

BIOINFORMATICS DEVELOPMENTS IN INDIA

Since 1990 : An Overview

International Conference on Biological Knowledge Discovery (BKD)

Biotechnology · Bioinformatics · Biomedicine

Muthalammale Arts and Science College, Cuddalore | 15-16th April 2026

Dr T Madhan Mohan

Former Senior Adviser, Dept. of Biotechnology | Ministry of Science & Technology,
Government of India

**35+ years of bioinformatics
innovation in India**

Overview

What I cover today

01

Early Foundations

1960s–1990s: Ramachandran Plot, BTISnet, DBT network

03

Infrastructure

Institutions, funding map, national bioinformatics network

05

Market & Growth

\$486M → \$2.5B market, 18.6% CAGR, industry drivers

07

Emerging Trends

Foundation models, spatial omics, NGS insurance 2025–26

02

Expansion Phase

1990s–2010s: IT boom, institutes, database creation

04

Research Areas

Genomics, AI+Bio, drug discovery, agriculture, environment

06

Breakthroughs

IBDC, Genome India Project, precision medicine milestones

08

Future & Conclusion

AI, quantum, Bio-IT parks, India's global positioning

Early Foundations [1960s–1990s]

India's path from structural biology to a national bioinformatics network



Ramachandran Plot (1963)

G. N. Ramachandran's landmark paper established the rules of protein backbone geometry — India's first contribution to computational structural biology and the seed of modern bioinformatics.

BTISnet (1986–89)

The Department of Biotechnology launched Asia's first national bioinformatics network connecting various institutions. India was among the first countries in the world to build such infrastructure.

Early Databases (1990s)

DBT established Distributed Information Centres (DICs), sequence repositories, and protein databases. M.Sc. Bioinformatics programmes introduced. Supercomputing facilities set up at IIT Delhi (2002).

Expansion Phase [1990s–2010s]

India's IT strength fuels rapid bioinformatics growth

India's IT Boom Fuels Bioinformatics

- Rapid growth driven by global strength in IT and computational sciences
- DBT-funded bioinformatics centres established nationwide
- Research output grew significantly during 2008–2017
- Indigenous bioinformatics software tools developed
- Genome sequencing and national database creation accelerated

2000

IRGS Joined

2002

IIT Delhi Supercomputing

2004

BPI Formulated

2005

BINC Exam Launched

2006

First M.Tech Comp.Bio

2010

NEBInet Established

2013

ASHOKA Hub Launched

2019

Big Data Program DBT

National Bioinformatics Infrastructure [BTISnet]

India's nationwide network spanning Centres of Excellence, DICs, BIF nodes



60+

Research Centres
in BTISnet

22

States & UTs
covered

6

Centres of
Excellence

100+

BIF Nodes
nationwide

1986

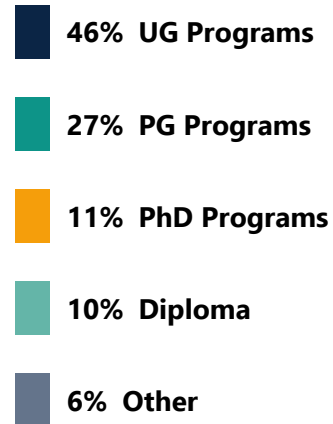
Year BTISnet
was launched

₹500Cr

DBT bioinformatics
funding (est.)

