ± 0.21	1.79 ± 0.21
4.	*Rubia cordiafolia*	+1	2.29 ± 0.21	2.79 ± 0.75
5.	*Bixa orellana+ Rubia cordiafolia*	-1	2.99±0.57	2.97±0.87
6.	*Bixa orellana+ Rubia cordiafolia*	+1	3.92±1.23	3.96±0.98
7.	*Melastomamalabathricum+Curcumasp*	+1	3.16±1.56	2.90±0.87

❖ **Standardized the protocol to develop First of its kind Triple purpose Tea bag from Banana fibre:**

DBT-APSS&T CoE for BRSD, Kimin has developed India's first plastic-free tea bag made from Banana's fibre in laboratory condition, a new product designed specifically to help cut down the plastic pollution – a plastic-free, unbleached, and non-genetically modified tea bag. This tea bag can further be reused for removing the tanning content from the eyes, the result showed that the dark circle of the eyes had minimized as compared to the other plastic tea bag. The tea bags were also found to be biodegradable and compostable, which means they can be put into household food waste bins. The sensory evaluation in several tea products had been checked to find out the content aroma and flavor. The result indicated that the aroma content in some of the tea products had increased significantly using the tea bag of banana fibre. Again, in the case of flavour, the result was shown at par (p-value 0.05) when compared to the purchased plastic tea bags.

First of its kind of banana fibre tea bag in India, developed by DBT-APSCS&T CoE for BRSD, Kimin, Arunachal Pradesh

Table: Sensory evaluation of the First of its kind of Banana fibre tea bag

Sl. No.	Attributes**	First of its kind of banana fibre tea bag	Market tea bag
1.	Taste	4.6±0.45	4.5±0.53
2.	Aroma	4.9±0.36	4.0±0.53
3.	Flavour	4.07±0.56	3.99±0.46
4.	Color/appearance	4.9±0.36	4.7± 0.23
n=**35**, * values are mean of the panel list scores; **1= dislike extremely, 2=dislike, 3=like moderately, 4=Like strongly and 5= Excellent			

❖ **Technology for mushroom cultivation using banana fibre as substrate material:**

The oyster mushroom (Pleurotus ostreatus) is increasingly recognized as an effective biotechnological method for converting agricultural by-products into valuable food sources. This study focuses on utilizing banana biomass residue (BBR) as a substrate and nutrient source for P. ostreatus, evaluating its potential as a substitute for traditional rice straw (RS). Our findings indicate that BBR alone outperforms RS in terms of basidiocarp yield, moisture retention, incubation duration, and various morphological characteristics such as cap weight, diameter, and thickness. Additionally, the antioxidant activity of mushrooms grown on BBR was significantly higher (75.78%) compared to those cultivated on RS. These results suggest that employing BBR as a substrate, combined with optimal nutrient conditions, can lead to superior quality and higher yield of oyster mushrooms.

Representative photograph of Oyester mushroom produced on the substrate BBR and RS substrate

***In Situ* template Synthesized Silver Nanoparticulate Banana fibre Materials with Antimicrobial and Antibiotic Release Properties: Efficacy evaluation in *Ex Vivo* Wound Infection model**

This study deals with the *in-situ* template synthesis of silver nanoparticles (SNPs) within banana fibres (BF), non-woven sheets (BFS), and microparticles (BFM), yielding multifunctional biocomposites with broad-spectrum antimicrobial properties and controlled antibiotic release capabilities. The prepared SNPs exhibited a uniform size distribution with an average diameter of 12.6 ± 2.4 nm, confirmed through field emission scanning electron microscopy (FESEM) and energy-dispersive X-ray spectroscopy (EDX). Attenuated total reflection-Fourier transform infrared spectroscopy (ATR-FTIR) analysis indicated strong interactions between the banana fibre matrix and SNPs, with characteristic peaks at 1384 and 1612 cm^{-1} corresponding to the Ag-O bonds. Thermogravimetric analysis (TGA) revealed enhanced thermal stability, with BFS-SNP showing a 25% improvement in decomposition onset temperature compared to pristine BFS. Mechanical testing demonstrated improved tensile strength in SNP-modified sheets (21.5 ± 0.8 MPa) compared to untreated sheets (16.8 ± 0.7 MPa), highlighting the reinforcement effect of SNP integration. The biocomposites exhibited potent antibacterial activity against *Escherichia coli*, *Staphylococcus aureus*, and methicillin-resistant *Staphylococcus aureus* (MRSA), with inhibition zones ranging from 18.5 ± 1.2 mm to 22.3 ± 1.1 mm. Controlled release

studies of amoxicillin-loaded composites demonstrated sustained drug release over 72 hours, achieving a cumulative release of 81.6% in BFS-SNP-AMOX. Cytotoxicity assessment on L929 fibroblasts confirmed the biocompatibility of the composites, with cell viabilities exceeding 90%. These findings establish BF-SNP, BFS-SNP, and BFM-SNP as promising candidates for antimicrobial wound care applications and controlled drug delivery systems, offering a sustainable, bioresource-based solution for advanced biomedical materials.

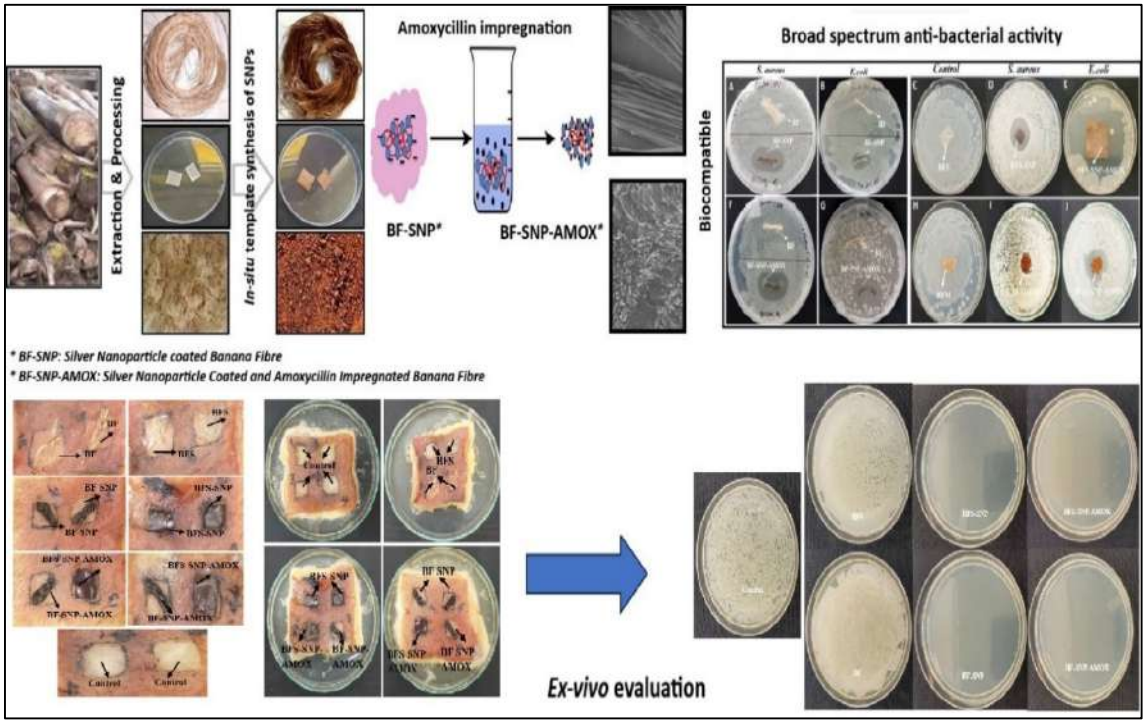


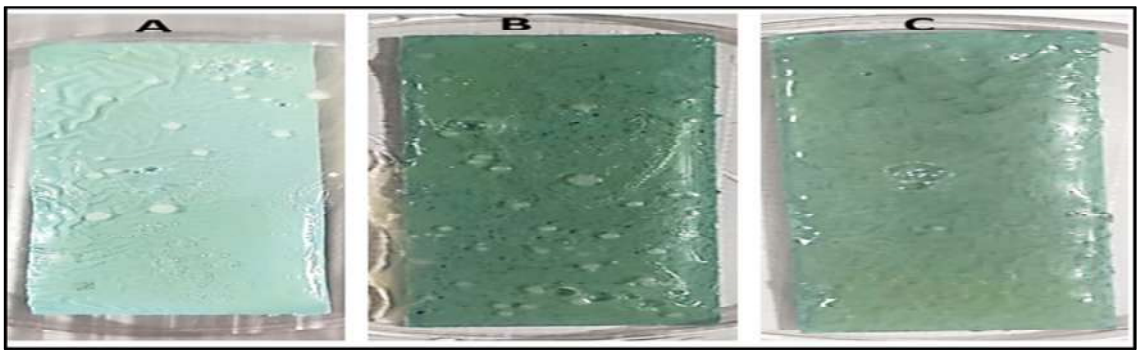
Table: Result of Drug Release Study in terms of Zone of Inhibition assay

S.No	Samples	Zone of inhibition (mm)[a]				
		E. coli	*B. subtilis*	*S. aureus*	MRSA 3160	MRSA1
1	Banana Fibre	0.4 ± 0.00	0.7 ± 0.00	0.1 ± 0.00	0.6 ± 0.00	0.01± 0.00
3	Banana Fibre-SNPs	42.4 ± 2.21	39.6 ± 1.86	37.9 ± 1.74	33.4 ± 1.28	29.1± 0.25
4	Banana Fibre/SNPs/Amox	51.8 ± 0.22	45.5 ± 1.94	52.4 ± 0.42	44.7 ± 2.26	46.4± 0.54

❖ **Proof of Concept experiment for establishing AgNP coated Banana fibre particle-based antimicrobial paint:**

The antimicrobial efficacy of *in-situ* template-synthesized AgNP-coated banana fiber particles was evaluated against both Gram-positive Staphylococcus aureus and Gram-negative Escherichia coli. Results indicated that glass slides coated with AgNP-embedded paint demonstrated complete bactericidal activity against both bacterial strains. Conversely, control experiments utilizing paint without AgNPs, as well as paint mixed with uncoated banana fibers, showed no bactericidal effects, affirming that the presence of AgNPs is

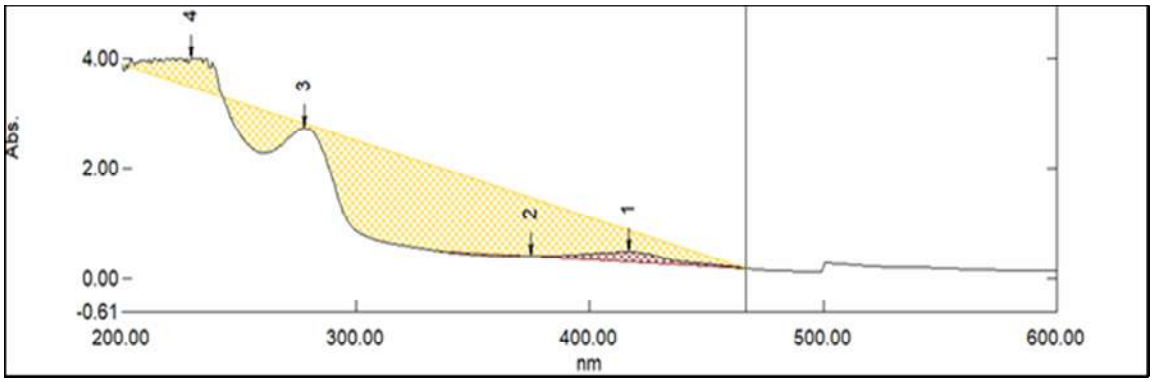
crucial for the observed antimicrobial activity.



