जैव प्रौद्योगिकी विभाग
Department of Biotechnology
Ministry of Science & Technology
Government of India

सत्यमेव जयते

http://www.dbtindia.gov.in

BIOTECHNOLOGY

Contributing To Growing Bioeconomy

VISION

MISSION

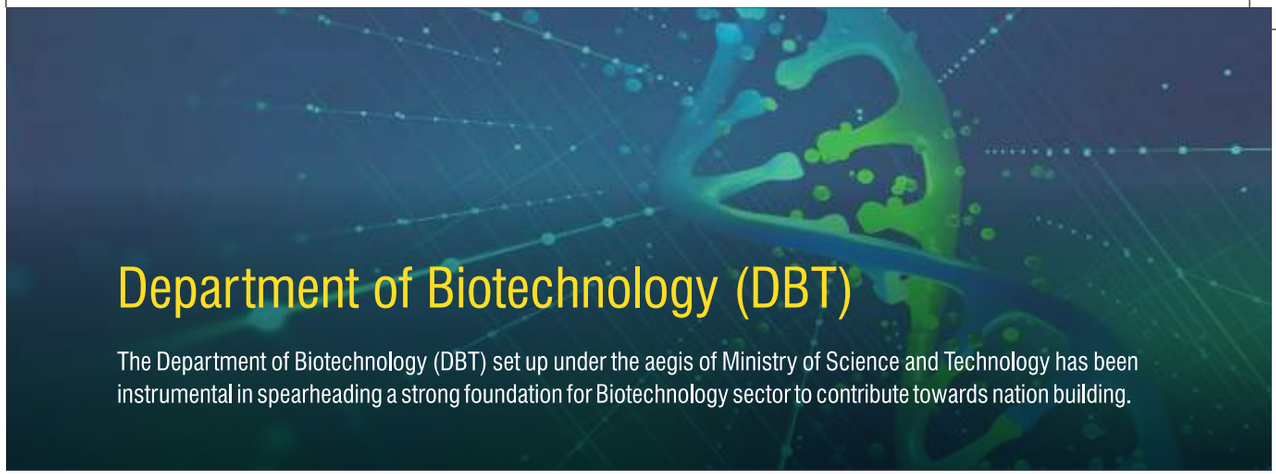
KEY ACHIEVEMENTS

सत्यमेव जयते

Department of Biotechnology
Ministry of Science & Technology
Government of India

Celebrating Biotechnology:
Building India as an Innovation Nation

Contributing to India's National Missions



Department of Biotechnology (DBT)

The Department of Biotechnology (DBT) set up under the aegis of Ministry of Science and Technology has been instrumental in spearheading a strong foundation for Biotechnology sector to contribute towards nation building.

Vision

"Attaining new heights in biotechnology research, shaping biotechnology into a premier precision tool of the future for creation of wealth and ensuring social justice – specially for the welfare of the poor."

Mission

Biotechnology is a frontline area of science with immense potential for the benefit of the human kind. The Department shall devote wholly to achieve excellence in the promotion of biotechnology. The Department shall provide services in the areas of

Research	Infrastructure	Generation of human resource
Popularization of biotechnology	Promotion of industries	Creation of centers of excellence
Implementation of biosafety guidelines for genetically modified organisms	Recombinant DNA products	Biotechnology-based programs for societal benefits

Our mission is

- Realising full potential of biotechnology
- A well directed effort, significant investment for generation of products, processes and technologies
- Enhance efficiency and productivity and cost-effectiveness of agriculture, nutritional security, molecular medicine, environmentally sustainable technologies, scientific and technological empowerment of human resource, a strong infrastructure for research and commercialization, enhance the knowledge base, nurturing the leads of potential utility, bringing the bioproducts to the market place
- Socio-economic development / applicants of biotech for upliftment of women, rural, SC & ST population
- Promote biotech industry

Key Strategies

- Promotion of excellence and innovation
- Creation of policy framework for Biotechnology in the country
- Support discovery research,
- Fundamental and applied research in areas various areas of biotechnology
- capacity building and nurturing talent by supporting various programs both at national and international level, through the high quality research and translational activities of 16 Autonomous Institutes each having a specific mandate
- Nurturing start up ecosystem and entrepreneurship & SMEs
- Facilitating Global competitiveness of Indian research & enterprises.
- Taking the fruits of biotechnology to the community at a large

Driving the Research and Development in the Frontline areas of Biotechnology

Department is Fostering Fundamental and applied research in the areas of

- Agriculture,
- animal and aquatic sciences,
- affordable healthcare & medical biotechnology,
- environmental safety,
- new generation bio-fuels,
- nutritional security
- Human Resource Development

Key Achievements

Ongoing Projects	2,859
Projects Sanctioned	3,143
International Collaborative Projects	143
Scientists Supported	1,184
Research Personnel	6,324
Capacity Building	3,130
CTEP-Proposals Sanctioned	3,176
Technology Generated	339
Publications	6,311
Patents Granted	160
Patents Applied	399

Leading Programs

Building a strong research Ecosystem Capacity Building

Capacity Building

Human Resource Development

Our Focus

- Building a Skilled Workforce and Leadership in Biotechnology
- Strengthen Institutional Capacity
- Enhance Research Opportunities in Basic, Disciplinary and Inter - disciplinary
- Research through Career Boosting Opportunities

Infrastructure Creation

Mission

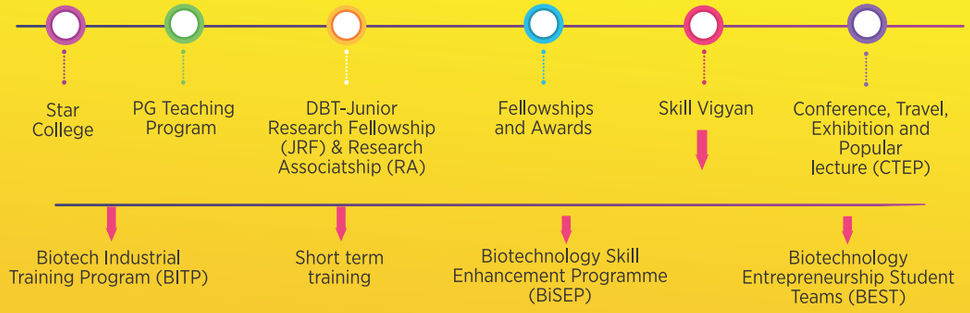
- Technological empowerment of human resource at various levels
- Create strong infrastructure for R&D and commercialization
- Enhance the knowledge base & nurture Talent

Major Milestones in HRD

Human Resource Development Programs supported in a year

- 72 Postgraduate Teaching Courses supported
- 159 Colleges supported under Star College Scheme for strengthen of Undergraduate science education
- 7 new infrastructure facilities for R&D and capacity building effalishment
- Six State S&T Councils supported under Skill Vigyan DBT-State Partnership
- 960 Fellows supported under DBT-JRF Program for Doctoral Research
- 185 Post-Doctoral Fellows supported under DBT-RA Programme
- 35 Fellows awarded DBT-Wellcome Trust Fellowship
- 47 fellowship awarded under DBT-TWAS Fellowship Programme
- 49 UG & PG Students supported under Khorana Program for Scholars
- 34 PhD Students selected for short term training in UK under Newton Bhabha PhD placement Programme.
- Supported 5 Foldscope workshops covering 53 aspirational districts in 12 states, trained about 300 teachers and > 2000 students
- Organized 3rd Nobel Prize Series India 2019 and 2500 students and research scholars as well as 900 odd teachers and young faculties participated
- 63 Fellows selected, 43 joined and 40 absorbed as regular faculty under Ramalingaswami Re-entry Fellowship Programme.

Program: Human Resource Development

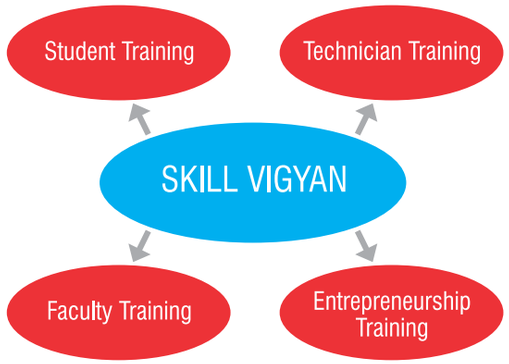


DBT-State Partnership Program on Skill Vigyan

Objective : To provide high quality hands on training in tools and techniques in multidisciplinary areas of biotechnology for entry level students (10+2 and Graduates in Biotechnology) in partnership with State Councils of Science & Technology in respective states.	**Proposals approved (6)**	**Proposals under consideration (5)**	**Expected Outcome (next 3 years)**
	Arunachal Pradesh	Karnataka	Student Training Program : 2535
	Himachal Pradesh	Telangana	Technician Training Program : 1140
	Meghalaya	West Bengal	Faculty Training Program : 840
	Odisha	Andhra Pradesh	Entrepreneurship Development Program : 240
	Punjab	Assam	Total No. of Students to be Trained : 47641
	Uttarakhand		

Skll Vigyan Programe

Department initiated Skill Vigyan Program with an objective to provide hands-on-training in tools and techniques in Biotechnology and allied areas to generate skilled manpower. This program is designed for providing skill training under four categories in partnership with State Science and Technology Councils of respective states. These are: Efforts are being made to partner with all states and UTs to implement the Skill Vigyan program across the country. Department is also supporting the Biotechnology Finishing School Programme.



National Fellowships and Awards

To nurture the talent various fellowships and awards were given to deserving candidates for doctoral and post-doctoral research in frontier areas of biotechnology and life sciences:

Fellowships and Awards

- DBT-JRF Program for Doctoral Research - 500 Fellows are supported every year
- DBT-RA Programme - 100 Post-Doctoral Fellows supported every year
- BioCare - Career advancement and reorientation for women scientists
- Biotechnology Social Development Award
- 11 B-ACER

DBT BRITE

- Hargobind Khorana Innovative Young Biotechnologist Award (IYBA) award - 15 young scientist are awarded every year,
- Tata Innovation Awards - 5 senior scientists awarded every year
- S Ramachandran National Bioscience Award for Career Development - 10 mid-career scientists every year
- Janaki Ammal-National Women Bioscientist Award - 1 Senior & 2 Young scientist awarded every year
- Biotech Product, Process Development and Commercialization Award – 5 Awards given every year
- DBT Distinguished Biotechnologist Research Professorship Award - 5 people at any given time

International Fellowships and Awards

Department lays strong impetus on giving wider exposure to young students and scientists at international platform

- **Khorana internship program** supported 49 students for summer internship in various institutions across US institutions.
- **Newton-Bhabha Placement Programme** for short term training of PhD students outside the country, 34 students were selected to work in different institution in UK.
- **Bharat Boston Bioscience Beginning** (B4), Department is generating critical mass of trained and skilled manpower required for overall development and growth of Biotechnology in the country.
- **DBT-TWAS Fellowship** 47 students and postdocs were supported from third world countries to carry out their PhD and postdoctoral research at Indian institutions across the country.