Bioinformatics Education in India

173 institutions · 273 programs across UG, PG, PhD, and diploma levels



BINC

Bioinformatics National certification
exam for professionals

Industry Growth & Market Trends

India's bioinformatics sector: \$486M in 2024 growing to \$2.5B by 2033

\$486M

Market Size 2024

18.6%

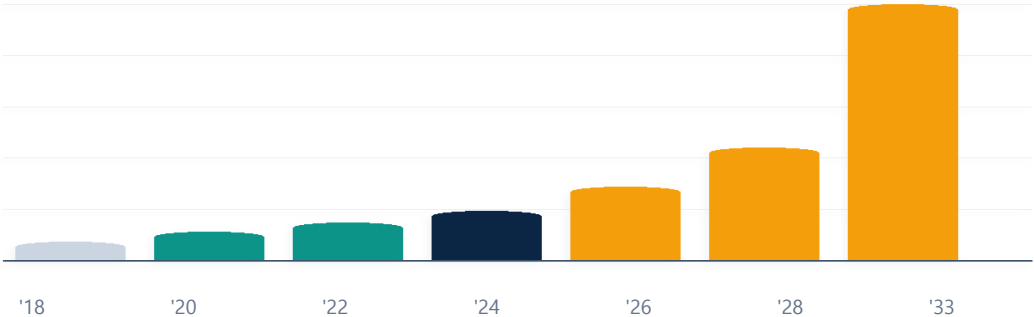
Annual CAGR

\$2.5B

Projected 2033

#3

Asia-Pacific Rank



Big Data & Cloud

Scalable genomic analysis across research institutions

AI Drug Discovery

Faster, cheaper target identification pipelines

Genomics Healthcare

Personalised medicine & rare disease diagnosis at scale

Biotech Startup Boom

350+ startups integrating AI-bioinformatics platforms

Recent Breakthroughs: Indian Biological Data Centre (IBDC)

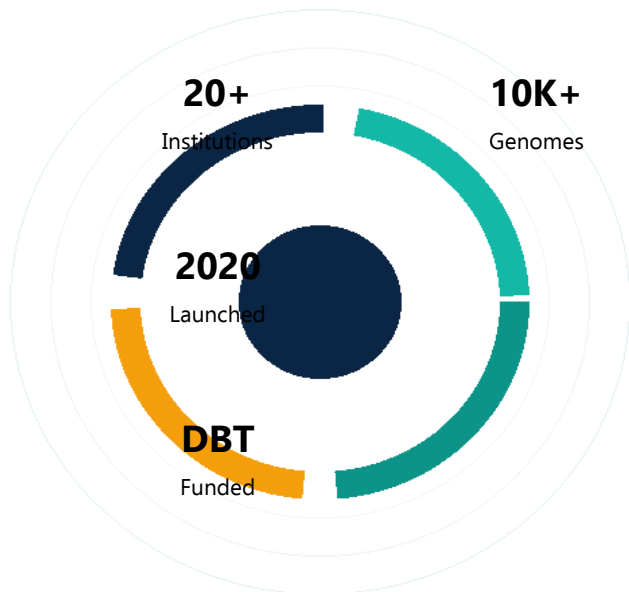
India's first national repository for all life science data

India's First National Life Science Data Repository

- First national repository for all life science data generated in India
- Supported by Government of India through DBT; hosted at RCB, Faridabad
- Built in collaboration with NII, ICGEB and National Informatics Centre (NIC)
- Modular design — separate sections for genomics, proteomics, transcriptomics
- Promotes FAIR data principles: Findable, Accessible, Interoperable, Reusable
- Will serve as the primary repository for all India-origin life science data

The Genome India Project (GIP)

Mapping the complete genetic diversity of 1.4 billion people



□ Indian Reference Genome

- Build a comprehensive database of genetic variation unique to India's diverse population groups

□ Enable Precision Medicine

- Tailor treatments based on each patient's specific genetic makeup, ancestral group, and regional variants

□ Study Disease Patterns

- Identify genetic links to diabetes, cancer, and rare disorders prevalent in Indian sub-populations

□ Boost Biotech Research

- Strengthen India's capabilities in genomics, computational biology, and personalised healthcare infrastructure

Key Application Areas

Bioinformatics driving impact across healthcare, drug discovery, agriculture & environment

🔍 Healthcare

- Cancer genomics & tumour profiling
- Personalized/precision medicine
- Disease outbreak prediction & surveillance
- Rare disease genetic diagnosis

🔍 Drug Discovery

- AI-based drug design & virtual screening
- Computational drug repurposing
- Target identification via proteomics
- Clinical trial optimization using ML

🔍 Agriculture

- Crop genome analysis for yield improvement
- Livestock genetic improvement programs
- Biofortification & climate-resilient crops
- Plant disease resistance genomics

🔍 Environment

- Microbiome profiling & diversity studies
- Biodiversity conservation genomics
- Metagenomics of soil & water ecosystems
- Climate change impact on genomes

India's Unmatched Advantage in Bioinformatics & Omics

Talent, scale, cost-efficiency, and an expanding innovation ecosystem



Deep Talent Pool

Universities and research institutes consistently produce bioinformaticians, computational biologists, and data scientists comfortable with multi-omics, ML, and drug discovery workflows.