Antibacterial properties of AgNP-containing paints on glass slides: A) Control paint B) Banana fibre particle mixed paint C) AgNPs coated banana fibre particle mixed paint

❖ **Standardized the procedure for production of Nano - Cellulose from banana fibre:**

The protocol was meticulously standardized to extract nano cellulose from banana fiber through a series of treatments, including chemical methods (alkaline treatment, bleaching, and acid hydrolysis) and enzymatic processes (alkaline treatment and hydrolysis using xylanase). The primary objective of this research endeavor was to engineer a versatile composite tailored for industrial applications. Initial investigation via UV-Vis spectrophotometry yielded pivotal insights into the nanoparticle characteristics. Notably, a discernible peak emerged within the absorbance spectrum range of 260-290 nm (Fig), affirming the successful synthesis of nanoparticles derived from banana fiber.



UV-Spectroscopy based characterization of Nano-Cellulose from banana fibre

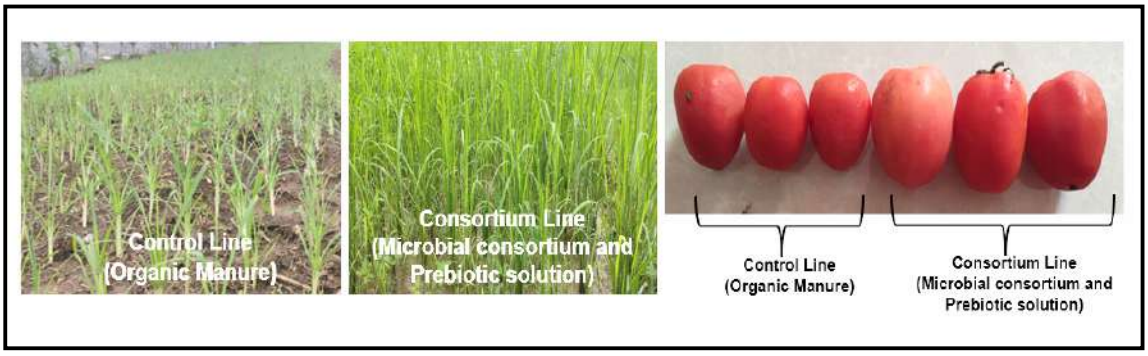
❖ **Development and Optimization of Prebiotic Solution from Banana Pseudo Stem Sap for Enhanced Crop Growth Using Liquid Bio-Inoculum**

We have successfully standardized the preparation method of a prebiotic solution derived from banana pseudo stem sap and optimized its application in liquid bio-inoculum to promote crop growth and development.

The addition of this prebiotic solution to microbial inoculum resulted in a fourfold increase in microbial activity and population. In vitro analyses, including seed germination and pot culture experiments,

demonstrated the effectiveness of the prebiotic solution and microbial inoculum prototype. Subsequent field evaluations were conducted on two major crops of Arunachal Pradesh, rice and tomato.

The results revealed a significant enhancement in agronomic traits and yield in plants treated with the combined microbial consortium and prebiotic solution. Specifically, crop growth showed an impressive increase of 65-78% compared to the control group treated with organic manure. This study underscores the potential of integrating prebiotic solutions with microbial inoculums to boost agricultural productivity sustainably.

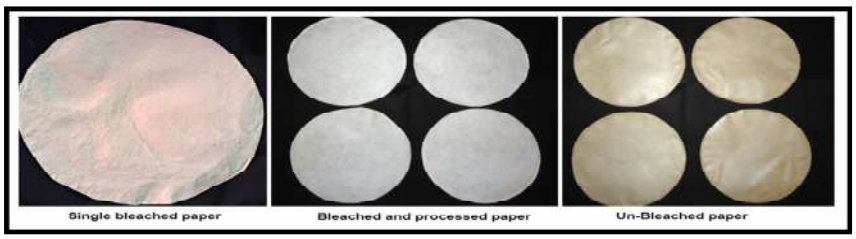


Representative photographs of a field trial in Papumpare district of Arunachal Pradesh

❖ **Standardized the protocol for preparation of Agarbatti and Paper sheet from the extracted banana fibre:**

A standardized protocol has been established for the preparation of agarbatti and paper sheets using extracted banana fiber. In a pioneering approach, banana fiber, a low-end byproduct, has been utilized as a substrate material to develop agarbatti. The process incorporates waste generated during fiber extraction, combined with scented aromas, to create banana fiberagarbatti, marking a novel value addition to banana pseudo-stem waste. Ongoing studies aim to further evaluate the beneficial attributes of this innovative product. Additionally, the papermaking process has been optimized to produce high-quality paper sheets from banana fiber and pulp material, showcasing another promising application of this sustainable resource. Similarly, the process of papermaking has been optimized and developed from banana fibre and pulp material.

Representative photographs of Agarbatti developed by DBT-APSCS&T CoE for BRSD, Kimin, Arunachal Pradesh from banana fibre



Representative photographs of paper sheet developed by DBT-

Photographs of the Banana fibre based sanitary napkin developed by DBT-APSCS&T CoE for BRSD, Kimin, Arunachal Pradesh

❖ **An improved method of brewing and processing banana fruit wine of Arunachal Pradesh and evaluating its Physicochemical, Organoleptic, Antioxidant, and other Quality control parameters optimized:**

A scientifically optimized method for brewing and processing banana fruit wine from the endemic Nyshikol of Arunachal Pradesh has been developed and meticulously evaluated. This improved protocol ensures a high-quality product by standardizing and refining the brewing process to enhance the wine's physicochemical properties, organoleptic characteristics, antioxidant capacity, and overall quality control parameters. Comprehensive assessments have demonstrated significant improvements in taste, aroma, and nutritional benefits, highlighting the potential of this value-added product to meet both local and broader market demands.

Representative photographs of the Banana wine developed by DBT-APSCS&T CoE for BRSD, Kimin Arunachal Pradesh

Development and Standardization of Cost-Effective, Biodegradable, Disposable Feminine Sanitary Napkins Using Banana Fibres and Pseudostem Waste

The introduction of banana fiber-based sanitary napkins aims to replace the traditional use of cloth and provide a hygienic solution for menstrual fluid management. Conventional sanitary napkins, which often contain super absorbent polymers (SAP) such as polyacrylate, pose health risks including itching, rashes, and even cervical and ovarian cancer due to their toxic chemical components. In contrast, banana fibers offer a promising alternative to synthetic fibers used in non-biodegradable napkins.

Our research has focused on developing a sustainable, eco-friendly, and cost-effective menstrual sanitary napkin using banana fibers. We have rigorously standardized the production process and assessed the feasibility and acceptability (FAA) of these napkins among tribal women in rural environments. The results indicate that banana fiber-based napkins not only meet the functional requirements but also provide a safer and more environmentally friendly option for menstrual hygiene.

Other products prepared by DBT-APSCS&T CoE for BRSD, Kimin, Arunachal Pradesh with technical support and guidance from collaborative institutes:

Initiatives towards Entrepreneurship development and promotion:

By skilfully utilizing banana waste material and fibre, women from local communities, along with staff members of the Centre of Excellence (CoE) in Kimin, such as Ms. Teli Rupa Ngurang, are crafting a range of high-quality products including mats, bags, and tea coasters. This innovative initiative significantly contributes to both domestic and local markets, fostering economic opportunities for these women while allowing them to engage in meaningful handcraft work without compromising their family responsibilities.

Moreover, this transformative approach addresses critical environmental concerns associated with the disposal of banana plant waste. By converting what would otherwise be

agricultural waste into valuable products, the initiative exemplifies a sustainable model that harmonizes economic viability with ecological responsibility. This method not only reduces waste and its negative environmental impact but also empowers local communities, particularly women, by providing them with sustainable livelihoods and entrepreneurial avenues.

3C. Initiatives Towards Circular Bioeconomy and Biomanufacturing:

During extensive surveys and documentation conducted across various districts of Arunachal Pradesh, an in-depth exploration of cultivated, wild, and endemic banana crops revealed significant losses from banana pseudo-stem waste, estimated to be approximately 20-30%. The natural biodegradation of banana waste not only produces a foul odor but also releases toxic compounds, which have detrimental effects on the environment and water quality.

In response, the DBT-APSCS&T Centre of Excellence for Bioresources and Sustainable Development (CoE for BRSD) in Kimin has spearheaded an initiative to transform this challenge into an opportunity. By leveraging a bioeconomy-based green approach, the initiative focuses on the sustainable utilization of waste banana pseudo-stems. Collaborating with farmer associations, local groups, and prospective entrepreneurs in Arunachal Pradesh, the CoE is pioneering efforts to minimize waste and enhance economic value.

The development and promotion of value-added banana products and craftsmanship are central to this initiative. By converting waste into profitable goods, the project aims to achieve waste minimization and foster a circular bioeconomy. This approach not only addresses environmental concerns but also holds tremendous potential for the bio-techno-economic upliftment of the tribal populace in Arunachal Pradesh, driving sustainable development and economic empowerment in the region.

D. Patent Granted: ***"Antimicrobial Suture Biomaterial from Banana Fibre"*** **(Patent No. 31006722)**

3.ESTABLISHMENT OF AROMA UNITS FOR PROMOTION OF CULTIVATION OF AROMATIC CROPS AND ENTREPRENEURSHIP DEVELOPMENT IN ARUNACHAL PRADESH

Summary of the progress:

In the verdant embrace of Arunachal Pradesh, adorned with an 82 percent forest canopy, an opulent tapestry of aromatic and medicinal flora flourishes. Guided by the Arunachal Pradesh Medicinal and Aromatic Plants Policy 2015, the state envisions unlocking economic sustainability through the profound utilization of this botanical treasure.