Program : Infrastructure

• Provide support to establish interdisciplinary School of Life Sciences for advanced research and education in universities through DBT-Boost to University Interdisciplinary Life science Departments for Education and Research (DBT-BUILDER)

• Promote, upgrade and establish new biotech facilities/infrastructure towards augmentation of research activities of scientific community at regional, national and international level through DBT- Scientific Infrastructure Access for Harnessing Academia University Research Joint Collaboration (SAHAJ)

DBT- BUILDER

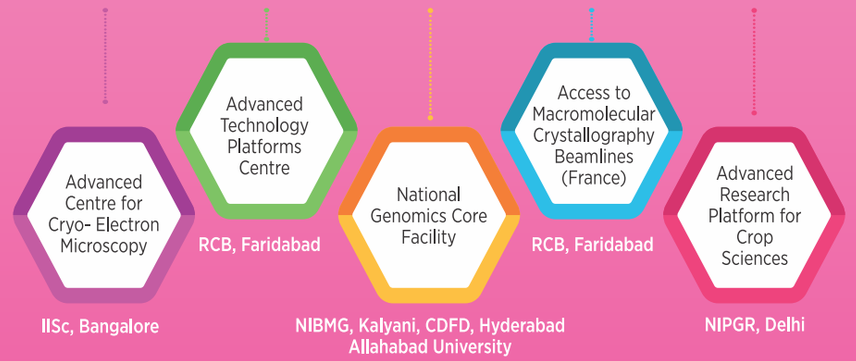
- Publications : 1853
- Patents : 48
- Technology Developed : 2
- Manpower trained : 2450

DBT-SAHAJ

- Publications : 724
- Patents : 4
- Technology Developed : 4
- Manpower trained : 957

Institutes : 31 **Facilities : 15** **Equipments : 262**

Some major facilities created under DBT-SAHAJ



National Facilities - Building a vibrant Ecosystem - University Research and Industry

The Department of Biotechnology has made an enormous effort towards establishing and creating research related infrastructural facilities (National Facilities) at several universities/ institutions across India

Infrastructure Facilities for connecting university research and industry

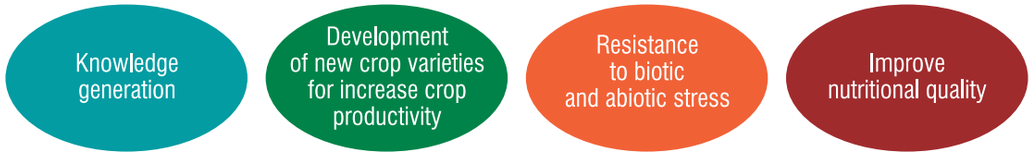
- Life Time Imaging Facility at RGCB, Thiruvananthapuram;
- Central Molecular Laboratory for diagnosis, prognosis and treatment of various disorders at GIPMER, New Delhi;
- Biophysical Characterization Facility, ILS, Bhubaneswar and NISER, Bhubaneswar
- High Resolution Mass Spectrometry based Proteomics Research and Training Facility, IIT, Bombay
- Advanced Research and Education in Diagnostics, IIT Bombay

Research and Development, Demonstration and Translational activities

The impetus of the department has been always on supporting basic fundamental research along with addressing hard pressing research questions under various cutting edge research areas. These include

Agriculture and allied areas	Health care & Medical & Biotechnology	Bioenergy, Bioresources Environment
Bioinformatics & Computational Biology	Nanotechnology	Special Programs
Entrepreneurship Development	International Collaboration	Autonomous Institutes

Agriculture and Allied Areas



New initiatives taken are as follows:

- Established National Genomics and Genotyping facilities at NIPGR, New Delhi for genotyping plant resources in public private partnership (PPP) mode.
- Twelve rice varieties were targeted for improved tolerance to biotic and abiotic stresses and 249 advanced multiple QTL introgressed breeding lines were developed through marker assisted selection.
- Initiated major network program on characterization, evaluation, genetic enhancement and generation of genomic resources for accelerated utilization and improvement of major crops including pulses.
- A network on Pathogenomics of Plant Viruses has also been initiated.

Agriculture Biotechnology

Bio-fortified Maize

First MAS-derived provitamin A rich QPM maize hybrid, Pusa Vivek QPM 9 Improved released in India during 2017

Characters	APQH9
Provitamin-A	8.15
% tryptophan in protein	0.74
% trsine in protein	2.67
Av. grain yield-NHZ (kg/ha)	5588
Protential grain yield-NHZ (kg/ha)	7968
Av. grain yield-P7 (kg/ha)	5916
Protential grain yield-PZ (kg/ha)	9368
Maturity	Extra earthy

NHZ: Northern Hill Zone, PZ: Peninsular Zone
Focus: QPM, provitamin-A, vitamin, Fe, Zn, low phytate

Bahadur-Sub 1 (Flooding tolerance)

Ranjit-Sub 1 (Flooding tolerance

Samba Mahsuri

Samba Mahsuri rice variety resistant to bacterial blight developed with DBT support through Marker Assisted Selection and Backcross Breeding and spread to 90,000 ha in Tamil Nadu, Karnataka, Telangana & Andhra Pradesh.

A backertial blight - resistant variety of Sambh Mahsuri that has fine quality that has fine quality and yield

Pusa Mahak

(Fragrant and suitable for garden display and floral arrangement):
Released by State Seed Sub-Committee for Agriculture & Horticulture Crops, Govt. of NCT Delhi

Pusa Aaradhana

(Thorniess and suitable for flower purpose and garland preparation, Highly floriferous, Recurrent Flowering, Compact flowers with more petals)

Agriculture Biotechnology

Crop Varieties Developed Through DBT Sponsored Projects

Unnat PBW343

Wheat variety Unnat PBW343-Resistant to leaf rust and stripe rust as developed by PAU, Ludhiana through marker assisted backcross breeding approach

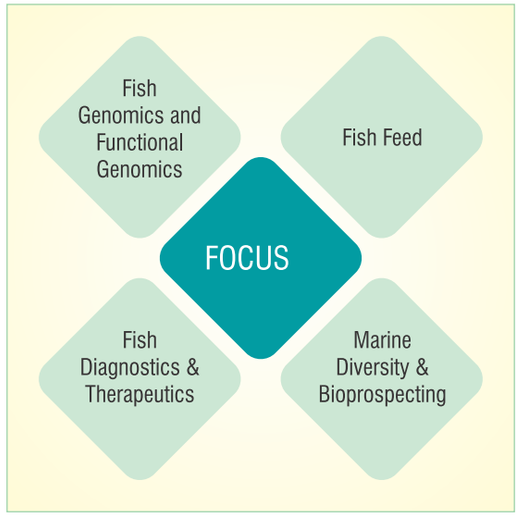
CARI Dhan 6 Resistant to Bacterial blight

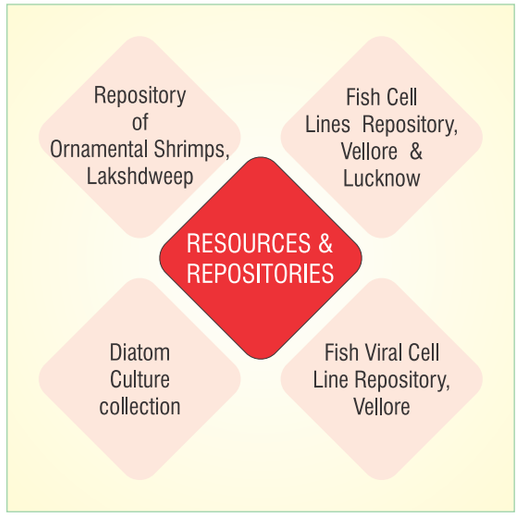
Pusa Basmati 1728 Bacterial blight resistant

Agriculture Biotechnology

Crop	Variety developed	Trait
Maize	HQPM1 (improved)	Pro-vitamin A rich variety
	Vivek QPM-9 (improved)	Pro-vitamin a rich Maize variety
Rice	Pusa Basmati 1728, Pusa Basmati 1718	Bacterial blight resistant
	CARI Dhan 6, CARI Dhan 7	
	Swarna-sub 1, IR64-sub 1, Samba-Mahsuri - sub 1	Submergence tolerance rice variety
	Ranjit - Sub 1, Bahadur - Sub 1	Flooding tolerance
	CR_Dhan 802	Swarna-Sub1 with qDTY2.1 and qDTY3.1
	Mushk Budjit (improved)	Blat resistant variety
	DRR Dhan - 50	Two-in-one flood and drought tolerant
Wheat	Unnat PBW 343	Leaf and stripe rust resistance
	Unnat PBW 347	Resistance against rust
	HI 8737 (Pusa Anmol)	High yielding durum variety with good quality
	HI 8759 (Pusa Tejas)	
Soybean	NRC127	Kunitz trypsin inhibitor free
Rose	Pusa Mahak	Fragrant and sustable for garden display and floral arrangement
	Pusa Aaradhana	Thornless and sustable for loose flower purpose and garland preparation, Highly Boriferous, Recurrent flowering, compact Bowers with more petais

Aquaculture and Marine Biotechnology





Achievements

- Whole genome sequence of economically important fish species Labeo rohita (Rohu) and Cirrhinus mrigala (Magur)
- Refrence protome map for Labeo rohita (Rohu)
- A “Germplasm resource Centre for Marine Ornamental Invertebrates” was established at Centre for Marine Living Resources & Ecology, Lakshadweep.
- Complete genome sequence and de novo assembly of Halomonas malpeensis PRIM 29T, a novel bacterium isolated from west coast of India was carried out.

New Initiatives

- Whole genome sequencing of Tor Khudree, a fresh water fish; Etroplus suratensis, a brackish/fresh water fish and Perna viridis, an Asian green mussel.
- Optimization of larval production of selected marine fish through microbiome manipulation and, supplementation of essential nutritional components to up-regulate growth and immune genes.

Whole Genome Sequencing and Development of Allied Genomic Research

Project initiated for two commercially impaortant Fish- Rohu (Labeo rohita) and Magur (Clarias batrachus) through five next-generation sequencing platforms

Magur (Clarias batrachus)

Rohu (Labeo rohita)

National Repository for Fish Cell Lines

Cell lines are being used for virological, tasicological and gene expression studies

54 + Fish cell lines

have been developed and are being maintained in National Repository established at ICAR-NBFGR, Lucknow and C. Abdul Hakeem College, Vellore.

Lysmata hochi

Ancylocaris brevicarpalis

Alpheus lottini

L. amboinensis

Alpheus sp.

Alpheus sp.

Alpheus sp.

Thor hainanensis

Stenopus hispidus

Gnathophyllum americanum

Urocaridella sp.