Scalable Expertise at Competitive Cost

India's combination of skilled manpower and cost efficiency gives global pharma the ability to scale innovation without escalating budgets



Growing Innovation Ecosystem

Startups, CROs, and government initiatives (BIO-GRID, CALIBRE, Bio-IT Parks, GenomeIndia) provide a fertile ecosystem for collaboration, talent sourcing, rapid innovation, and IP creation.

Major Funding Opportunities

National and International programmes

Dept. of Biotechnology (DBT)

BTISnet, CALIBRE, BIO-GRID, Genome India, IBDC, BINC exam, and core bioinformatics infrastructure grants.

ICMR

Biomedical genomics, health data science, clinical omics, precision medicine, and translational research.

BIRAC -BIG Scheme (DBT)

Biotechnology Ignition Grant — up to ₹50 Lakhs for early-stage biotech and bioinformatics innovation.

Dept. of Science & Technology (DST)

SERB grants, National Supercomputing Mission (NSM), quantum biology, and AI-biology frontier research.

CSIR

Applied genomics, bioprospecting, crop bioinformatics, metagenomics, and biodiversity conservation.

International (NIH / Wellcome)

Indo-US, Indo-UK, BRICS collaborative programs for genomics, drug discovery, and precision medicine.

Future Directions for India's Bioinformatics Sector

AI, quantum computing, wearables, and workforce expansion

AI, ML & Foundation Models



Large language models for protein design, drug discovery, and genomics interpretation.

Quantum Biology



Quantum computing for molecular simulation, drug-target interaction, and pipeline optimization.

Blockchain for Genomic Data



Immutable, patient-controlled genomic data ownership and cross-border sharing.

Bio-IT Parks & Missions



Expansion of precision medicine databases and collaborative Bio-IT park infrastructure.

Wearables + Genomics



Wearable health data integrated with personal genomic profiles for real-time wellness.

Workforce Expansion



Rising demand for bioinformaticians, computational biologists, and AI-biology specialists.

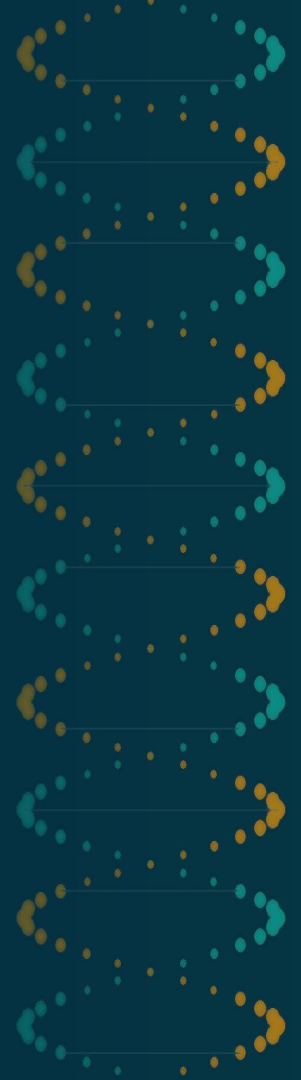
CONCLUSION

Bioinformatics in India has progressed from
foundational theoretical work → national infrastructure → AI-driven genomic innovation

- Plays a crucial role in healthcare, agriculture, and biotechnology
- AI, foundation models, and multi-omics are the defining frontiers of 2025–2026
- India is uniquely positioned — talent, scale, diversity, and cost advantage
- Poised to be a major contributor to global bioinformatics and precision medicine

THANK YOU

Dr T Madhan Mohan



Major Research Areas

From genomics and AI to agriculture and environmental science

□ Genomics & Precision Medicine

- Bharat Cancer Genome Atlas (BCGA) launched
- Personalized treatment databases
- Indian population genomics reference

□ AI + Bioinformatics

- CALIBRE initiative for AI-biology integration
- AI & quantum for mutation detection
- Deep learning for protein structure

□ Biodiversity & Genomics

- DNA barcoding for species identification
- Microbiome diversity studies
- Conservation genomics programs

□ Drug Discovery

- Computational drug repurposing pipelines
- AI-based virtual screening
- In-silico target identification

□ Agriculture

- Crop genome analysis for yield
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□ Environmental Science

- Metagenomics of soil & water
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