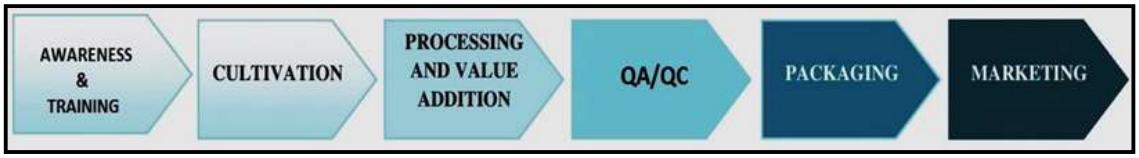
Quite a good number of high-value aromatic plants are available in Arunachal Pradesh which grow wildly. Arunachal Pradesh is endowed with five different agroecological zones suitable for growing different high-value aromatic plants with national and international market potential. The indigenous people of Arunachal Pradesh, who are ignorant of the price and importance of conservation of these valuable aromatic plants used to collect these plants indiscriminately from the wild source and sell them to the traders at throw-away prices. This not only resulted in the near extinction of important aromatic crops but also deprived the indigenous people of their earnings. It is necessary to make the local people aware of the importance of aromatic plants and their conservation for sustainability and income generation.

Harmonizing with this vision, the DBT-APSCS&T CoE for BRSD, Kimin, spearheads the cause through its *"Establishment of Aroma Unit for Promotion of Cultivation of Aromatic Crops and*

*Entrepreneurship Development"*programme. This transformative initiative encompasses facets like awareness, training, mass cultivation, processing, value addition, quality assurance, and the strategic marketing of essential oils. Recognizing the potential to uplift tribal communities and the economically disadvantaged, the program strategically establishes three Aroma Units in Kimin, Namsai, and Pasighat. A standout achievement is witnessed in the commercial success of Lemongrass and Citronella cultivation, starting at 55 acres and poised to expand to an impressive 70 acres within six months. Going beyond cultivation, the initiative catalyzes entrepreneurship by training over 1000 individuals and fostering market connections through the dynamic platform of Buyers-Sellers Meets. Elevating standards further, a first-of-its kind ISO-certified QA/QC lab for essential oils in NER distinguishes the CoE. Embracing a holistic approach, it emerges as a linchpin for aroma crop cultivation and processing, actively contributing to R&D and initiating patent filings for the development of value-added products. This endeavor transcends mere preservation of aromatic plant biodiversity; it propels Arunachal Pradesh into a sphere of economic prosperity and innovation, marking a trailblazing journey into a sustainable and innovative future.

Specific objectives:

- Commercial cultivation of selected aromatic plants in two demonstration areas in the two selected districts (Papum Pare, Namsai, and East-Siang) of Arunachal Pradesh.
- Installation of aroma processing, and distillation units at the identified demonstration areas.
- Training farmers, SHGs, and entrepreneurs on the cultivation of medicinal and aromatic plants and encourage large-scale cultivation of aromatic crops.
- To develop linkages with industries along with buy-back arrangements for the marketing of the produce for improvement of the socio-economic status of the local populace and create employment through aromatic plant cultivation.



Capacity building initiatives:

The organization of awareness and training programs in Arunachal Pradesh is critical to fostering a sustainable and economically viable essential oil, fragrance, and flavor industry. This region, with its rich biodiversity and unique climatic conditions, holds immense potential for the cultivation of aromatic plants. However, realizing this potential requires comprehensive education and hands-on training for local farmers and entrepreneurs. By covering all aspects of the essential oil industry—from aromatic plant cultivation and processing to commercial production and marketing—these programs aim to empower participants with the knowledge and skills necessary to thrive in this sector. Furthermore, specialized training sessions on the production of agarbatti, dhoopbhatti, havansamgri, and perfumery, along with practical demonstrations on quality assessment, processing, and control of essential oils, will ensure that participants can produce high-quality products that meet market standards. These initiatives are expected to significantly enhance local capabilities, drive economic growth, and improve the livelihoods of communities in Arunachal Pradesh. In this line, an Awareness Programme was organized on Aromatic Crop Cultivation, Processing, and Marketing at Centre of Excellence for Bioresources and Sustainable Development (CoE for BRSD), Kimin, Arunachal Pradesh.This one-day awareness programme focusing on the *cultivation, processing, and marketing of aromatic crops* was held at the DBT-APSCS&T Centre of Excellence for Bioresources and Sustainable Development (CoE for BRSD), Kimin. The event was organized in technical collaboration with the Fragrance and Flavour Development Centre (FFDC), Kannauj, Uttar Pradesh.

The programme witnessed active participation from over 50 farmers and aspiring entrepreneurs. Sessions were led by experts from FFDC, including Shri A.P. Singh (Assistant Director & Head of Training), Shri Gidam Vilas (Assistant Director, Processing Technology), and Shri Kamlesh Kumar (Scientific Officer). The discussions focused on best practices in aromatic crop cultivation, modern processing methods, quality enhancement, and market strategies.

This event marked a continuation of the ongoing partnership between CoE for BRSD and FFDC Kannauj, which has jointly conducted more than ten training and awareness programmes over the past three years. These initiatives aim to build local capacity and promote sustainable livelihoods through value addition to bioresources.

The programme included testimonials from successful entrepreneurs who have adopted aromatic crop cultivation, providing practical insights and motivation for new entrants. Personalized consultations allowed participants to discuss specific challenges and solutions with the experts.

The initiative aligns with CoE for BRSD's broader objective of promoting sustainable agricultural practices and entrepreneurship in Arunachal Pradesh. Through such collaborative efforts, the Centre seeks to develop a robust ecosystem for aromatic crops and related industries in the region.

Commercial Cultivation of Aroma Crops in Three Districts of Arunachal Pradesh

In 2024–25, the commercial cultivation of aroma crops was successfully implemented in Papum Pare, East Siang, and Namsai districts of Arunachal Pradesh. Satellite units were established in Kimin, Pasighat, and Namsai, covering over 45 acres and benefiting more than 550 farmers. Thirteen aromatic crops were introduced, with Lemongrass, Citronella, and Palmarosa selected for large-scale cultivation. Despite initial weather-related challenges, nurseries for quality planting material were raised during April–May 2025. An additional 10 acres were brought under cultivation, marking a significant step toward developing a sustainable aroma crop sector in the region.

Representative images of Commercial cultivation of

Continuous operation of Processing units for extraction and processing of Aromatic crops:

In line with the approved objectives, Field Distillation Units (FDUs) have been successfully installed in Papum Pare, Namsai, and East Siang districts. These units are in continuous operation for the processing of aromatic crops, supported by active technical handholding from the DBT-APSCS&T Centre of Excellence for Bioresources and Sustainable Development (CoE for BRSD), Kimin. The ongoing support ensures efficient extraction, quality control, and value addition, thereby strengthening the overall aromatic crop value chain in the region.

Cohobation based Field Distillation Unit (Capacity 250 kg) at Kakoi village, Papumpare district, Arunachal Pradesh

One ton capacity hydro-steam distillation unit established at Nampong Village, Namsai district, Arunachal Pradesh

One ton capacity hydro-steam distillation unit established at Seram Village, East-Siang district, Arunachal Pradesh

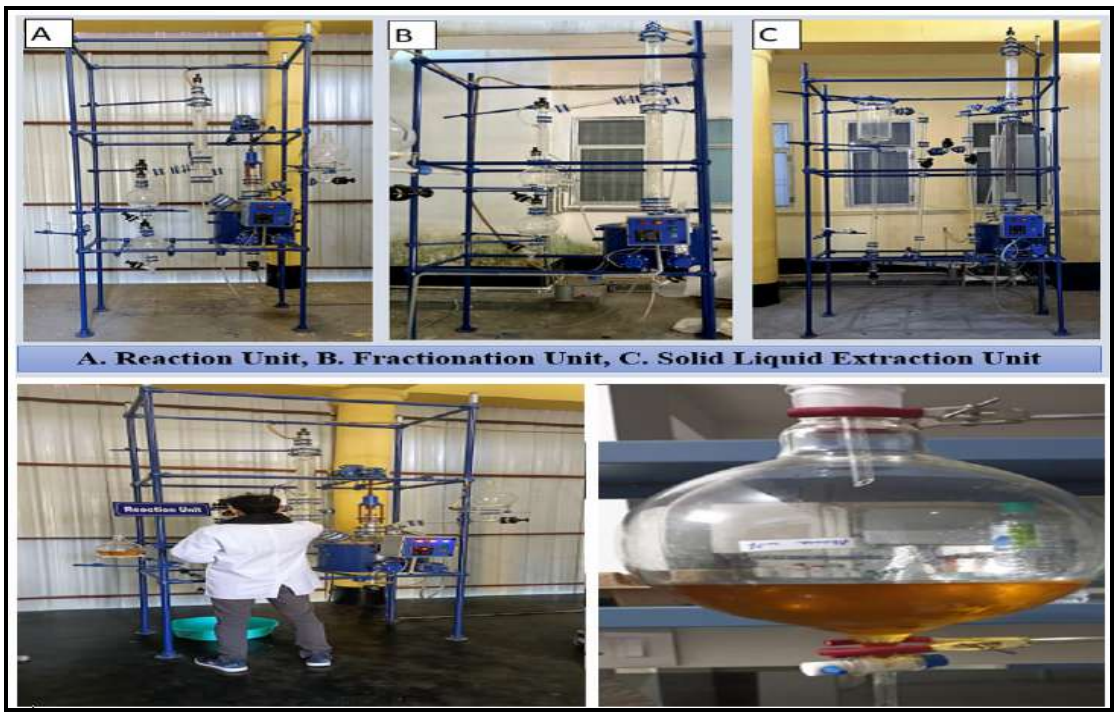
To date, between 25 to 30 harvests have been conducted, successfully extracting Lemongrass and Citronella essential oils at all three cultivation sites. The cumulative yield from these harvests totals approximately 1500 liters of high-quality essential oils, which have been marketed to both domestic and national buyers. A portion of this yield has been allocated for value addition and further processing purposes.

The establishment of FDUs represents a pivotal advancement in local processing capabilities, promising more efficient and scalable extraction of essential oils. This development is anticipated to significantly bolster economic returns for farmers by optimizing the aromatic crop value chain, ensuring consistent quality, and meeting burgeoning market demands.