Saron marmoratus

Ornamental Shrimps

Animal Biotechnology

MAJOR FOCUS

- Livestock genetics & Genomics
- Livestock reproduction
- Production of therapeutics
- Canine Health Research
- Translation Research

New initiatives

- Brucella free village
- Novel semen extender for goats to help in enhancement of goat productivity.
- Detection of paratuberclosis infection in indigenous breeds of cows
- Early detection of pregnancy in buffalo

Achievements

Technologies commercialized TRPVB

Quick Heal – A collagen based wound healing cream	*ABT Choice*	*EndoMetB and Bovine TB kit*
Nano NDV vaccine	*Collagen Bead based oral delivery*	*Bovine Platelet Lysate*
Photolyser	*Portable Incubator*	*LAMP*

- 11 Technologies supplied to Tamil Nadu Livestock Development Agencies
- 25 Products Ready for Commercialization

Nano ivermectin shampoo	*Nano ivermectin spot on*	*Freeze dried egg yolk for semen extender*	*Pan ABT detect*	*Ketoquant*
Sure heal Nano Herbal methicon lotion	*CPV and Rabies antibody dual kit*	*Cysticercosis LFA Kit*	*PCV LFA Kit*	*Wild TB Kit*
PPRV BHK21 suspension vaccine	*A1-A2 Milk testing kit*	*Lepto LAT*	*ABT detect*	*Medicated Gauze*
TRPVB-Classic dog EC	*Metrozinc gel*	*Sarcoid cream*	*AMS beads*	*Probeads - Shampoo*

TRPVB as incubator incubated many start ups
TRPVB as Veterinary incubation centre
Products supplied : TNLDA supplied Teat Protect (60000 Nos.) and ProSync NC (60000 Nos) to 24 District Veterinary Dispensaries of Tamil in 2018. Biotechnology Services

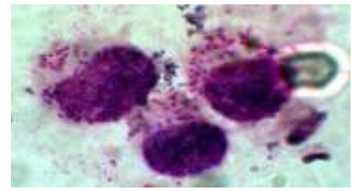
Biotechnology Services

- β-casein A1 A2 genotyping
- Cell Culture Services
- Trichomonas testing
- Brucella antibody testing service
- Detection of Infectious Bovine Rhino tracheitis genome
- Detection of Evans sydrome (IMHA and IMTP) in dog
- Identification of Prevalent Canine Blood Parasites by Multiplex PCR

Products and technologies in animal Biotechnology

Nano Ivermectin spot on

Ketoquant



***Theileria annulata* Vaccine**

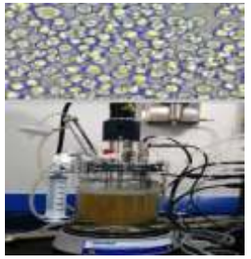
Metrozinc Gel

Nano Herbal Methicon Lotion

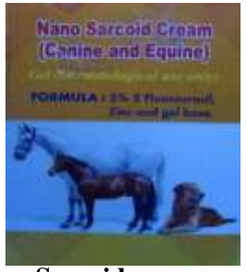
ABT Detect

AMS beads

Pan ABT detect



CPV2b Vaccine

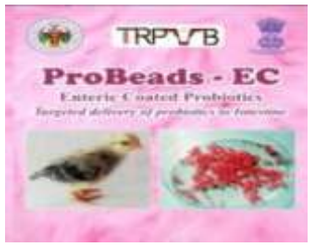


Sarcoid cream

Sure Heal

Portable Canine Pregnancy Detection Device & Test Kit

AMS green tea



Probeads-EC

India has the largest repertore of cattle in the world, Indian cattle population is highly heterogeneous. 69% of Indian cows are owned by the poor

Cattle Genomics

The cattle genomics programme has been initiated at the National Institute of Animal Biotechnology, Hyderabad. Whole genome sequencing of five important milch breeds of cattle has been initiated.

High and low SNP chips will be developed to help identify pure elite animal of a particular cattle breed in its early age and also for conservation.

Based on the results, Phasse-II programme of genomic selection will be carried out by involving farmers in breeding programme.

Brucellosis Free Villages Mission

'Brucellosis Free Villages' Mission was launched and implemented across 50 villages in 10 states in a phased manner. Three new Brucella diagnostic kits were introduced under this mission. 27 countries collaborated to discuss one directive health approach for Brucella.

Development of Various Technologies to Support Animal Husbandry

Five technologies developed to support animal husbandry through innovation.

KETOCHECK for the detection of ketosis

Conductivity Meter for the detection of Subclinical mastitis

Lepto Lat for the detection of Leptospirosis

LFA kit for the detection of CPV maternal antibody level in pups

Egg yolk semen extender for the cryopreservation of bull semen

Health Care & Medical Biotechnology

For understanding the cellular and molecular phenomenon and understand the disease biology. DBT is engaged in advancing research and promoting innovation through applications of nano-biotechnology to address issues in healthcare.

Focus

i. Application of Artificial Intelligence (AI) for affordable and accessible healthcare-

- Big Data and Genomics in areas of cancer,
- tuberculosis and pulmonary diseases,
- diabetic & cardiovascular diseases,
- ophthalmological diseases,
- neurological disorders and
- methods/ drug development.

Genome India Network Program

ii. To catalogue genetic variation in Indian population including whole genome sequencing and data analysis of 10,000 individuals representing the country's diverse population. With 20 national institutions for large-scale genetic studies.

iii. A major programme was launched as Unique Methods of Management of Inherited Disorders (UMMID) and NIDAN Kendras (National Inherited Disorders AdministratioN Kendras) were set up in Government hospitals in four States for comprehensive clinical care including diagnosis, management, multidisciplinary care, counseling, prenatal testing in new born babies. Seven aspirational districts namely Mewat, Haryana; Yadgir, Karnataka; Haridwar, Uttarakhand; Washim & Nandurbar, Maharashtra; Ranchi, Jharkhand; Shrawasti, Uttar Pradesh have been identified for screening of 10,000 pregnant women and 5000 new born babies per year in each district for diagnosis of inherited genetic diseases and to provide comprehensive clinical care. This initiative was officially launched by the Honorable Minister Dr Harsh Vardhan on 23rd October 2019 in New Delhi.

iv. Anti Microbial Mission (AMR) to develop indigenous and cost effective therapies for drug resistance.

DBT launches

GenomeINDIA

Whole genome sequencing of 10,000 Indians
3 years (2019-22)

Create exhaustive catalog of genetic variations in Indians that will serve as reference for our population

Genome-wide arrays specific for Indian population, enabling
- Large scale human genetics research
- Diagnostic measures

Create a biobank of the DNA and plasma samples collected from study individuals along with their detailed demographic and phenotype information.

Genomic information is the backbone to fully harvest the fruits of new advancements in medical science such as Precision Healthcare

Unique Methods of Management of Inherited Disorders Programme

Component I Training of In Service Clinicians

CLINICAL TRAINING

- Personally participate in the care of at least 50 patients with various Genetic Disorders.
- The Prenatal Diagnosis Training.

LABORATORY TRAINING

- Laboratory training in Cytogenetics, Biochemical Genetics, and Molecular Genetics

ACADEMIC ACTIVITIES

- Attend academic activities of the department .
- Seminar
- Journal club
- 3 Case presentations

Component II Aspirational District

NEWBORN & ANTENATAL SCREENING

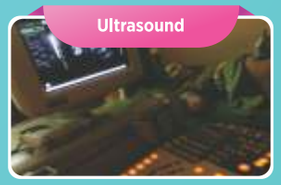
Thalassemia/Sickle Cell Anemia Screening

