Indigen project

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Manifest pedagogy: Genetics and biotechnology are such areas from which we can expect decent number of conceptual questions in Prelims and generalist questions in Mains. This is area would fetch sure shot marks with little preparation. Hence, we advice aspirants to prepare this section well.

In news: The Council of Scientific and Industrial Research (CSIR) recently announced the conclusion of a six-month exercise of conducting a "whole-genome sequence" of 1,008 Indians.

Placing it in syllabus: S&T developments

Static dimensions:

- What is Gene Sequencing?
- Gene Sequencing projects across world

Current dimensions:

- India's Indigen project and other projects
- Prospects of gene Sequencing
- Issues with gene sequencing

Content:

What is Gene Sequencing?

- A **genome is the DNA or sequence of genes** in a cell.
- Most of the DNA is in the nucleus and intricately coiled into a structure called the **chromosome**.
- **Every human cell contains a pair of chromosomes,** each of which has three billion base pairs or one of **four molecules that pair** in precise ways
- The **order of base pairs and varying lengths** of these

sequences constitute the “genes”.

- **Sequencing a genome means deciphering the exact order of base pairs in an individual.**
- It has been known that the portion of the **genes responsible for making proteins** called the **exome** occupies about 1% of the actual gene.
- The **genome has to be mapped in its entirety** to know which genes of a person’s DNA are “mutated”.

Gene Sequencing projects across world:

- The UK was the first to launch a program called **Genomics England** which aims to sequence up to **100,000 whole genomes from patients with rare diseases,** their families, and cancer patients.
- **Australia** is working on the **4-year 100,000 Genomes Project,** sequencing patients with rare diseases and cancer to create a massive database for R&D.
- **Estonian Genome Project Foundation** collected data from 52,000 adult donors by February 2014 and in March, 2019 has offered a further 100,000 people free genetic testing.
- In the **USA, the Precision Medicine Initiative (PMI),** with its 1-million-volunteer health study, is gathering a large database of health data including genetics and lifestyle factors. The **Mayo Clinic** (American non-profit academic medical center) will **analyze and store one million blood and DNA samples.**
- In 2016, France announced the “**France Médecine Génomique 2025**” program, aiming to open 12 sequencing centers and ensure 235,000 whole genome sequencing (WGS) a year which can be used as diagnostics tool.
- The **non-profit consortium GenomeAsia 100K** decided to generate **genomic data for Asian populations. Supporters** of the initiative include genomics companies **Macrogen in Korea and MedGenome in India, as well as Illumina.**
- The **Qatar Genome Program** aims to establish the Qatari

Reference Genome Map by sequencing 3,000 whole genomes, which accounts for around 1% of the Qatari population.

- In 2010, the **BGI genomics institute in Shenzhen**, China hosted a higher sequencing program which aims at sequencing one million human genomes and will include subgroups of 50,000 people, each with specific conditions such as cancer or metabolic disease.

India's Indigen project and other projects:

- The CSIR project is part of a programme called "**IndiGen**".
- Though **CSIR first sequenced** an Indian genome **in 2009**, only now it has been able to scale up whole-genome sequencing and offer them to the public.
- The driving **motive** of the project is to **understand the extent of genetic variation in Indians,** and **learn why some genes linked to certain diseases** based on publications in international literature **does not always translate into disease.**
- Under "IndiGen", the CSIR drafted about **1,000 youth** from a pool of about 5,000 and included **representatives from every State and diverse ethnicities.**
- Every person whose genomes are sequenced would be **given a report.**
- The **participants would be informed if they carry gene variants that make them less responsive** to certain classes of medicines.
- The project involved the Hyderabad-based **Centre for Cellular and Molecular Biology** (CCMB), the **CSIR-Institute of Genomics and Integrative Biology** (IGIB).
- The project **ties in with** a much larger programme **Genome India project,**

Genome India project:

- It is **funded by the Department of Biotechnology (DBT)** to sequence at least 10,000 Indian genomes.

- **22 partner organisations including public health institutions will be rope**d in that have obtained regulatory ethical clearances.
- Investigators in hospitals will lead the **data collection through a simple blood test** from participants and the **information** will be **added to bio banks.**

- The project will **aim to make predictive diagnostic markers available for some priority diseases** such as cancer and other rare and genetic disorders.
- The department has also initiated an **outreach programme to provide genetic diagnosis and counselling to families** affected by common genetic disorders in certain districts.

Medgenome project:

- **Sequoia-backed MedGenome, a start-up** is planning to fund its own research in the area of **DNA sequencing and precision medicine,** with an aim to licence the findings to biotechnology firms and drug makers.
- Launched in 2013, **San Francisco- and Bengaluru-based MedGenome Labs Pvt. Ltd** has a network of Next Generation Sequencing (NGS) laboratories in India, Singapore and the US.
- Its **research is in four main areas:** cancer immunotherapy, inherited diseases, diabetes and ophthalmology.
- About **70% of the company's revenue** is earned from **project-based research** mainly for US-based pharmaceutical clients, while the **rest is from consumer diagnostic tests in Asia.**
- Its labs combine **state-of-the-art testing equipments and powerful computers to perform DNA sequencing** that is used for a wide variety of **purposes such as** biomarker discovery, drug research and new market discovery.

Prospects of gene Sequencing:

- Determining unique **genetic traits, susceptibility and resilience to diseases.**
- For new advancements in medical science like **predictive diagnosis and precision medicine,** genomic information is the backbone.
- The technique has allowed drug makers to come up with **medicines that work on a select group of individuals based on similar genetic makeup**, as against generic drugs used with little success so far.
- With the help of DNA sequencing, healthcare practitioners are using the new technique called **cancer immunotherapy** to treat cancer where the patient's genes are altered to help his or her immune system fight cancer cells.
- The common **early onset disorders with "complex" inheritance** like asthma, type-1 diabetes mellitus, and the epilepsies and behavioural phenotypes of autism and attention deficit hyperactivity disorder can **be understood.**

Issues with gene sequencing:

- **Synthetic human genome** could be created which will be **against the law of nature.**
- Morality of eugenics, which is the theory and practice of improving the genetic quality of the human population.
- Danger of **genetic misuse.**
- **Biosafety and biosecurity concerns related to implications of technology.**
- Selection of genes for specific traits might **change the dynamics of genes and alter the ecological balance.**
- Agencies that fund large genomic initiatives have tended to **treat the data these projects produce as a community resource to be made publicly available** before thorough analysis by the consortia that generate them which

violates privacy.

- The **inability to anticipate the types of benefits and risks associated with future research** using donated biological materials raises major ethical worries.
- By its very nature, a fully or partially sequenced individual genome can reveal **information about** genetically based or -contributed **characteristics that is unknown to the participant.**
- Where targeted populations comprise organized cultural entities like different tribes consultation demonstrates respect for the moral authority of those communities. **Community consultation or engagement, however, should not be mistaken for community consent** nor does every medical-sequencing project or every population warrant advance consultation.