Processing and Value Addition of Extracted Essential Oils

The Aroma Processing Unit at the DBT-APSCS&T Centre of Excellence for Bioresources and Sustainable Development (CoE for BRSD), Kimin, is in continuous operation, playing a pivotal role in the value addition of essential oils extracted from aromatic crops. Equipped with advanced facilities—including a Reaction Unit, Fractionation Unit, Solid-Liquid Extraction Unit, Bucket Centrifuge, and Crystallization Unit—the unit enables rigorous processing steps such as isolation, fractionalization, and crystallization to meet industry-specific standards.

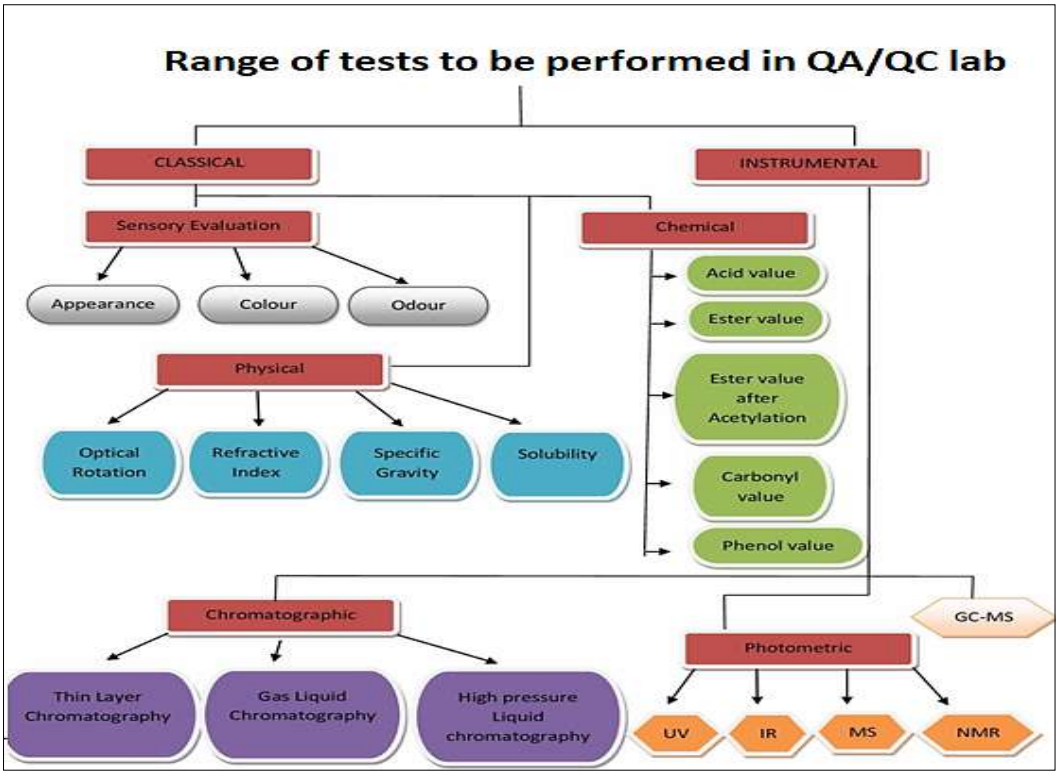
Ongoing activities include the isolation of key aromatic compounds like Citral, Geraniol, and Thymol, and the production of natural aroma chemicals and their derivatives. This continuous operation supports the commercial viability of essential oils for use in perfumery, cosmeceuticals, pharmaceuticals, and food processing industries. As the first facility of its kind in Arunachal Pradesh, the unit serves as a critical intervention under the DBT-supported programme for promoting aromatic crop cultivation and entrepreneurship development in the region.



Aroma processing unit at DBT-APSCS&T CoE for Bioresources and Sustainable Development.

Quality Assurance and Quality Control for Essential Oils

The DBT-APSCS&T CoE for BRSD, Kimin, is actively supporting farmers and entrepreneurs through the establishment of a state-of-the-art QA/QC Laboratory for essential oils—the first of its kind in Northeast India. With technical support from FFDC Kannauj, the lab is operational and facilitates quality testing as per BIS and ISO standards. Essential oils from 16 wild aromatic plants have been extracted and chemically profiled, enabling value-added product development and improved market access for local producers.

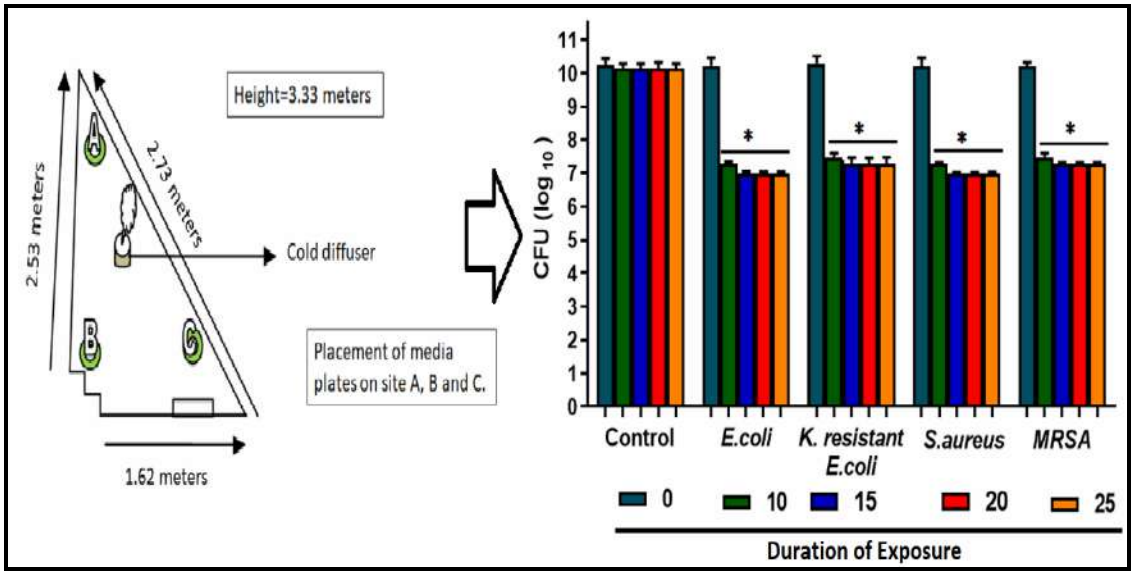


Few snapshots of QA/QC laboratory at DBT-APSCS&T CoE for Bioresources and Sustainable Development

Translational R&D, Technologies, IPR, and, Product Prototype development:

Innovative use of essential oil diffuser system for reducing indoor airborne microbial burden including Candida, MRSA, and ESKAPE pathogens:

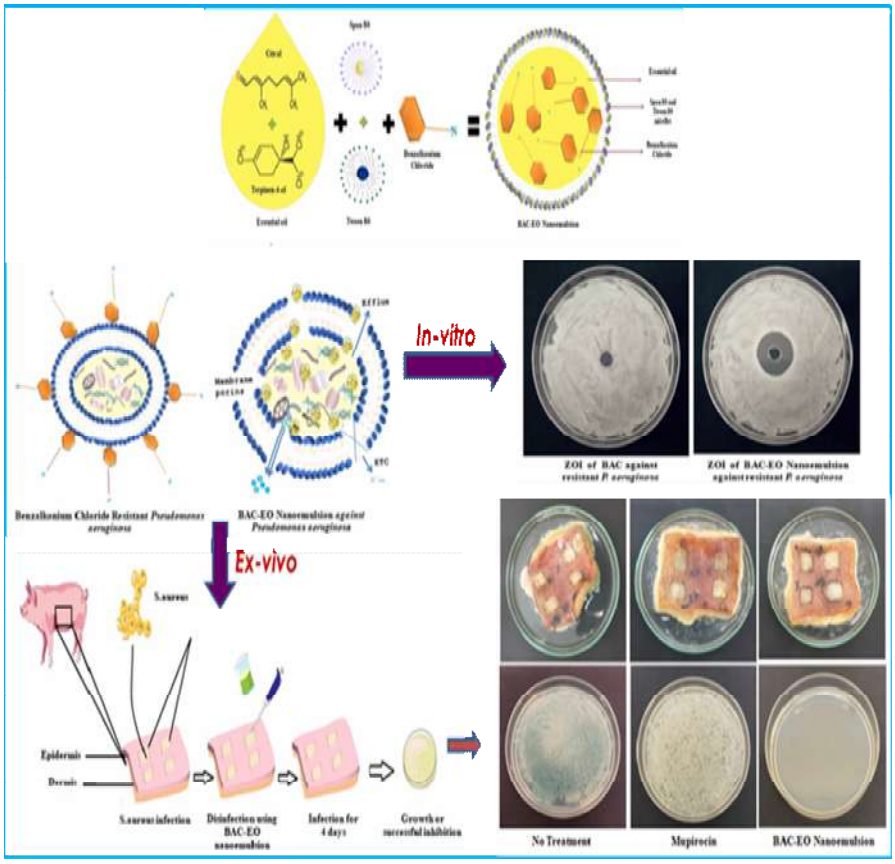
This referred technology reduces or diminishes the fungal, and bacterial load on a specified air space. The efficiency of the technology has been tested against the most common pathogenic air microflora *i.e.Candida albicans*, MRSA, and ESKAPE pathogens. The developed technology demonstrated 99.9% efficacy with reproducible results. The biocompatible nature of the formulation used in the technology makes it suitable for application in household, hospital, and lab space environments. The active Volatile Organic Compounds (VOCs), have proven records of antiviral activity too even against SARS-COV-2; though not tested for this specifically developed technology. We also confirm that there is no prior art closely or distantly related to this innovation.