Newborn Screening for five Genetic Disorders

Component III Establishment of NIDAN Kendras

NIDAN KENDRA

Ultrasound

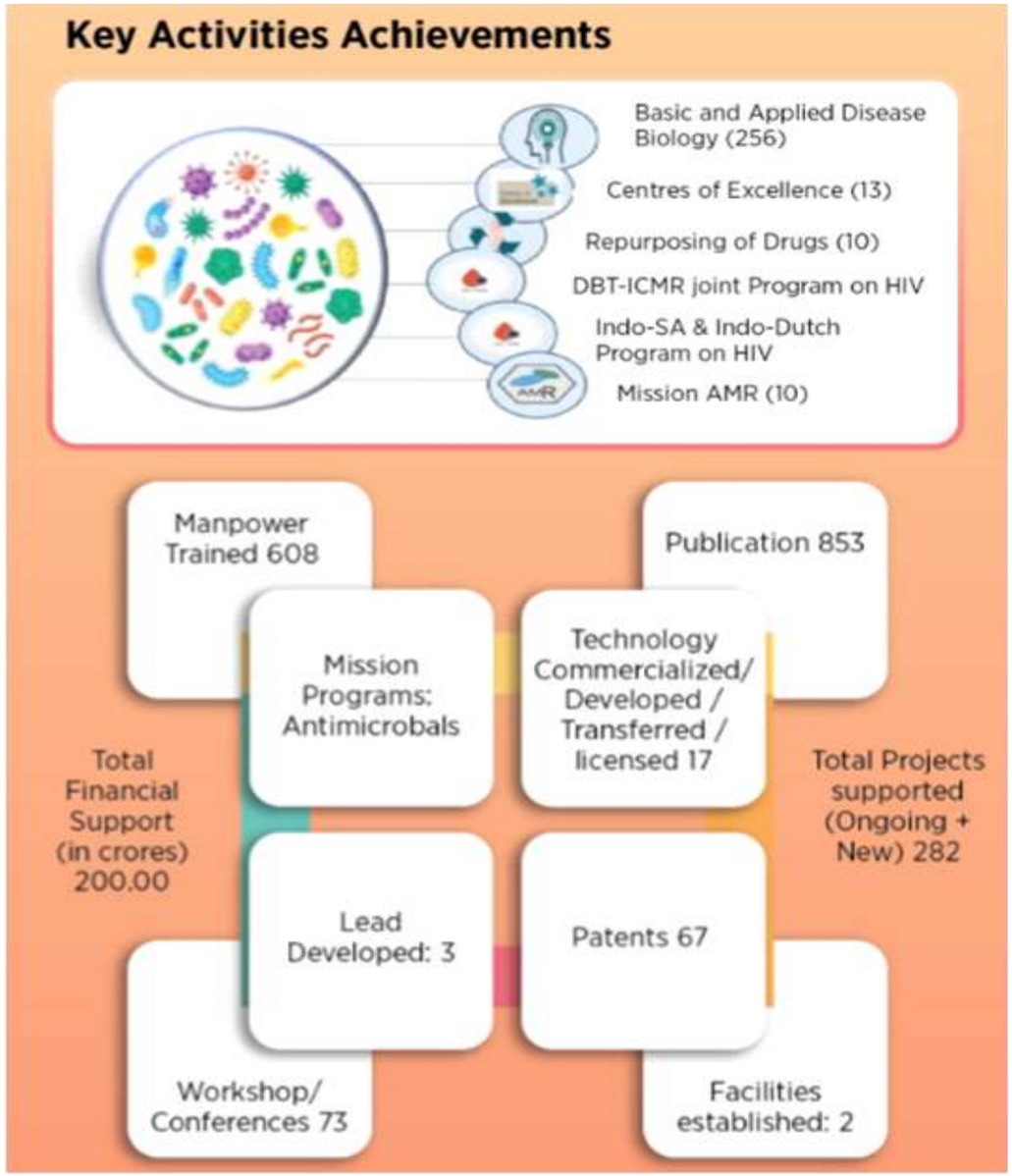


High and Technology

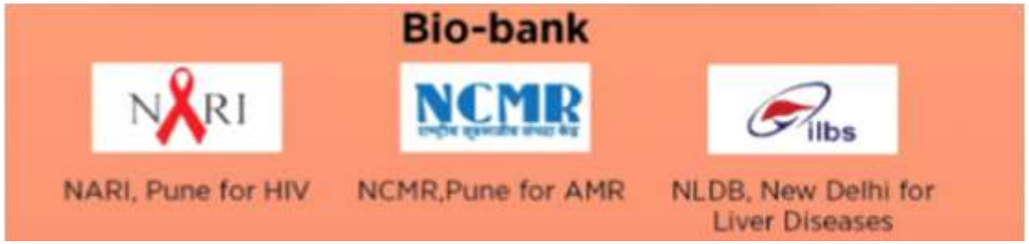
Genetic Counselling

Infectious Disease Biology

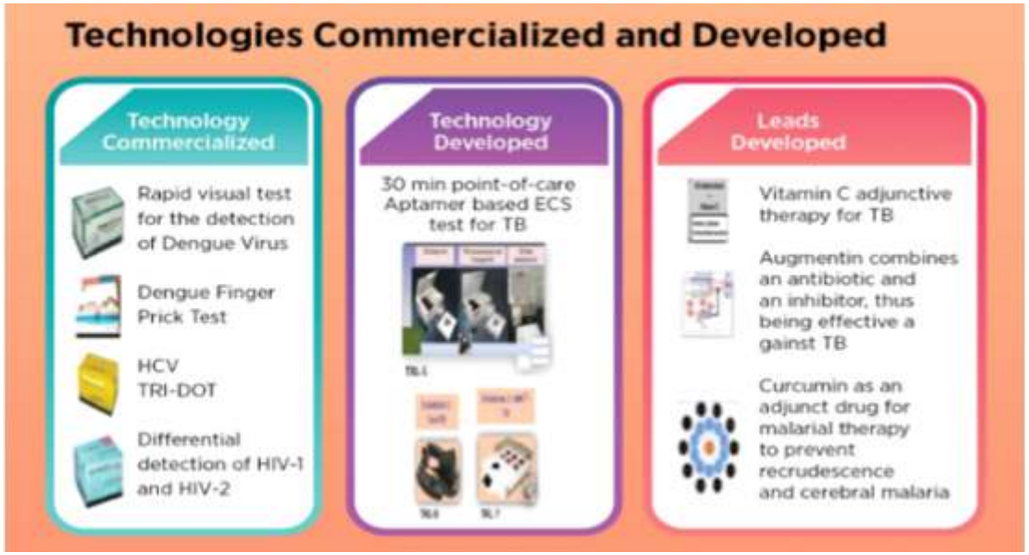
Department supports projects, repositories and initiatives on bacterial, viral, parasitic, and fungal diseases with following key activities



1. Biorepository and Biobank facilities



2. Technologies commercialized:

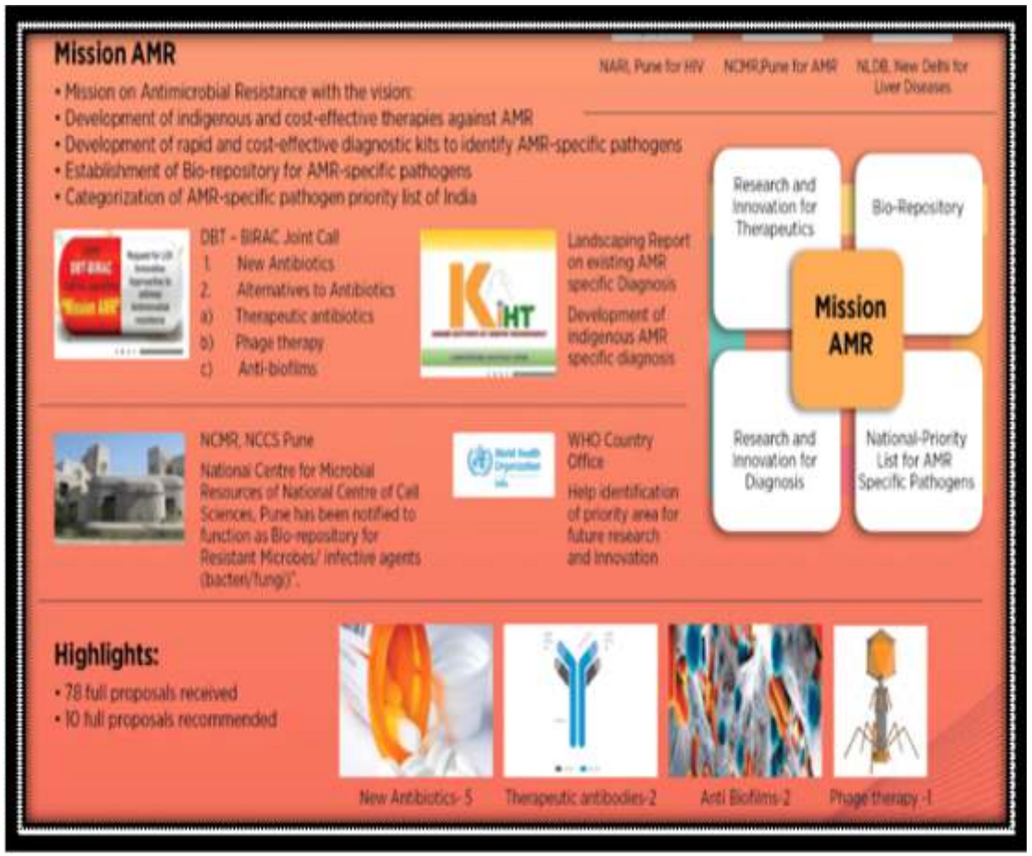


New Initiatives

1. Initiation on a "Novel Monoclonal Antibody (mAb) based Immunotherapeutics to discover and develop cost affordable and globally accessible novel antibodies against Antimicrobial Resistance, HIV and Snakebite Envenoming (SBE).
2. Initiative on New Drug Development against four prioritized areas covering cardio vascular disease (CVD), chronic obstructive pulmonary disease (COPD), cancer and tuberculosis (TB).
3. Initiative on Snakebite Envenomation to develop cost-effective indigenous treatment against snakebite.
4. Adjuvant discovery and development to boost immunity and increase the efficacy of new or existing vaccines.
5. Emerging and re-emerging infectious diseases to support research on basic microbiology of host and pathogen interaction of emerging diseases.

Mission Program on Antimicrobial Resistance

Considering Antimicrobial Resistance as a global threat, the Department has launched an ambitious with the vision to develop indigenous and cost-effective therapies against AMR



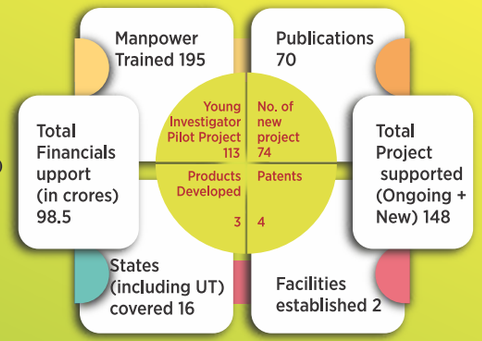
MEDICAL BIOTECHNOLOGY

Chronic Disease Biology

Objective: To support Basic, Clinical, Translational & Interdisciplinary Research in Chronic Diseases.

Key Activities & Achievements during last 5 years

- Basic & Applied Disease Biology (134)
- Centres of Excellence (5)
- Units of Excellence (7)
- Virtual National Cancer Institutes (2)
- Systems Medicine Cluster, Kalyani



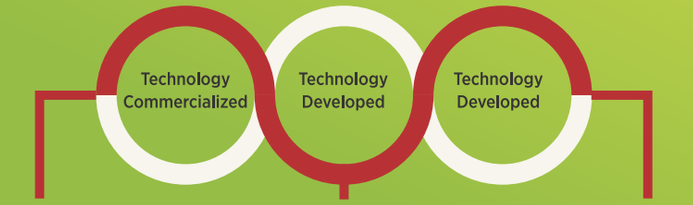
Key Initiatives

- DBT CRUK Affordable approaches to cancer
- DBT –DAE NCG MoU on Transnational Research & Clinical Trials
- DBT, ICMR, NCI-AIIMS, NCI-NIH MoU on Transnational Research & Cancer
- ICGC India Component (Gingivobuccal Cancer)

Bio-bank

- SGPGIMS, Lucknow for SLE
- ACTREC, Mumbai for Gingivobuccal Cancer
- PGIMER, Chandigarh for Iconic Chronic Kidney disease

Technology Commercialized & Developed



Celiac Test Kits

Two types of diagnostic kits:

- Celiac Microlisa – based on indirect ELISA
- Celiac Card – a point of care test that gives result in 20 minutes.
- Commercialized to J. Mitra & Co.Pvt.Ltd.

Folding Foropter

- Novel device for screening for refractive errors.
- Cost – INR 500 (Can be used on more than 500 patients).
- Won an international prize of US $50,000
- Device has reached around 18 countries.

OIO

- Takes real time photograph of patients fundus and is as accurate as high end fundus camera.
- Portable device easily operated by an unskilled person.
- Costs just 800 $ v/s 2500-3500 $ for international products.

Atal Jai Anusandhan Biotech Mission

Some of the missions already initiated under AJABM Undertaking Nationally Relevant Technology Innovation (UNaTI), expected to transform Health, Agriculture and Energy sectors during the next 5 years. This mission includes:

GARBH-INI MISSION

PRETERM BIRTH

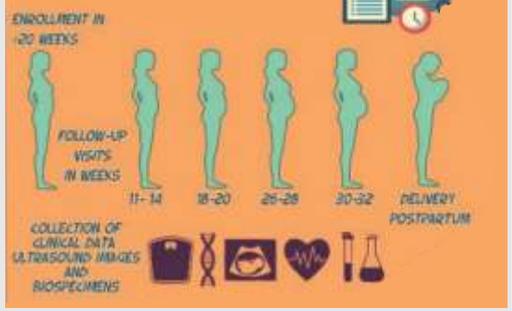
↘ SINGLE LARGEST CAUSE OF NEONATAL DEATHS
↘ 3,00,000 PRETERM INFANTS DIE EACH YEAR IN INDIA
↘ INDIA HAS A HIGHER PROPORTION OF PRETERM BIRTH THAN ECONOMICALLY DEVELOPED OR LOW INCOME COUNTRIES IN AFRICA

IN MAY 2015,
A GROUP OF SCIENTISTS AND CLINICIANS INITIATED A COHORT OF PREGNANT WOMEN

- 6962 WOMEN HAVE BEEN ENROLLED IN GURUGRAM CIVIL HOSPITAL HARYANA
- 5538 BIRTH OUTCOMES HAVE BEEN DOCUMENTED
- ATLEAST 8000 WOMEN WILL BE **ENROLLED**

- ENROLLMENT ≤ 20 WEEKS

COHORT FRAMEWORK

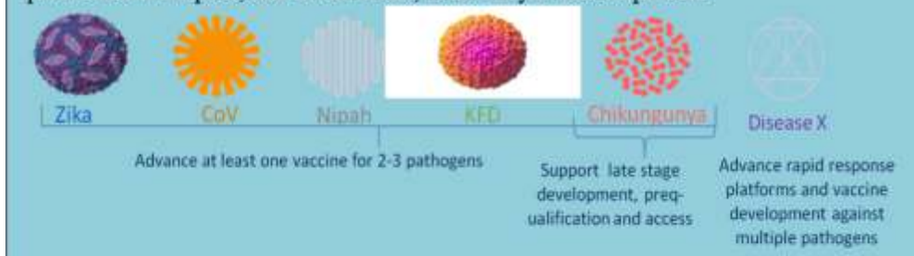


- UNDERSTAND **MULTIDIMENSIONAL CORRELATES** OF PRETERM BIRTH
- **STRATIFY** WOMEN INTO DEFINED **RISK GROUPS** FOR PRETERM BIRTH
- DEVELOP PREDICTIVE BIOMARKERS AND AN EFFECTIVE ALGORITHM FOR **EARLY PREDICTION** AND TIMING OF INTERVENTION OF PRETERM BIRTH
- INFRASTRUCTURE DEVELOPMENT AND CAPACITY BUILDING
- DATA SCIENCE HUB, CLINICAL RESEARCH UNITS IN SMALL HOSPITALS, AND REPOSITORY OF BIOLOGICAL SAMPLES, CLINICAL PHENOTYPES AND ULTRASOUND IMAGES

Ind-CEPI Mission

'India Centric Epidemic Preparedness through Rapid Vaccine Development: Supporting Indian Vaccine Development Aligned with the Global Initiative of the Coalition for Epidemic Preparedness Innovations (CEPI)', aimed to strengthen the development of vaccines and associated competencies/technologies for the diseases of epidemic potential in India, focuses on strengthening infrastructure for vaccine development through academia-industry interface, enabling skill development and capacity building activities and supporting development of surveillance frameworks for use of new vaccines.

