Genome India Project

Posted at: 10/01/2025

Genome India Project: A Landmark in India's Biotechnology Revolution

Context : Prime Minister Narendra Modi has announced the successful completion of the **Genome India Project**, describing it as a major milestone in India's biotechnology sector. Speaking via a video message at the **Genomics Data Conclave**, organized by the **Department of Biotechnology**, the Prime Minister also unveiled a sequencing database of **10,000 Indian genomes**, which will be accessible through the **Indian Biological Data Centre (IBDC)**.

This project is a significant step towards understanding India's vast genetic diversity and addressing pressing healthcare challenges through precision medicine.

What is Genome Sequencing?

Human Genome

1. The **human genome** is the complete set of **DNA** in the nucleus of every cell in the human body.
2. It carries all the genetic information necessary for the development and functioning of an organism.
3. DNA is composed of **four bases**:
    - **Adenine (A)**
    - **Thymine (T)**
    - **Cytosine (C)**
    - **Guanine (G)**
4. These bases form approximately **3.05 billion base pairs**, structured in a double helix.

Genome Sequencing Process

- **Genome sequencing** determines the precise order of these base pairs, revealing the unique genetic makeup of an individual.
- While human genomes are largely similar, small variations account for individuality and susceptibility to diseases.
- The most common method, **Next-Generation Sequencing (NGS)**, is known for its speed, accuracy, and cost-effectiveness.

What is the Genome India Project?

Overview

- Approved in **2020**, the project aims to **sequence the genomes of over 10,000 Indians** across diverse regions and ethnicities.
- Sanctioned by the **Department of Biotechnology**, it will create a **reference genome** for India's population.

Significance

1. **Identifying Unique Genetic Traits**
    - India's population of **1.4 billion** includes over **4,600 distinct population groups**, many of which are **endogamous**.
    - This genetic diversity is a treasure trove for research and innovation.
2. **Understanding Disease Susceptibility**
    - The project enables researchers to study genetic risk factors for chronic diseases like:
        - **Diabetes**
        - **Hypertension**
        - **Cancer**
        - **Neurodegenerative disorders**
3. **Personalized Medicine and Drug Development**
    - Insights from this project will help design therapies and medications specifically tailored to the Indian population.

How Does Genetic Research Benefit India?

1. Understanding Genetic Risk Factors

- Specific genetic mutations prevalent in India can inform preventive measures:
    - The **MYBPC3 mutation**, linked to early cardiac arrest, affects **4.5%** of Indians but is rare globally.
    - The **LAMB3 mutation**, causing a fatal skin condition, affects **4%** of a population near Madurai but is absent in global databases.

2. Developing Targeted Treatments

- Genome data enables:
    - Creation of **mRNA vaccines** for conditions like **pancreatic cancer**.
    - Development of therapies for rare genetic disorders specific to Indian populations.

3. Enhancing Drug Efficacy and Safety

- Genetic studies can identify resistance-indicating variants to improve treatment outcomes.
- Example: Some members of the **Vaishya community** in South India lack a gene essential for processing anaesthetics, necessitating alternative drugs.

Key Data on Genome India Project

1. **Database Creation:**
    - The genomes of **10,000 Indians** from **99 distinct populations** have been sequenced.
    - Data storage: **8 petabytes** at the **Indian Biological Data Centre (IBDC)**.
2. **Data Access and Security:**
    - **Managed Access:** Only approved researchers from partner institutes can access the data.
    - **Anonymisation:** Genetic data is encrypted to ensure privacy and prevent identity breaches.

Conclusion

The **Genome India Project** marks a transformative moment in India's scientific and healthcare landscape. By decoding the genetic blueprint of India's diverse population, this initiative will:

- Propel advancements in **personalized medicine**.
- Address **genetic disorders and chronic diseases** effectively.
- Strengthen India's position in the global **biotechnology and biopharma sectors**.

This groundbreaking achievement is a testament to India's scientific prowess and its commitment to leveraging cutting-edge technology for the well-being of its people.