Graphical Representation of the Innovation

Plant volatile and plant surfactants revert *Pseudomonas auriginosa's* resistance against Benzalkonium chloride:

This referred technology is a microemulsion of Benzalkonium chloride (BKC) encapsulated in the lipid micelles/droplets of naturally originating VOCs. BKC is a cationic organic quaternary ammonium compound with broad-spectrum antimicrobial properties. It's a fast-acting agent used for protecting the skin from microbes, pathogens, bacteria, viruses, fungi, and protozoa. Due to the excessive and irrational use of hand sanitizers during the time of the Covid-19 pandemic, alarming incidents of resistance have been reported from around the Globe. This developed technology will revert to the resistance mechanisms and restore the activity of BKC against resistant strains of pathogenic bacteria and fungi. We also confirm that there is no prior art closely or distantly related to this innovation.Graphical Representation of the Innovation

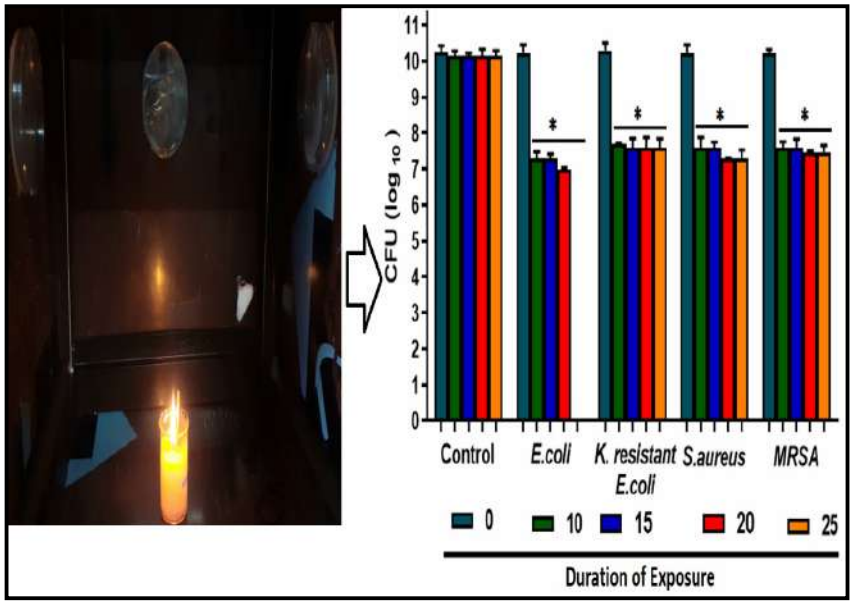


Phyto-active fumigation-based management of microbial infection and insect control in indoor plants:

This referred technology uses Phyto-chemical-based VoCs to produce active fumes for fumigation to sterile infections of plants. This technology has been tested in indoor plants so far and achieved promising results in the eradication of aphids (white flies), and fungal infection of chilly plants. The developed technology is in a package form in terms of design and novel photoactive formulations. The developed formulation is not phytotoxic as tested in the lab and is also biocompatible towards human exposure and consumption. We also confirm that there is no prior art closely or distantly related to this innovation.

Plant volatile and based antimicrobial candle

This referred technology deals with the development of a first-of-its-kind antimicrobial candle. This is a design and process innovation of technology, which allow us to diffuse natural origin VOCs in their original form, for the benefit of indoor environment-based issues related to contaminated air microflora and pests. We also confirm that there is no prior art closely related to this innovation.



Graphical Representation of the Innovation

Standardization of techniques and SOP development for the following product prototypes has been completed:

1. Charcoal based agarbatti
2. White-premix powder-based premium quality agarbatti
3. White-premix powder-based premium quality mosquito repellent agarbatti
4. Fragrance candle

These technologies are ready to transfer to prospective entrepreneurs of the state.

Designing of Eight (8) exclusive fragrances:

The design of the four (4) numbers of fragrance has been completed and the other four (4) numbers are in progress with technical help from Flavour and Fragrance Creation Division of FFDC, Kannuaj. The designing of following fragrances has been completed;

Rose Fragrance, Jasmine Fragrance, Lavender Fragrance, Lilac Fragrance,

Formulation of Fragrances at FFDC, Kannauj, Uttar Pradesh

Design and Development of Mobile cohobation-based essential oil distillation system

A mobile cohobation-based essential oil distillation system has been successfully developed to enhance the efficiency and portability of essential oil extraction, particularly suited for remote and rural locations. This innovative system integrates cohobation technology, which allows for the recycling of aromatic water to improve oil yield and quality. The design supports on-site processing of aromatic crops, minimizing post-harvest losses and transportation challenges. In recognition of its novelty and utility, an Indian patent application has been filed to protect the intellectual property rights associated with the system.

Prototype of Mobile cohobation-based essential oil distillation system. Indian patent application filed: Application Number: 202531026339

Market Analysis, SWOT Survey, and Market Linkage Development

In 2024–25, a comprehensive market and SWOT analysis was conducted to assess the potential of the aroma sector in Arunachal Pradesh. The study identified the region's rich biodiversity, traditional knowledge, and government support as key strengths, while highlighting infrastructure gaps, limited market access, and skill shortages as areas needing attention. A detailed business model was developed focusing on product development, branding, sustainability, and direct market linkages. Strategic efforts were made to connect entrepreneurs with national and international buyers, enabling the sale of essential oils and value-added products, and laying the groundwork for a sustainable aroma-based economy in the region.

In 2024–25, DBT-APSCS&T CoE for BRSD continued to strengthen and expand market linkages for essential oils and value-added products. Under this effort, partnerships were established with over 100 business entities, including leading dealers and exporters such as the Essential Oil Association of India (EOAI), Northern Aromatic Ltd. (Ghaziabad), Expo Essential Oil (New Delhi), and Sugandh Vyapar Sangh (New Delhi). These linkages have significantly enhanced market access for local producers, enabling better price realization and wider product reach.

Entrepreneurship Development in Aroma Sector

In 2024–25, the DBT-APSCS&T CoE for BRSD continued to provide active technical support and handholding to entrepreneurs engaged in the aroma sector. Through sustained capacity building and mentoring under the project "Establishment of Aroma Unit for Promotion of Cultivation of Aromatic Crops and Entrepreneurship Development," entrepreneurs achieved significant milestones in essential oil production, processing, value addition, and marketing. Notably, two aroma-based start-ups have been successfully established, reflecting the growing entrepreneurial ecosystem and economic potential of this sector in Arunachal Pradesh.

Capacity Building:

Capacity building objectives are being achieved during the implementation of the project "Establishment of Aroma Unit for Promotion of Cultivation of Aromatic Crops and Entrepreneurship Development". The key services offered by DBT-APSCS&T CoE for Bioresources and Sustainable Development in the aroma cultivation and processing sectors include the following:

Agro-Technology Services

- Consultancy services / technical know-how for the cultivation of aromatic plants
- Supply of quality planting material
- Preparation of feasibility reports
- Visit to farmers' fields for on-the-spot consultancy/guidance
- Training to farmers
- Distillation of oil by Field Distillation Unit (FDU) on job work basis
- Production and sale of essential oils
- Consultancy for the establishment of aromatic/herbal gardens

Processing and Value Addition

- Research and development for scaling up the developed processes
- Processing of essential oil through a semi-commercial scale pilot plant

- Development of aroma chemical
- Upgradation of the technological status of the essential oil and perfumery industry
- Fractionation / Re-fractionation / Extraction / Distillation processing for aroma oils
- Solvent extraction
- Hydrogenation for making aroma chemicals
- Rectification of essential oil

Quality Assessment

- Quality testing and analysis of essential oil, aroma chemicals, fragrances and flavours
- Setting up a quality assessment laboratory for essential oils and aroma chemicals
- Consultancy for specific criteria like the development of a specific test for particular component

Training

- Training on cultivation techniques, processing, value addition, marketing, packaging, and application of fragrances and flavors, etc.
- Outreach training programme in different parts of the state.

Consultancy

- Consultancy services for the cultivation of aromatic crops and medicinal plants.
- Preparation of feasibility reports
- Consultancy on value addition in oils
- Consultancy on the development of products from oils

DBT-APSCS&T CoE for Bioresources and Sustainable Development has made significant strides in promoting the cultivation of aromatic crops and fostering entrepreneurship across Arunachal Pradesh. Through the establishment of Aroma Units, development of essential oil technologies, and extensive training of over 1,000 entrepreneurs, the project has laid a robust foundation for the aroma sector's growth. The roadmap outlined, focusing on leveraging GIS for optimal cultivation, establishing Aroma Clusters, and deploying innovative technologies, underscores our commitment to sustainable development and economic empowerment in the region.

III. LIST OF PROSPECTIVE TECHNOLOGIES DEVELOPED AT DBT-APSCS&T CENTRE OF EXCELLENCE FOR BIORESOURCES AND SUSTAINABLE DEVELOPMENT, KIMIN, ARUNACHAL PRADESH.

1. A technique developed for drying and preservation of orchids to enhance their value through improved shelf life and aesthetic appeal.
2. Cost-effective and efficient micropropagation protocols standardized for 17 numbers of commercial orchid varieties including *Dendrobium* hybrid, *Phalaenopsis* hybrid, *Cattleya*, and *Vanda* hybrid.
3. A comprehensive package of technologies formulated to support sustainable and organic mushroom production practices.

4. A refillable candle diffuser system designed for controlled and consistent aroma release, promoting indoor wellness.
5. A polyherbal formulation developed for the treatment and prevention of dermatophytic skin infections, offering a broad-spectrum antifungal solution.
6. A broad-spectrum antiseptic formulation based on polyherbal extracts aimed at wound care and infection control.
7. Essential oil-based formulations designed for sterilizing indoor air environments, contributing to improved air hygiene and respiratory wellness.
8. Spice based mosquito repellent products developed in the form of agarbatti, dhoop cones, and other delivery formats, aimed at eco-friendly vector control.
9. A process for preparing banana peat as a replacement of coco-peat
10. Muffler, paper, first of kind tea bag, Incense stick, yoga mat, bags, ropes, banana flour, compost and other handicraft product
11. Charcoal based agarbatti , White-premix powder-based premium quality agarbatti, White-premix based premium quality mosquito repellent agarbatti, Fragrance candle, Eight numbers of exclusive fragrance developed.
12. Biofertilizer, Fermented Alcoholic & Non-alcoholic beverages and Indigenous Fortified Rice Flour
13. Medicinal plant database: 330 plants

Patent Filed:

1. Temperature independent Revivable formulation and Methodology for long term preservation, storage, and transport of live Bacteria, Yeast and, filamentous fungus. **Application No. 2023-31-086447**
2. Mobile Cohobation Essential Oil Distillation System. **Application Number: 202531026339**

IV. DISSEMINATION OF ESTABLISHED GRASSROOTS TECHNOLOGICAL INNOVATIONS (NIF-INDIA) FOR LIVELIHOOD GENERATION:

a) Areca leaf plate making machine

The Arunachal Pradesh State Council for Science & Technology (APSCS&T), in collaboration with the National Innovation Foundation (NIF), India, facilitated the installation and training for Areca Leaf Plate Making Machines in Namsai District as part of its 2024–25 rural innovation initiative.

The innovative machine, developed by Mr. Jogendra Patra, is designed to produce biodegradable, sturdy plates of various sizes and designs using areca leaves. These eco-friendly plates cater to a growing market demand for sustainable alternatives to plastic disposables. The hydraulic machine is highly efficient, capable of operating on a single or three-phase power supply, and supports multiple punch-and-die configurations for versatile output.