The Ind-CEPI targets are selected in alignment with WHO R&D Blueprint based on: public health impact, risk of outbreak, feasibility of development.



Biotechnology Industry Research Assistance Council (BIRAC) - a Public Sector Undertaking of DBT and Translational Health Science and Technology Institute- an autonomous institute of DBT are the working arms of the Department for implementing the Ind-CEPI mission.

Vaccine Action Programme (VAP) and the Vaccine Grand Challenge Programme

the collaboration determines important achievements like the lowest cost Rotavirus vaccine and major strides towards vaccine for diseases like malaria & dengue.

Cohort studies, Bio-banks, Bio-repositories and Clinical Trials:

During the recent years, the Department has supported various cohort studies; establishment of Bio-banks; Bio-repositories and Clinical Trial facilities for various diseases across the country.

Cohort studies supported on

cerebral stroke biology	stem cell technology	trajectories for healthy life	HIV
adult health	young adolescents	renal biology	TB
brain aging		chronic kidney diseases	
dementia	maternal & child health	systemic lupus erythematosus	genetics of healthy people

Establishment of bio-banks facilitated on

microbial cultures	liver diseases
antimicrobial resistant pathogens	

National Biopharma Mission

The Cabinet Committee on Economic Affairs in May 2017 approved the National Biopharma Mission, "Innovate in India (I3) – Empowering biotech entrepreneurs & accelerating inclusive innovation".

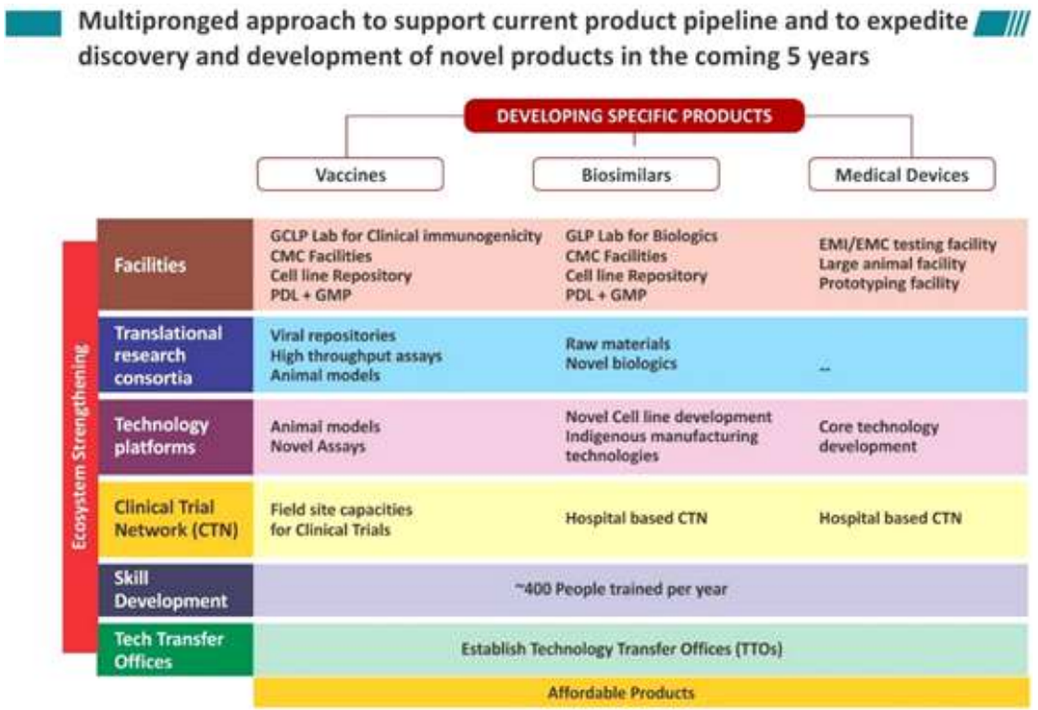
- Total project cost of ₹ 1500 Crores.
- Period five years on a 50% cost sharing via World Bank loan
- Implemented (BIRAC) - a Public Sector Undertaking of DBT.

Vision

To enable and nurture an ecosystem for preparing India's technological and product development capabilities in biopharmaceuticals to a level that will be globally competitive over the next decade, and transform the health standards of India's population.

Focus

To transformer the health standard of the country through affordable product development
Achievements: 5-7 biofarmaceutical products the coming 4 years.
Major activities: (i) Specific Product Development (ii) Building Shared Infrastructure and (iii) Building and strengthening domain specific knowledge and management skills.



Major Achievements under NBM

PRODUCT DEVELOPMENT
- **Vaccines: 06 candidates**
- **Biosimilars: 12 Biosimilar products and 03 Biosimilar Clones**
- **Medical Devices: 07** core technologies

SHARED FACILITIES
- **Facilities: 17** Facilities GLP, GCLP, PDL-GMP, Cell Line Repositories, Medical device testing & prototyping facilities along with EMI/EMC testing facility
- **Translational Research Consortia:** Multidisciplinary partnership platforms for tackling Dengue & Chikungunya
- **Clinical Trial Capacity Enhancement:** Hospital based sites for testing and biotherapeutics & Field sites for testing vaccine efficacy

SKILL DEVELOPMENT
- **937 candidates trained including 303 female participants**
- **15 Workshops successfully conducted (ending Jan 2020)**

TECHNOLOGY TRANSFER
- **Establishing five Technology Transfer Offices (TTOs): 05** TTO's

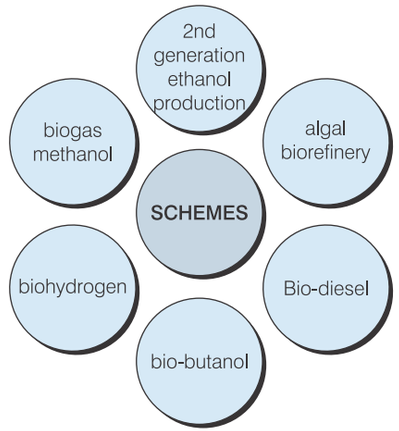
National Biopharma Mission

The first ever Industry-Academia mission to accelerate biopharmaceutical development in India was launched by the Cabinet Minister for Science and Technology. Earth Sciences, Environment, Forests and Climate Change, Dr. Harsh Vardhan in New Delhi in June 2017.

Department of Biotechnology's PSU Biotechnology Industry Research Assistance Council (BIRAC) in collaboration with World Bank isimplementing the mission with the goal to bring to the market 5 Biopharma products vaccine, Biotherapeautics Medical devices & diagnostic and creating on ecosystem to facilitate the pipeline of products.

Clean Energy Mission -
Innovative Technology interventions for Swachh Bharat

- **Bioenergy and Bioresources and Environmental Biotechnology:** development of alternative fuels.
- **Focus: development of 2nd generation biofuels**



National Bioresources Development Programme:

Focus

research for bioprospecting	inventorization and characterization
value addition	sustainable utilization of bioresouces
capacity building	awareness generation

Network Programme on Marine Bioresources and Biotechnology

Established the program in collaboration CSIR institutions, Ministry of Earth Sciences and other institutions/ universities working in areas of marine biology in the country.

Turmeric Mission

Mission programme on turmeric with

Aim

To generate high-quality raw material for developing nutraceutical products / dietary supplements from turmeric for global market.

Focus

(a) Turmeric as a whole

biodiversity studies	genetic improvement	developing elite varieties
agro-technologies	post-harvest processing	

(b) Curcuminoids

testing in animal model systems	standardization of extracts
bioactive fractions enriched with curcumin and curcuminoids	production of GMP grade curcumin
efficacy studies in selected disease conditions such as arthritic pain, cancer and infectious disease	to generate enough high-quality scientific data

Environmental Biotechnology

Focus

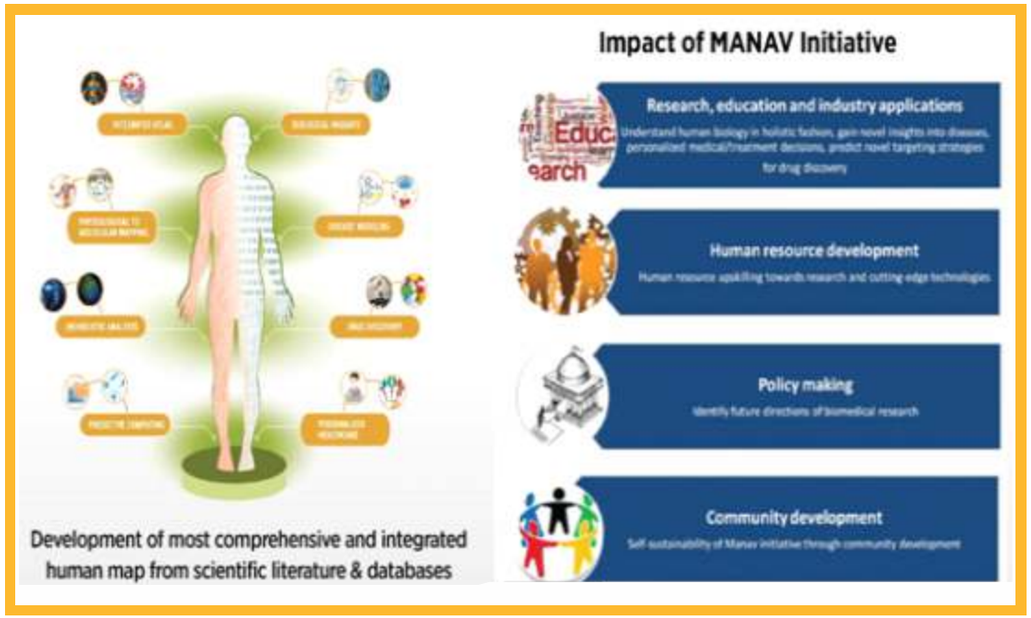
- bioremediation,
- waste management,
- forest conservation,
- resource utilization and
- climate change mitigation.