Recognizing the abundance of arecanut plantations in Namsai, Lohit, and Changlang districts, APSCS&T identified this innovation as a valuable tool for local economic development. As part of the initiative, two units of the machine were distributed with support from NIF:

1. Woisali Self Help Group, Village: Nampong, District: Namsai
2. Lekang Farmer's Club, Village: Mahadevpur (Lekang HQ), District: Namsai

The deployment aims to empower Self-Help Groups by enabling value addition to areca leaves and generating additional income through sustainable entrepreneurship.

b) Large Cardamom Dryer

To boost sustainable agro-processing and empower rural communities, the Arunachal Pradesh State Council for Science & Technology (APSCS&T) facilitated the deployment of a Large Cardamom Dryer unit to "AAB TALAM Self Help Group", located in Neelam village, Circle: Deed, District: Keyi Panyor, Arunachal Pradesh.

The region is known for its extensive cardamom cultivation, and the introduction of the innovative dryer is expected to significantly enhance local processing capabilities. The dryer allows for controlled drying of cardamom pods in just 5 hours for 200 kg of produce, using only 50 kg of firewood, compared to the conventional method that takes several days and consumes more resources.

The eco-friendly, efficient drying unit, designed with a combustion chamber, layered heat distribution, and protective shed, ensures minimal degradation of pod color and quality. This installation not only addresses the critical need for improved post-harvest technology in hilly terrains but also enables value addition and income generation for the Self-Help Group.

This initiative aligns with APSCS&T's mission of promoting grassroots innovations and supporting livelihood development in agricultural communities across Arunachal Pradesh.

c) Introduction of Corn Shelling Machine for Small-Scale Agro-Processing in Arunachal Pradesh

In a significant step towards empowering rural communities through grassroots innovation, the Arunachal Pradesh State Council for Science & Technology (APSCS&T), in collaboration with the National Innovation Foundation (NIF), India, facilitated the distribution of four Corn Shelling Machines to Self-Help Groups (SHGs) in Lower Dibang Valley district.

The machines, developed by innovator Mr. Vishwanath Vishwakarma from Nalanda, Bihar, are designed for small to medium-scale corn processing with high efficiency and minimal kernel damage. This initiative aims to enhance post-harvest productivity and promote self-reliance among SHGs by enabling value addition in agriculture.

Recipient SHGs and Locations:

ANE SIRUM SHG – (02 Units)

Village: Midland Agamgite, PO/PS: Roing, District: Lower Dibang Valley

S.T. OLUNG SHG – (01 Unit)

Village: Kalek, PO/PS: Shantipur, District: Lower Dibang Valley

LEKOBOSULAI SHG – (01 Unit)

Village: Poblung, PO/PS: Dambuk, District: Lower Dibang Valley

The introduction of these machines is expected to significantly reduce manual labor, improve processing efficiency, and generate supplementary income for the beneficiary groups. APSCS&T continues to support sustainable rural innovation through such impactful technology interventions.

d) Deployment of Modified Aara incorporated with solar panel mobile charger and baby carrier: (Bengia Ama, School Student INSPIR MANK Award 2023 Siver medal)

The Arunachal Pradesh State Council for Science & Technology (APSCS&T), in collaboration with the National Innovation Foundation (NIF), India, supported a grassroots innovation developed by Bengia Ama, a school student and recipient of the INSPIRE MANAK Award 2023 (Silver Medal). His innovative creation — a Modified Arra (bamboo basket) — integrates traditional craftsmanship with practical modern features aimed at improving rural livelihoods.

The traditional 'Arra', widely used across Arunachal Pradesh by indigenous communities for carrying materials, was redesigned by Bengia to address key issues faced by women in rural areas. The modified basket incorporates:

- A foldable design for easy storage.
- A baby carrier feature, allowing women to carry infants safely along with the basket.
- An integrated solar panel, enabling mobile phone or torch charging during long walks to fields or forests — a common routine in hilly and remote villages.

This low-cost, multifunctional innovation is not only women-friendly but also enhances mobility and convenience, reflecting a thoughtful blend of tradition and technology.

As a pilot initiative, 10 units of the modified Arra are planned for trial distribution among cardamom pluckers in Deed, Keyi Panyor district, to assess functionality and community impact before wider dissemination. The project is currently under development, with strong potential for scalability across similar terrains in the region.

e) Bamboo Splitter Machine – Innovation by Liagi Bhat, Ziro (GYTI Awardee 2016)

The **Bamboo Splitter**, innovated by **Liagi Bhat** from Ziro, Arunachal Pradesh, and awarded the prestigious **Gandhian Young Technological Innovation (GYTI) Award in 2016**, offers an efficient mechanized solution for splitting and dressing bamboo. Bamboo, being a vital resource for the people of Arunachal Pradesh, is traditionally split manually using a dao, a process that is labor-intensive and time-consuming.

This machine can split bamboo lengthwise into smaller pieces and also shave them into finer strips. It is easy to operate, economical, and delivers output nearly three times higher than manual labor. The innovation aims to increase productivity and income for local communities while promoting a modern approach to traditional crafts.

Currently, the machine is in the **development phase**, and **three units** are planned for dissemination to selected Self-Help Groups (SHGs) for **field trials**. This step will help assess the machine's effectiveness in real-world conditions and support further improvements before wider distribution.

f) Technology Transfer from CSIR-NEIST, Jorhat to APSCS&T

During the year 2024-25, the Arunachal Pradesh State Council for Science & Technology (APSCST) successfully facilitated the transfer of **eight advanced technologies** from the CSIR-North East Institute of Science and Technology (NEIST), Jorhat, Assam. These technologies were implemented through the Rural Technology Demonstration Centre (RTDC) at Kimin to promote sustainable agriculture and rural development in Arunachal Pradesh.

The technologies transferred included:

1. **Java Citronella Cultivation**
2. **Lemongrass Cultivation**
3. **Essential Oil Distillation Unit**
4. **Mushroom Cluster and Spawn Production**
5. **Mushroom Cultivation**
6. **Banana Fibre Extraction**
7. **Bacterial Formulation of TP-16 Biofertilizer for Sustainable Crop Yield**
8. **Vermicomposting Method**

These interventions aimed to enhance local farming practices, increase crop yield sustainably, support livelihood generation, and promote eco-friendly technologies among farmers and Self-Help Groups (SHGs) in the region.

g) Installation of Fruit Squashes and Syrups Making Technology at RTDC, Kimin

During 2024-25, the Arunachal Pradesh State Council for Science & Technology (APSCST) facilitated the installation of fruit squashes and syrups making technology acquired from the Central Food Technological Research Institute (CFTRI), Mysuru, Karnataka. This technology was set up at the Rural Technology Demonstration Centre (RTDC) in Kimin to support and encourage local entrepreneurs interested in food processing and value addition.

The availability of this technology aims to empower aspiring entrepreneurs by providing them with the necessary tools and know-how to produce high-quality fruit-based products, thereby promoting rural industrialization and enhancing income opportunities in the region.

V.ORGANIZED WORKSHOP / SEMINAR/ OUTREACH ACTIVITIES AND PARTICIPATED IN SCIENTIFIC PROGRAMME.

1. **Participation in International Museum Expo (18th-19thMay):**

At the International Museum Expo 2024, held from 18–19 May, young innovators from across the country showcased their ideas and creativity. Among them, **Mr. Bengia Ama** and **Mr. Abhishek Chetri** proudly represented **Arunachal Pradesh** with their innovative creation, the **Modified Arra (Bamboo Basket)**. Their unique approach to enhancing this traditional craft earned them the **3rd Prize in the Young Innovator Innovation Exhibition Competition**.

This recognition brought pride to the state and highlighted their dedication to sustainability and cultural heritage. Their achievement served as an inspiration for aspiring creators, proving that meaningful innovation can emerge from the heart of tradition.

2. Summer Science Camp (21st May to 31st May)

Every year, Summer Science Camp is organised at the Arunachal Pradesh Science Centre, under the aegis of the Arunachal Pradesh State Council for Science and Technology, featuring different activities for Junior and Senior groups. The activities were designed to stimulate curiosity and promote experiential learning among participants, encouraging a creative and practical understanding of science.This year, thecamp covers the following activities:

Day1: Microgreen & Grafting

Day2: Kite and Star Making

Day3: Astronomy

Day4: Educational visit to Jawaharlal Nehru State Museum

Day5: Hands-on Flower pot art and Traditional trap making

Day6: Introduction to Microbit

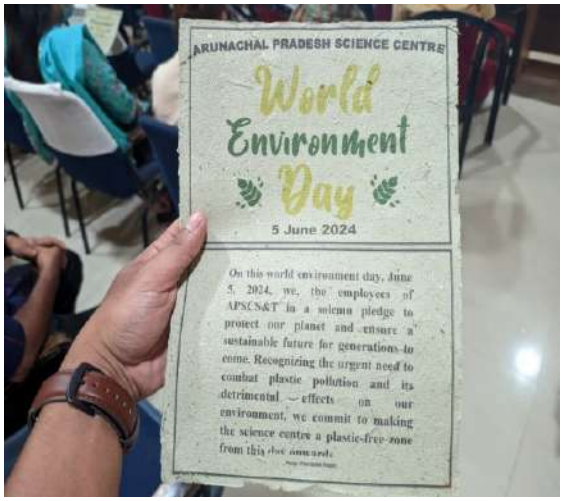
Day7: Hands-on leaf art and paper making

Day8: Educational visit to Biological Park

Day9: Treasure hunt & Valedictory

3. World Environment Day(5th June 2024)

As part of the environmental awareness initiative, several activities were organized to promote sustainability and eco-friendly practices. These included cement pot making, encouraging the use of durable and reusable materials for gardening. A plantation drive was also conducted to promote greenery and contribute to combating deforestation. Additionally, participants engaged in recycledpaper making using organic materials, highlighting the importance of waste reduction and sustainable alternatives. The event successfully emphasized environmental awareness and practical steps toward creating a greener, healthier future.