Major network project implemented

- On-site bioremediation of petroleum contaminated soils. With impetus on understanding the cause of human diseases at genetic and molecular level to enable the development of innovative therapies or preventive measures and early detection in areas of enormous importance for public health.

Knowledge Generation, Discovery Research, New Tools and Technologies

The main focus areas of the knowledge generation, discovery research, new tools and technologies include Basic Research in Modern Biology, Nanobiotechnology, Genome Editing Technologies & their application and Theoretical and Computational Biology (Bioinformatics, Artificial Intelligence and Big Data etc.). Efforts have been made to encourage R&D programs in emerging genome engineering technologies and their applications. DBT is also supporting projects and programmes under bioinformatics for more than three decades as one of the thrust areas of Biotechnology. Bioinformatics programme has given impetus to the development of new knowledge and discovery research.



Theoretical & Computational Biology

MANAV: Human Atlas Initiative

• Department of Biotechnology has supported ""MANAV: Human Atlas Initiative programme" for construction of world's most comprehensive human atlas till date by assimilating all the known macro-level and micro-level information from scientific literature and public databases.

• The proposed human map refers to a computational representation, which will provide knowledge in holistic fashion from inter-organ dependencies to intra-organ, tissue level, cell and sub-cellular level biological reactions.

• MANAV can serve as analogous to the 'human reference genome' and will have applications such as patient-specific support for medical/treatment decisions, understanding of pre-clinical and clinical assessment of healthcare products and personal health forecasting.

• MANAV will also help to identify gaps in the current biological knowledge, which could be the basis for future studies and policies.

Artificial Intelligence

Artificial intelligence (AI) aims to mimic human cognitive functions. It is bringing a paradigm shift to healthcare, powered by increasing availability of healthcare data and rapid progress of analytics techniques. Considering the importance of AI, a call for proposal on Artificial Intelligence Applications for Affordable and Accessible Healthcare - Big Data and Genomics was issued. A total of 22 projects are being supported in the areas of cancer, tuberculosis and pulmonary diseases, diabetic & cardiovascular diseases, ophthalmological diseases, neurological disorders and methods/ drug development. A project on Imaging BioBank for Cancer is also being initiated with an intent to develop AI tools and database for advance research in cancer and will also be aimed at cancer diagnosis/ prognosis and cancer care.

Nanobiotechnology

A need was felt to have specific guidelines that will help in regulatory process pertaining to Nano products focusing on 'Capacity Building for Translational Research' to create an enabling ecosystem for product development in the field of nanopharma, Hon'ble Minister of Science & Technology has recently released the “Guidelines for evaluation of Nanopharmaceuticals in India” developed by DBT jointly with ICMR and CDSCO. Further, Designing of Nano-Agri Input and Nano-Agri Products have emerged as the new concept under the domain of 'minimal usage with maximum effect' for agricultural and food applications. Guidelines for “Evaluation of Nano Based Agri Inputs and Food Products in India” have been finalized and would be released soon.

“Guidelines for Evaluation of Nanopharmaceuticals in India" At a Glance

- Jointly developed by DBT, ICMR and CDSCO
- Apply to the nanopharmaceuticals in the form of finished formulation as well as Active Pharmaceutical Ingredient (API) of a new molecule or an already approved molecule with altered nanoscale dimensions
- Facilitate translational research in line with the regulatory requirements
- Provide transparent, consistent and predictable regulatory pathways for nanopharmaceuticals in India

Genome Editing Technologies & Their Applications

Aim:

Promoting research and innovation in the area of genome engineering technology and their applications with a vision to foster innovation and promote development of Genome-wide Analysis and Engineering Technologies to make them accessible and affordable for wider use in Life Sciences.

Focus:

- Drive research for New Methods, Tools, Processes Development for Genome Editing towards Basic and Applied research use.
- Establish Accessible Platforms Facilities on Emerging Genome Editing Technologies for Research & Development and Applied Use.
- Improvement of Existing Genome Editing Technology Platforms.
- Development of New Applications of Existing Genome Editing Technologies

Highlights/Achievements:

Using CRISPR-Cas-based gene editing system:

- The role of Plasminogen Activator Inhibitor Type-1 (PAI-1) in the pathogenesis of tissue fibrosis has been elucidated.
- Spatiotemporal organization of cancer-associated genes has been delineated
- Early blight pathogen Alternaria solani stress-responsive miRNAs, novel small RNAs, and mRNAs, miRNA-mRNA interacting pairs in tomato have been identified.
- microRNAs involved in fragile X syndrome have been unravelled.

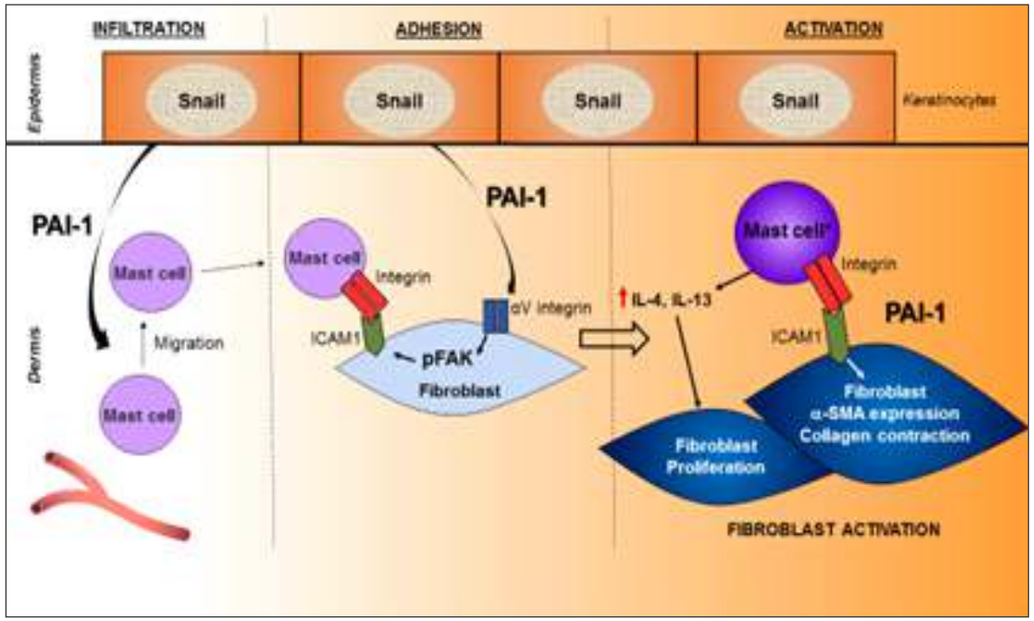


Fig.: PAI1 mediates fibroblast–mast cell interactions in skin fibrosis

Indo-US Getin Program

Objectives:

- Providing opportunity to Indian students and scientists to gain exposure and access to world class research facilities in leading US institutions,
- Capacity building in the frontline area of Genome Engineering/Editing Technologies,
- Building long-term R&D linkages and collaborations with US institutions/ researchers.

Fostering International Collaboration

India-Sweden Joint Committee on Science &Technology

Building international partnerships between organizations, countries, institutes is a critical tool for the developing strategic partnerships in globalizing their programmes to help academics, students, and their faculties to become more competitive in global scenario. The Department is implementing various international collaborative programs with a number of countries and philanthropic organizations in different areas of biotechnology.

New Initiatives

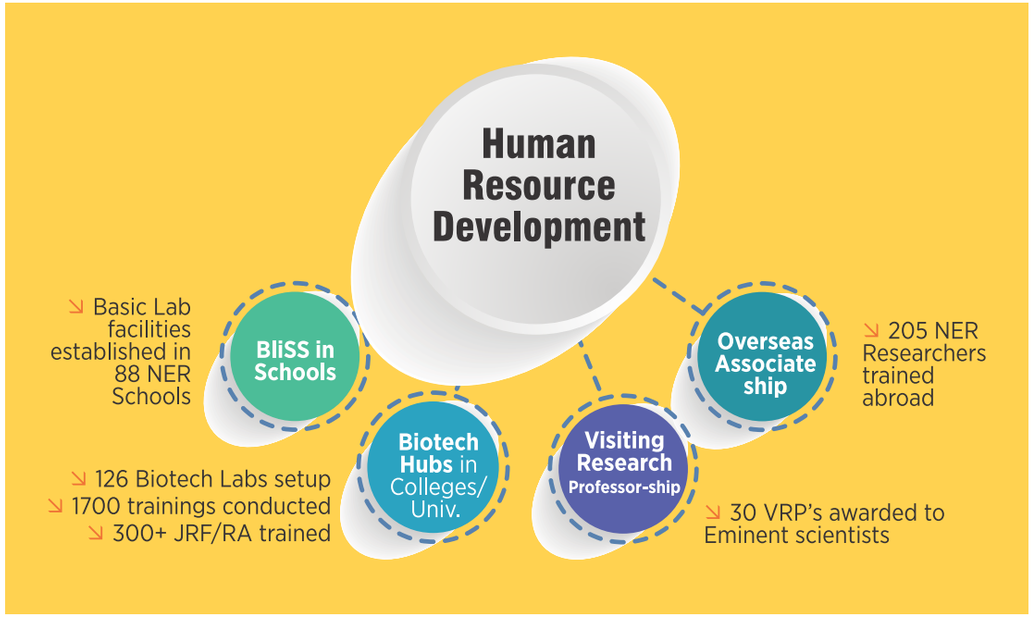
- 'Global Stars Initiative in Field of One Health' with the EUREKA with UK, Netherlands and Spain.
- Global Research Programme (GRP) Phase II addressing the health needs of women and children in the most disadvantaged populations globally in partnership with DFID-ESRC-MRC, UK.
- Digital Healthcare: A joint workshop under Indo-Swedish collaboration was organized on Digital Healthcare to enhance the cooperation across academia and start-ups in Digital Healthcare across both the countries.

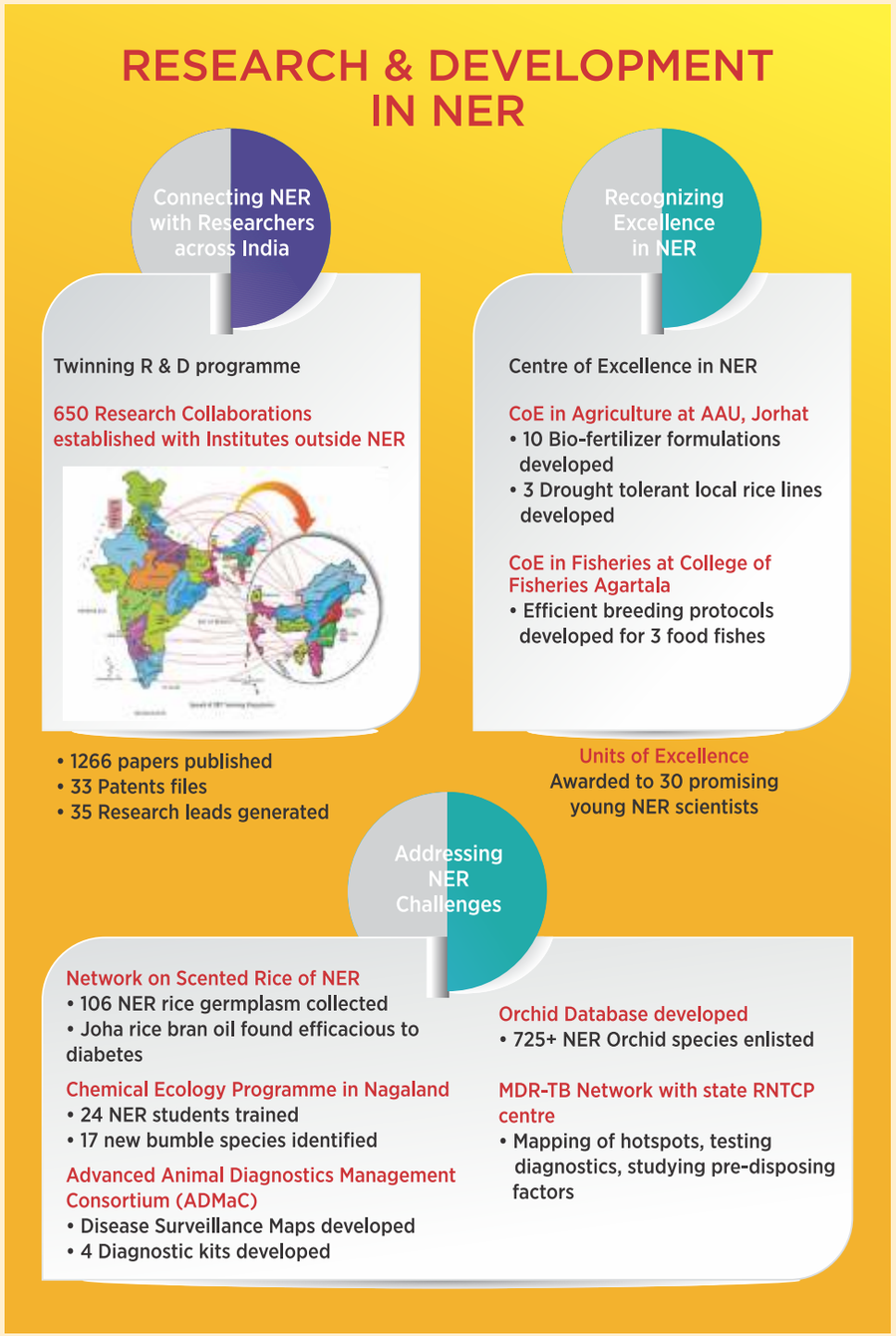
Special Programmes for Aspirational Districts and States

The Department has undertaken focused program for improving livelihood towards of small & marginal communities in selected aspirational districts. Programs developed are :

- 09 Rural Bio Resource Complex Innovation Hubs to address pertinent issues related to health and nutrition,
- agriculture & allied areas using biotechnological tools,
- techniques and processes have been supported in 11 Aspirational districts in 7 states.
- Biotech-Krishi Innovation Science Application Network Programme (Biotech-KISAN) in a mission mode to create platform for self-employment generation among the target population by diffusion of proven and field-tested technologies through demonstration, training and extension activities. This program has made significant progress during the year by expanding its activities in 92 Aspirational Districts. The efforts have been continued towards establishing Biotech-KISAN Hub in each of 15 agro-climatic zones of the country under the leadership of a champion, who will act as the Facilitator. Each Hub will create a network by developing strong linkages with top quality scientific institutions / State Agricultural Universities (SAUs) / Krishi Vigyan Kendras (KVKs) / existing state agriculture extension services / system and other Farmers' organizations in the region as well as linkages with leading international institutions / organizations. Biotech-KISAN Hub will also have a tinkering laboratory.

Promotion of Biotechnology in North Eastern Region (NER)





Autonomous Institutions

The Department has set up 16 theme based autonomous institutions and also supporting one International Centre. These institutions facilitate flow of knowledge from basic science to translational research in Healthcare, Agriculture, Bioresource and Basic & Emerging Biotechnologies etc. These institutes are also playing an important role towards capacity building, training for up gradation of skills of young scientists, students and researchers. These, institutions are also involved in outreach activities for popularization of science among students and dissemination of knowledge.

1. Bioprocessing Unit (BPU), Mohali
2. Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad
3. Institute of Life Sciences (ILS), Bhubaneshwar
4. Institute of Bioresources and Sustainable Development (IBSD), Imphal
5. Institute for Stem Cell Science & Regenerative Medicine (ISCSR), Bengaluru
6. National Institute of Immunology (NII), New Delhi
7. National Centre for Cell Science (NCCS), Pune
8. National Brain Research Centre (NBRC), Manesar
9. National Institute of Plant Genome Research (NIPGR), New Delhi
10. National Agri-Food Biotechnology Institute (NABI), Mohali
11. National Institute of Animal Biotechnology (NIAB), Hyderabad
12. National Institute of Bio Medical Genomics (NIBMG), Kalyani
13. Regional Centre for Biotechnology (RCB), Gurgaon
14. Rajiv Gandhi Centre for Biotechnology (RGCB), Thiruvananthapuram
15. International Centre for Genetic Engineering and Biotechnology (ICGEB), New
16 DelhiTranslational Health Sciences and Technology Institute (THSTI), Gurgaon

Flagship programs of DBT Autonomous Institutions

Name of Institute	Flagship Programme
NII, New Delhi	*Immuno Engineering : Cell Therapy Platform*
CDFD, Hyderabad	*Development of Genomic Technologies for predictive genetic health and forensic profiling*
NIPGR, New Delhi	*Imparting sheath blight disease tolerance in rice*
NBRC, Manesar	*Comparative mapping of common mental disorders (CMD) over lifespan*
IBSD, Imphal	*Conservation, Propagation, Mass Multiplication and Research & Development activities of Selected Orchids, Prunus and Parkia species for developing biobased entrepreneurship in North East India*
ILS,Bhubhaneshwar	*A research initiative to uplift health and well-being of Tribal communities of Odisha*
RCB, Faridabad	*Development of small molecular antivirus against chikungunya and Japanese encephalitis virus*
THSTI, Faridabad	*Inter-Institutional program or maternal, neonatal and infant sciences : GARBH-INI– interdisciplinary Group for Advanced Research on BirtH outcomes - DBT India Initiative*
InStem, Bangalore	*Leveraging stem cell technologies to facility discover for Human disease biology in India*
NIBMG, Kalyani	*Integrating Multi-Omics Data Using Big Data Analytics to Infer Optimal Wellness Trajectories for Management of NCDsAdv(SS)*
NABI, Mohali	*Development of Bio-fortified and Protein rich Wheat*
CIAB	*Utilization of Rice Residues for Value Added Product Development*
NIAB, Hyderabad	*Genomics assisted pathobiology to identify novel targets for diagnosis and therapeutic intervention (s) of Japanese encephalitis and Leptospirosis*

Promoting Entrepreneurship and Industrial growth

Indian bio-economy is expected to grow from USD 64 Bn in FY 2019-20 to USD 150 Bn by 2025. This growth trajectory for the sector is an outcome of GoI's constant effort and initiatives to promote this sector making India a global Biotech leader. The focus has been primarily on Startup India ecosystem and promotion of Make in India concept.

Startup India

Startup India is a flagship initiative of the Government of India, intended to build a strong eco-system for nurturing innovation and startups in the country that will drive sustainable economic growth and generate large scale employment opportunities. The Department of Biotechnology and Biotechnology Industry Research Assistance Council (BIRAC), a not-for-profit Section 8, Schedule B, Public Sector Enterprise endeavours to scale up the number of startups in the sector by handholding them from ideation to commercialization of their products/ technologies. 45 Bioincubators have been setup across India creating total incubation space of 4,85,000+ sq. ft.

DBT established a Make-in-India Facilitation Cell for Biotechnology Sector in 2016 with the following mandate

- Facilitating Investments
- Fostering Innovations
- Protecting Intellectual Property
- Building best in class infrastructure
- Ease of doing Business
- Providing Employment in Manufacturing Sector
- State Partnerships to Expand Biotech Innovation Ecosystem
- Create Global Start-ups Connect

Global Bio-India 2019

DBT and BIRAC organized Global Bio-India 2019 from 21st – 23rd November 2019 at Aerocity, Delhi in partnership with Confederation of Indian Industry (CII), Association of Biotechnology Led Enterprises (ABLE) and Invest India. This event is a testimony of growing prowess of biotechnology sector in the country and showcase to International community. The three-day long event witnessed a rich technical program of

40 sessions	CEO roundtables	workshops	product launches
3000+delegates 25+countries	190 exhibitors 300+start-ups	50+incubators 800+business meetings	60+Research Institutes representation from 10+states
60 government, research and educational institutions			

Glimpses of Global Bio-India 2019

DBT Biodesign Program

- Innovation is the key to address the unmet clinical needs. The demand for medical devices and implants is growing rapidly globally as well as in India. Realising the need to foster and promote development of indigenous affordable medical technologies, DBT established biodesign centers across the country. They are-

  - School of International Biodesign (SIB) programme jointly at AIIMS and IIT Delhi;
  - Healthcare Technology Innovation Centre, IIT-Madras;
  - Centre for Bioscience and Bioengineering, IISc., Bangalore.

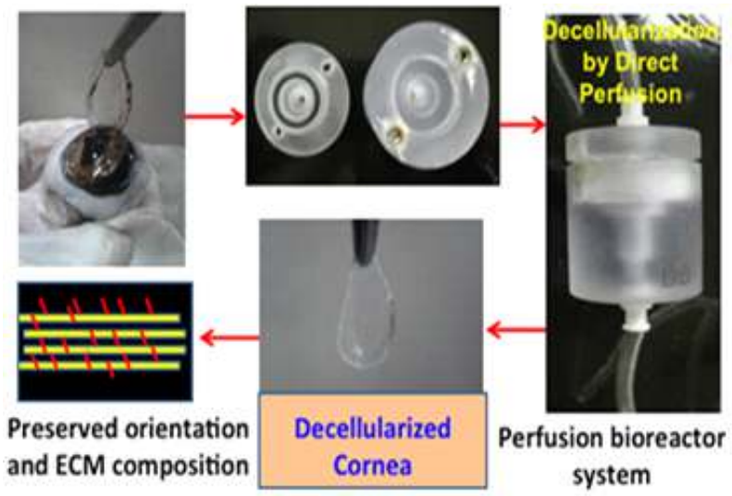
Technologies Developed under Biodesign program

Mobile Development under Biodesign program

Collaboration with Sankara Nethralaya

First-of-its-kind indigenous technology in the country for targeting unaddressed backlog of cataract surgeries in rural India

14.000+ surgeries in rural areas 100+ camps



High Resolution Digital Holographic Microscope (DHM) for 3D Cell Imaging

FlexiOH

NeoBreathe

Sohum

Noxeno

Biotechnology Science Cluster:

Considering the importance of Biotech Cluster in economic development of any region, the multi institutional regional clusters were established by the Department as an initial step towards accelerating innovation. This was in principle approved as a part of the National Biotechnology Strategy that aims to develop India as a world-class bio-manufacturing hub by creating a technology development and translation network across the country. Four Bioclusters were established at Faridabad, Bangalore, Pune and Kalyani.