4. Innovation for Entrepreneurship(10th June 2024)

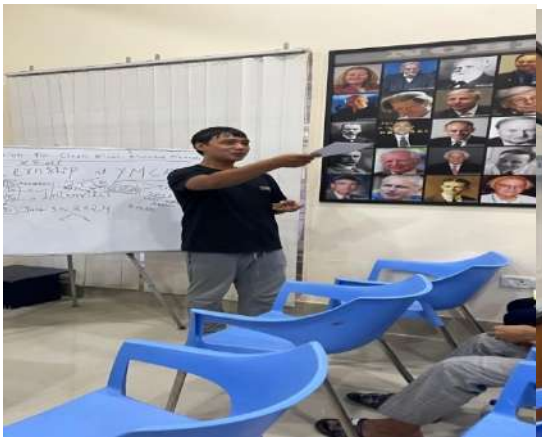
A workshop, the event aimed to empower local innovators and entrepreneurs by fostering creativity and sustainable business practices. Various non-governmental self-help groups actively participated, sharing insights and experiences to promote grassroots innovation as a tool for economic growth. The workshop highlighted the importance of leveraging local knowledge and skills to create impactful entrepreneurial ventures.

5. Exhibition(29th to 30th June 2024)

Celebration of Pride Month, organized an exhibition in collaboration with AP QueerStation titled "Pride in Expression: Showcasing Queerness and Queer Embodiment

6. Orientation Session (30th June 2024)

Orientation Session In collaboration with Youth Mission for clean river conducted an orientation session and hired a part time social intern.




7. Celebrating Van Mahotsav 2024: Science & Sustainability for a Greener Tomorrow

On 4th July 2024, the Arunachal Pradesh State Council for Science & Technology (APSCS&T), in collaboration with the Botanical Survey of India (BSI), observed *Van Mahotsav*—a nationwide celebration dedicated to forest conservation—at the Arunachal Pradesh Science Centre, Itanagar. The event echoed the Council's ongoing commitment to sustainability, biodiversity conservation, and climate resilience through science and technology.

The programme was graced by Shri C.D. Mungyak, Director-cum-Member Secretary, APSCS&T, who emphasized the need for integrated approaches in protecting Arunachal Pradesh's unique ecological heritage. The welcome address was delivered by Shri Vivek Kumar, Curator, A.P. Science Centre, setting the tone for a day of reflection and action.

8. **Zoonoses day** (6th **July 2024)**

The Centre commemorated World Zoonoses Day with an interaction program featuring Dr. Nido Tayo, MVSC(Surgery and Radiology), Veterinary Surgeon. Students from PI Academy, Itanagar, and local pet owners participated. The program aimed to raise awareness about zoonotic diseases - those that can spread from animals to humans. The importance of collaboration between veterinary and public health sectors to prevent such diseases was emphasized.

9. **Educational Workshop(13th July 2024)**

Educational workshop with NN charitable NN Charitable Trust visited Arunachal Pradesh Science Centre, exploring its Innovation Hub and Robotics facilities. The visit aimed to introduce the group to the latest advancements in science and technology, fostering interest and knowledge in these fields.

10. **21st July 2024**

Field Visit Shri Mihin Doilang, a renowned grassroots innovator from the National Innovation Foundation of India, conducted a site inspection in KhachNyelam Village. The visit was undertaken to evaluate the proposed location for installing a Large Cardamom Dryer.

11. **Outreach Program (6th -7th August 2024)**

A two-day outreach program was conducted at Government Higher Secondary School, Kimin, PapumPare district**,** featuring hands-on activities in Physics, Chemistry, and EV3 Robotics**.** The program aimed to promote scientific learning and practical exposure among school students.

12. **Yagamso River Arts and Expression Competition(11th August 2024)**

The "Yagamso River Arts and Expression Competition was conducted in collaboration with, Abralow Multi-purpose Cooperative Society, Itanagar Smart City Development Corporation Ltd., and Youth Mission for Clean River, the programme highlighted the intersection of art, community engagement, and environmental stewardship. activities, such as Poetry competition, Painting Competition, Essay Writing, and Extempore Speech Competition to the preservation of the Yagamso River and the broader environmental context.


13. **Indian Space Week (15th - 22nd August 2024)**

As a part of the celebration of Indian Space Week and National Space Day, & in honor of these special occasions, FREE Planetarium Show and screening of the Chandrayaan Mission was organized from 15thto 22nd August, 2024.

14. National Space Day(23rd August 2024)

The celebration of National Space Day 2024 was organised with various activities like webinar by Shri P. Aravinda Kumar, Sci/Engr "SG" & Group Head, Bhuvan Content Generation Group, ISRO, painting competition with themes ranging from famous cartoon characters on the moon for classes I-V, to moon missions for classes VI-VIII, and space technology in India for classes IX-XII followed by a DIY Rocketry Show. The immersive planetariums show "Back to the Moon for good" was displayed for Parents, Teachers, and Students, exploring the history, science, and future of lunar exploration. Special screening of short movies on the theme "India's Space Sage" provided by ISRO was also displayed for the attendee's gaining insight into one of India's most significant achievements in space exploration.

15. Arduino Training program (18th and 25th August 2024)

Arduino Microcontroller training program was conducted for the students of Class - X, XI, & XII, HIM International School, Jollang

16. Educational visit by PI Academic, Itanagar (27th August 2024)

PI Academic, Itanagar visited Arunachal Pradesh Science Centre, exploring Innovation Hub and Robotics facilities. The visit aimed to introduce the group to the latest advancements in science and technology, fostering interest and knowledge in these fields.

17. Educational visit by Little Genius School (27th August 2024)

Little Genius School, Nirjuli visited Arunachal Pradesh Science Centre, exploring Innovation Hub, planetarium, and Robotics facilities.

18. Participation in WRO Regional- Junior Team on 04 September 2024

The junior team from the Innovation Hub, Arunachal Pradesh State Council for Science and Technology, successfully qualified for the national level of the World Robot Olympiad (WRO) Robo Mission competition. The team, consisting of Tagru Loli (Class XI, JP Public School), Tinyo Sarah (Class VIII, JNK Public School), and TakheMumpi (Class VIII, Holy Cross Hr. Sec School), participated in the regional level competition held in BITM Kolkata.

19. Educational workshop with North-East Regional Institute Science & Technology on 14th September 2024

During an educational visit organized by NERIST, students were introduced to the exciting fields of innovation and robotics, as well as the wonders of planetarium star exploration. Planetarium session offered them a captivating journey through the cosmos, enhancing their understanding of astronomy and the night sky.


20. Ozone Day (16th September 2024)

On World Ozone Day 2024, themed “Ozone for Life,” students from J.P. Public School and Government Secondary School - P Sector, Itanagar Capital Region, participated in a program that included a presentation on the importance of the ozone layer. They learned about opportunities at the Innovation Hub and saw achievements in robotics and sustainable tech. A survey on ozone conservation was distributed, and feedback was gathered. The Arunachal Pradesh Science Centre also hosted a planetarium show, highlighting Earth’s atmosphere and the ozone layer’s role in sustaining life

21. **Month Long Model making by Rajiv Gandhi Govt Polytechnic College**

Students from Rajiv Gandhi Government Polytechnic actively participated in a month-long model-making activityin preparation for the upcoming Inter-Polytechnic College Meet**,** scheduled from 3rd to 5th October 2024**.** The activity aimed to encourage creativity, technical skills, and teamwork among the students.

22. **Gearing up for World Robot Olympiad (WRO) National Level**

Both the junior and senior teams from our institution are currently undergoing intensive training for the World Robot Olympiad 2024. The competition, scheduled to take place at Science City in Ahmedabad, Gujarat, 6th and 7th October 2024

23. **Participation inWorld Robotics Olympiad(WRO) National Level, Gujarat (6th -7th October 2024)**

Two teams represented Arunachal Pradesh in the World Robotics Olympiad in the categories of Robo Mission Senior and Junior. The Senior team consisted of Kure Kojing, Neelam Chada, and Chow Silika Chowhai. The Junior team included Loli Tagru, Tinyo Sarah, and TakheMumpi. After a two-day-long competition consisting of three rounds, the Senior team scored a total of 94 points, while the Junior team scored 136 points.

24. National Entrepreneurship Day (26th October 2024)

Participated in National Entrepreneurship Day organized by the Institution Innovation Council (IIC) at NERIST. TEDx Speaker Prof. Rajeev Kumar Mehajan talked about Mission Innovation: Start Up, Stand Up, and Stay Up.

25. Introduction to Innovation & Robotics, VKV Itanagar(27th October 2024).

VKV Itanagar Class VIII students were introduced to innovation and the LEGO EV3 prototyping robot. They also took membership of the Innovation Hub.


26. Science Drama (30th October 2024)

The State Level Science Drama Competition 2024, held on October 30th in Itanagar, showcased the talent and creativity of Arunachal Pradesh's students. The event promoted scientific literacy and critical thinking through theatre, with performances on topics like climate change, AI, and sustainable development. Judges Dr. Swapna Acharjee, Shri Radhe Tajung, and Smt. Barnali Medhi evaluated the performances. The winners were: Vivekananda Kendra Vidyalaya, Balijan (First Place); Vivekananda Kendra Vidyalaya, Itanagar (Second Place); and Him International School, Jullang (Third Place). Individual awards went to Kumar PhassangChungma (Best Actor, Male), Miss Nabam Rinyi (Best Actor, Female), Kumari Bamang Aya (Best Scriptwriter), and Miss Juhi Gupta (Best Director). The winning team will represent Arunachal Pradesh at the NE Zonal Level Science Drama Competition in Guwahati on November 14, 2024, aiming for the National Science Drama Festival in Delhi from January 5 to 6, 2025.

27. World Sunday School (3rd November 2024)

The 3rd World Sunday School Day was observed in collaboration with CRC Chandranagar under the theme "The Harvest is Plentiful, but the Workers are Few." The visit included interactive sessions, discussions, and hands-on activities aimed at enhancing the educational experience.

28. Micro controller (3rd ,10th ,17th& 24th November 2024)

Throughout November, VKV Itanagar students of class VIII participated in hands-on activities every Sunday, exploring LEGO EV3, basic electronics, and Arduino projects. These sessions provided practical learning experiences, enhancing their technical skills, and fostering innovation

29. 7th November 2024: Education Visit (Kendriya Vidyalaya No.1)

Kendriya Vidyalaya No.1 students visited the Arunachal Pradesh Science Centre, where they explored all the exhibits as part of their educational visit. This experience provided them with a hands-on learning opportunity, enhancing their understanding of various scientific concepts.

30. SPACE Lab Inauguration (13th November 2024)

On November 13th, participated in the inauguration of the Dr. Nilesh Desai ISRO SPACE Lab at Government Higher Secondary School, Yazali. The event marked a significant milestone in advancing space science education and provided an inspiring platform for students to engage with cutting-edge space technology and research.

31. Space Exploration Zion Kids School (14th November 2024)

Students from Zion Kids School, Senki, recently embarked on an educational visit to the Arunachal Pradesh Science Centre to delve into space exploration. The trip offered an exciting and enlightening experience, allowing them to interact with various space-related exhibits and expand their knowledge of the cosmos.

32. Showcasing Innovation on a National Stage: APSCS&T at IISF 2024

The Arunachal Pradesh State Council for Science & Technology (APSCS&T) made a strong and visionary presence at the 10th India International Science Festival (IISF) 2024, held from November 30 to December 3 at IIT Guwahati. Under the overarching theme *"Make in India, Make for the World,"* the festival celebrated India's aspirations to emerge as a global science and manufacturing leader. The event was spearheaded by the Council for Scientific & Industrial Research (CSIR) in collaboration with the Ministry of Science & Technology, Ministry of Earth Sciences, and Vijnana Bharati.

Fig: India International Science Festival, IIT-G, 2024

33. Science Fair(7th December 2024)

Attended Science fair at Green Mount School on 7th December as a guest. The whole school, from primary to secondary, participated in the science fair. Exchanged ideas and learned from diverse scientific exhibits and demonstrations.

34. Participation in Northeast Science Fair 2025 (7th -10th January 2025:)

Students from VKV Chimpu, Innovation Hub Itanagar, Green Mount School, and VKV Balijan, participated in the Northeast Science Fair 2025 organized by National Science Centre, Guwahati

35. NERIST Students' Educational Tour (1st February 2025)

A group of 70 B.Tech students from the North Eastern Regional Institute of Science and Technology (NERIST), Nirjuli, collaborated with the Innovation Hub at the Arunachal Pradesh State Council for Science and Technology today. They were accompanied by Dr. Akhilesh Sharma, Associate Professor, Department of Electrical Engineering, NERIST.


36. Kendra Vidyalaya No.2 educational Tour (4th, 12th & 22nd February 2025

On 2nd, 12th, and 22ndof February 2025, Kendra Vidyalaya No. 2 School organized educational tours to the Arunachal Pradesh Science Centre. The students, accompanied by teachers, explored the Innovation Hub and its facilities. They saw a 3D printing demonstration, learned about its applications, and visited the Mini Planetarium to study celestial phenomena. These tours provided valuable insights into the latest advancements in science and technology.

37. Expert Insight: Meet the Scientist (14th February 2025)

As part of the month-long Science Day Celebration 2025, a program titled "Expert Insight: Meet the Scientist" was conducted at VKV Itanagar with the focal theme of "Empowering Indian Youth for Global Leadership in Science and Innovation for Viksit Bharat." Bharat Bhushan Bhatt, a retired Senior Research Officer, delivered an expert talk on the "Role of Students and Tribal Community in Sustainable Wildlife Management," providing valuable insights into the importance of youth and community involvement in conservation efforts. Additionally, both mentors covered the topic of "AI and Robotics,"

38. Women's Day (8th march 2025)

Celebrated Women's Day with a lively program that combined education, creativity, and entertainment, shining a spotlight on the importance of women in society. The festivities included an engaging quiz competition that tested participants' knowledge on women's contributions, a thought-provoking session on the significance of empowering women, a creative drawing competition to visually express ideas on women's empowerment, and a series of interactive games that added an element of fun and collaboration to the event.

39. World Water Day(22 March 2025)

The World Water Day event at the Arunachal Pradesh Science Centre featured an exhibit display designed to educate the public about water conservation and sustainable practices. An Ihub member provided detailed explanations on various innovative concepts, including the functionality and importance of sedimentation filters for purifying water. The interactive exhibits and insightful sessions aimed to raise awareness about global water challenges and inspire attendees to take active roles in protecting this vital resource, making the event both informative and impactful for the community.

40. One-Day Workshop on ST Cell (21st march 2025)

The Arunachal Pradesh State Council for Science & Technology (APSCS&T) successfully organized a one-day workshop on March 21, 2025, focusing on the ongoing ST Cell project. The workshop provided a comprehensive review of the project's status and progress. Shri D.T. Bhutia, Principal Director of the Sikkim State Council of Science & Technology (DST, Govt. of Sikkim), was the visiting officer and offered valuable guidance on effective project execution.

His insightful presentation equipped the APSCS&T team with practical strategies and a deeper understanding of the project framework, significantly enhancing their capacity for successful completion. Shri C.D. Mungyak, Director-cum-Member Secretary of APSCS&T, addressed the event, underscoring the vital role of the ST Cell in advancing scientific initiatives within the state. The workshop was attended by senior officials, dignitaries, and staff members who actively engaged in knowledge exchange and collaborative discussions. This event strengthened the team's resolve and coordination, paving the way for efficient achievement of the project's goals.

41. Hands-On Training Programme on Areca Leaf Plate Making Machine

The Arunachal Pradesh State Council for Science and Technology, in collaboration with the National Innovation Foundation (NIF), India, organized a hands-on training programme on the Areca Leaf Plate Making Machine from April 2 to April 5, 2025, held in Namsai. This initiative aimed to promote grassroots technological innovations among end-users, especially Self-Help Groups (SHGs), to enhance livelihood opportunities.

During the programme, two semi-automatic, women-friendly Areca Leaf Plate Making Machines, innovated by Shri Jogendra Patra from Mayurbhanj, Odisha, were distributed to the Woisali Self Help Group of Nampong village and the Lekang Farmer's Club of Mahadevpur village in Namsai district. The machines, capable of producing 1,500 to 2,000 plates per day, were expected to empower women's groups by adding value to the abundant areca leaves in the region. Shri Jogendra Patra and his assistant Shri Budhia Singh conducted the training sessions in the presence of officials from NIF and APSCS&T, ensuring hands-on knowledge transfer and skill development. This programme reflected APSCS&T's commitment to fostering sustainable grassroots innovation and supporting rural livelihoods through technology.

42. Leadership and Strategic Engagement

Hon'ble Minister of Science & Technology, Smti. Dasanglu Pul, participated as Guest of Honour in the high-level Round Table on "India as the Global Manufacturing Hub through S&T." She presented the Vision 2047 for Arunachal Pradesh, emphasizing strategic investment in innovation, indigenous technologies, and the ambition to transform the state into a leading Science & Technology hub in the Northeast.

APSCS&T Director-cum-Member Secretary, Shri C.D. Mungyak, actively participated in the panel discussion titled *"Focused S&T for the NorthEast – Science Odyssey of the North East,"* highlighting the Council's initiatives in leveraging scientific advancement for regional development, with a strong focus on sustainability and inclusive innovation.

VI. PUBLICATIONS

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- Maharana J, Maharana D, Bej A, Sahoo B.R, Panda D, Wadavrao S.B, Vats A, Pradhan S.K, De S. 2021. Structural Elucidation of Inter-CARD Interfaces involved in NOD2 Tandem CARD Association and RIP2 Recognition. **J Phys Chem B,**125(49):13349-13365. doi: 10.1021/acs.jpcb.1c06176.

- Joram A, Das A.K., Mahanta D. 2021. Documentation of wild edible plants of ethnobotanical significance associated with selected tribes of Arunachal Pradesh, India. ***Pleione.*** 15(2): 127-140.

- Borah D, Taram M, Yama L, Wahlstenn W. 2021. *Begonia arunachalensis*(Begoniaceae), a new tuberous species of Begonia from Arunachal Pradesh, India. Gardens' Bulletin Singapore. 73(2):475-480. DOI:10.26492/gbs73(2).2021-17.

- Yama L, Borah D, Singh R.K.2022. *Staurogynearunachalensis* (Acanthaceae), A New Species from the Eastern state Arunachal Pradesh. Ann. Bot. Fennici, 59: 47-51.

- Kode J, Maharana J, Dar A.A, Mukherjee S, Gadewal N, Sigalapalli D, Kumar S, Panda D et al., 2022. 6-Shogaol exhibits anti-viral and anti-inflammatory activity in COVID-19 associated inflammation by regulating NLRP3 inflammasome. ACS Omega, doi.org/10.1021/acsomega.2c07138.

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- Das P, et al., (2021). Microbiome Stimulant for crops; In: S. Jaychandra (Eds): Actinomycetes as biostimulants and their application in agricultural practices, Elsevier.

- Das P, Kaldate R et al., (2021). Microbiome Stimulant for crops; In: S. Jaychandra (Eds): Gene expression studies in crop plants for disease management Elsevier.

- Das P, et al., (2021). Stress tolerance in horticulture crops: Challenges and mitigating strategies; Microbial Consortium: a key player for combating the effect of abiotic stresses, Springer.

Establishing linkages with National and International Academic and Research Institutions.

Attention has been given for establishing linkages with following institutes of national and international reputation for pursuing technical support, guidance and collaboration in joint programmes. Linkages and collaboration with some of the following institutions has been established:

International Collaboration

Sl. No.	Name of Institute	Area of Collaborations
1.	The Biomedical Research Institute, National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan	R&D

Sl. No.	Name of Institute	Area of Collaborations
1.	Institute of Bioresources and Sustainable Development (IBSD), Department of Biotechnology, Govt. of India, Imphal	R&D
2.	ICAR- Central Institute of Agricultural Engineering, Regional Centre, Coimbatore	R&D and Capacity building
3.	ICAR-National Research Centre For Orchids, Pakyong, Sikkim	R&D and Capacity building
4.	Life Sciences Sector Skill Development Council (LSSSDC), New Delhi	R&D and Capacity building
5.	Food Industry Capacity & Skill Initiative (FICSI), New Delhi	R&D and Capacity building
6.	Agriculture Skill Council of India (ASCI), Gurugram, Haryana	R&D and Capacity building
7.	Dibrugarh University, Dibrugarh, Assam	R&D and Academia

8.	Assam Agriculture University, Jorhat, Assam	R&D
9.	CSIR-North East Institute of Science & Technology, Jorhat, Assam	R&D
10.	Tezpur University, Tezpur, Assam	R&D
11.	College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh	R&D and Capacity building
12.	Rajiv Gandhi University, Doimukh, Itanagar, Arunachal Pradesh	R&D and Academia
13.	North Eastern Regional Institute of Science and Technology, Nirjuli, Arunachal Pradesh	R&D and Academia
14.	Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Chennai, Tamil Nadu	R&D and Academia
15.	National Research Development Corporation (NRDC), New Delhi	IPR
16.	Translational Health Science and Technology Institute (THSTI), Faridabad	R&D
17.	National Agri-Food Biotechnology Institute (NABI), Mohali	R&D
18.	Institute of Microbial Technology (IMTECH), Chandigarh	R&D
19,	M/S-Allied Engineers, Guwahati	Technology and pro Development