Biotechnology Parks & Incubators

Department of Biotechnology partnered with various State Governments to establish Biotech Parks since 2003

- To promote equitable opportunities in biotechnology sector across the country,
- to translate research into products and services by providing necessary infrastructure
- to facilitate networking amongst various biotech stakeholders
- to provide entrepreneurial opportunities even in remote places of India.

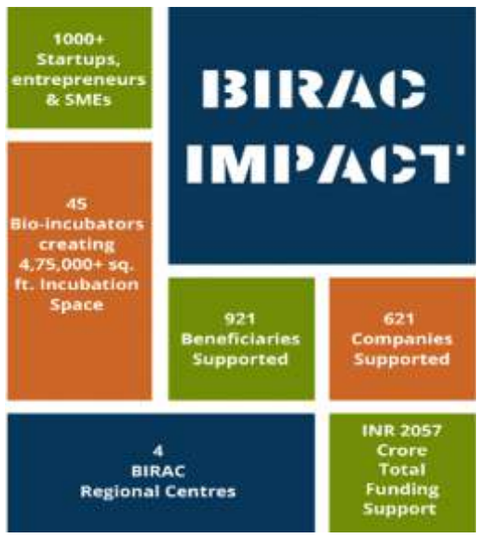
New Biotech Parks and Incubation Centres

- Kerala Biotech Park, Cochin has major infrastructure facilities and houses 22 incubatees.
- Guwahati, Biotech Park and Technology Incubation Centre Assam.
- Jammu & Kashmir- Two Industrial Biotechnology Parks have been recently set-up focusing on medicinal & aromatic products, enzymes/value-added biomolecules.
- Chhattisgarh Biotech Park -interfaces research institutes with industry for bio-resource based product commercialization.

Public Sector Undertakings

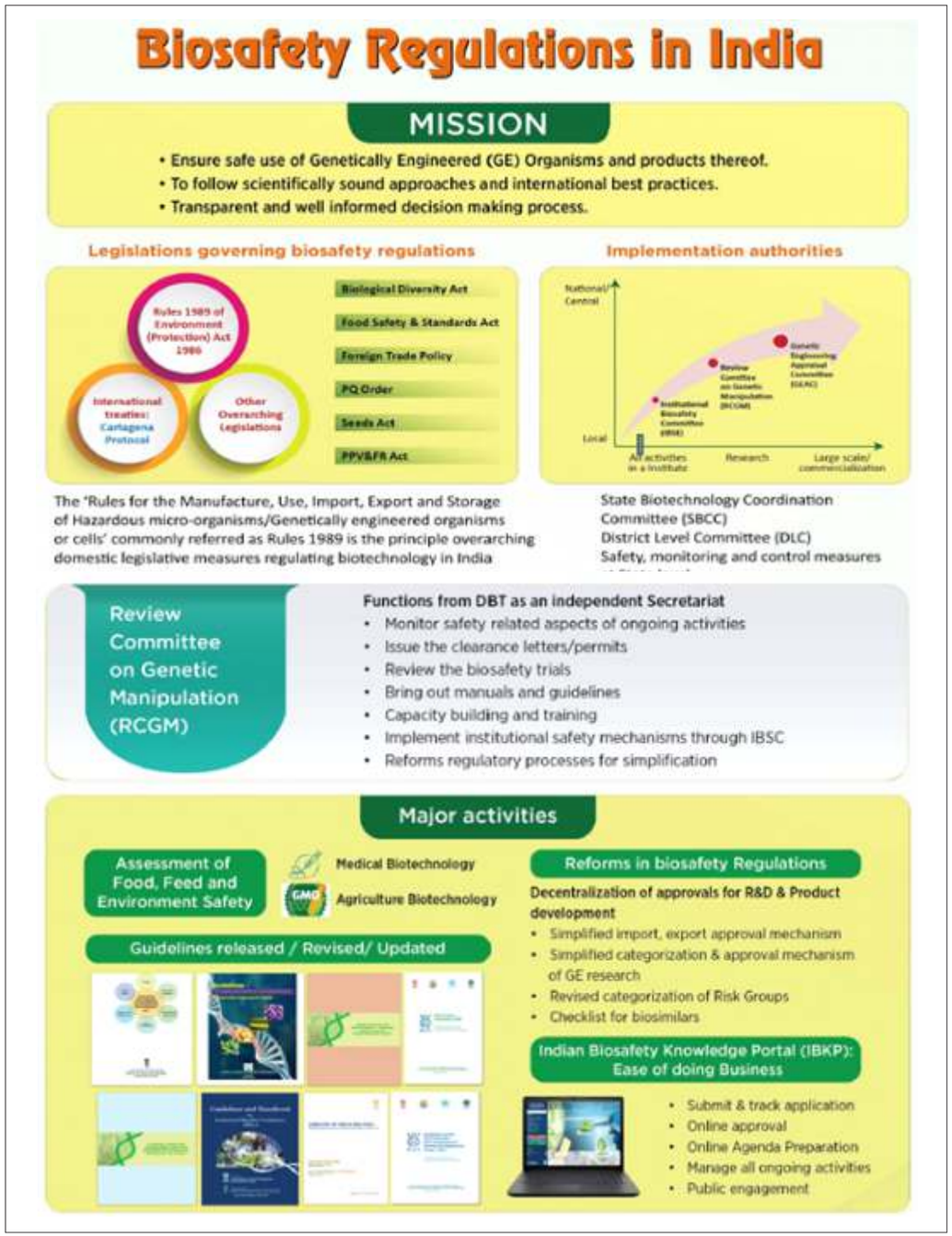
Biotechnology Industry Research Assistant Council (BIRAC)

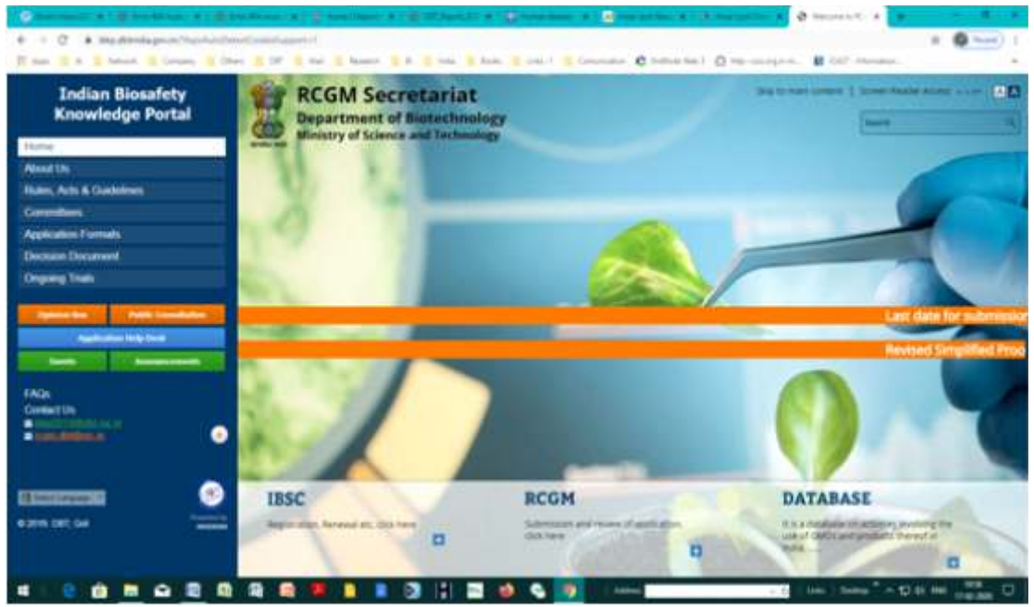
BIRAC since its inception supported 1000+ Startups, Entrepreneurs & SMEs creating Intellectual wealth (185+IP filed) and a robust pipeline of 130+commercialized products and technologies across the country. BIRAC's BioNEST program has supported 45 Bio-incubators creating a total space of 4,85,000+sq. ft that is expected to grow to 50 by Mar 2020. BIRAC is playing is a significant role in improvement of innovation chain and start up ecosystem for affordable product development in the country. The Biotech Start up ecosystem supported by BIRAC is now enriched with 2500+ Biotech Startups in the country. Neurotouch, Smart Scope, Mobile X-ray, SPLAT , MushD+, Sanmitra Hand Cranked Defibrillator, oral nutraceutical, Paratuberculosis Point of care diagnostics, Virtual Reality Goggles and SeeSound App are the new products commercialized during the year.



BIBCOL

1. Turnover of Rs. 83.64 crores
2. Supplied 180.46 million doses of bOPV to Ministry of Health and Family Welfare in a year
3. Manufacturing and marketing
   - Dispersible Zinc Tablet and
   - Diarrhea Treatment Kit
4. BIBCOL is in process of
   - Developing a vaccine candidate like Oral Cholera Vaccine
   - Setting up the facility for production of plasma fractionation facility for production of plasma derived medicines (PDMs) with NII, THSTI and IVI Korea





Foreign Trade, In-House R&D recognition and other issues:

Trade plays an indispensable role and always been a decisive parameter for the growth of country's economy. The Department had fixed and communicated Input/output norms for 04 biotechnological products. Comments on export/import of 06 restricted items were also shared with Directorate General of Foreign Trade (DGFT) to facilitate trade in biotechnology. Incentivize the core research & developmental capabilities of various public and private establishments' remains a major boost for innovation driven industrial growth in the country. Keeping in view of the technical expertise, relevancy & essentiality of the projects, resources & manpower established, intellectual property (IP) generated, and the Department had recommended 19 R&D units of biotechnology firms under in-house R&D unit scheme to Department of Scientific & Industrial Research.

Patent facilitation and Capacity Building:

The Biotechnology Patent Facilitating Cell (BPFC) provides single window awareness-cum-Patent facilitation (examination, filing, maintenance and follow-ups) to scientists and researchers on request for filing of Patent Co-operation Treaty (PCT) and National phase applications on inventions pertaining to Life Sciences and Biotechnology through empaneled IPR firms. US Patent on "A Method for the Control of Nematodes in Plants" has been granted during the year.

Biotechnology Based Programme for Societal Development

Key Activities:

• To promote use of biotechnological processes and tools for the benefit of the community.

• To create platform for self-employment generation among the target population by diffusion of proven and field-tested technologies through demonstration, training and extension activities by supporting projects in various identified area.

Training & Demonstrations/ Scale up activities during the last five years have Benefitted:

Supported Rural Bio-resource centre/ Technology Demonstration Centre in Aspirational Districts

• 9 projects sanctioned in 12 Aspirational districts covering 7 states (Assam, Manipur, Meghalaya, West Bengal, Jharkhand, Odisha and Punjab)

• Benefitting 8000+ farmers in Agriculture and Allied areas

Project Implementation Sites In different States of India