DNA Profiling in the Justice System

For Prelims: Deoxyribonucleic acid (DNA), DNA Profiling, Monozygotic twins, Law Commission of India, Article 20(3), Bharatiya Nagarik Suraksha Sanhita (BNSS) 2023

For Mains: DNA Profiling and challenges, Application of Emerging Technologies in the Judicial System

Source: TH

Why in News?

The June 2024 Madras High Court decision to overturn a Protection of Children from Sexual Offences (POCSO) Act, 2012 conviction has reignited debate on the reliability of Deoxyribonucleic acid (DNA) profiling in legal cases.

- The court stressed the importance of not relying solely on DNA evidence for convictions, highlighting the need for corroborating evidence.

What is DNA profiling?

- **About:** DNA profiling, or **DNA fingerprinting,** identifies individuals by analysing unique regions of their DNA. While **human DNA is 99.9% identical**, the remaining 0.1% includes unique sequences called **Short Tandem Repeats (STRs),** which are crucial for forensic investigations.
- **DNA as Genetic Code:** DNA is the genetic material found in the **nucleus of eukaryotic cells (animal and plant)** and the cytoplasm of prokaryotic cells (bacteria). It is structured as a **double helix**.
    - It is **organised into 23 pairs of chromosomes**, which are inherited equally from both parents, which encode genetic information in **sequences of four nucleotides called Adenine (A), Guanine (G), Thymine (T), and Cytosine (C).**
    - DNA can be extracted from various biological materials such as blood, saliva, semen, and other body fluids. These samples are collected and analysed to generate a DNA profile.
        - DNA left behind during physical contact, **known as touch DNA**, is often in low quantities and not ideal for profiling due to potential contamination.
    - **DNA profiling focuses on specific regions** called genetic markers, with **STRs** being the preferred markers due to their variability among individuals, **except monozygotic twins (identical twins).**
- **Process of DNA Profiling:**
    - **Isolation:** Extracting DNA from the collected biological samples.
    - **Purification & Quantitation:** Ensuring the DNA is free from contaminants and determining its concentration.
    - **Amplification:** Replicating selected genetic markers to generate enough DNA for analysis.

- **Visualization & Genotyping:** Identifying the specific sequences of the DNA markers.
- **Statistical Analysis & Interpretation:** Comparing the DNA profiles and calculating the probability of a match.
- **Special Cases:**
    - In cases involving degraded samples, **miniSTRs (smaller DNA fragments)** may be used as they are more likely to survive environmental stress.
      Additionally, **mitochondrial DNA (mtDNA)** is useful for tracing maternal lineage and is often employed when nuclear DNA is insufficient.

How is DNA Profiling Used in Legal Proceedings?

- **Matching Process:** In forensic cases, DNA profiles from evidence are compared with known or reference samples. The results of this comparison can lead to three possible outcomes:
    - **Match:** The DNA profiles are indistinguishable, suggesting a common source.
    - **Exclusion:** The profiles differ, indicating different sources.
    - **Inconclusive:** The data does not provide a clear result.
- **Statistical Support:** Even if profiles match, **this does not conclusively prove identity;** instead, experts **provide a "random occurrence ratio"** indicating how often similar profiles may appear in the population.
- **Legal Interpretation:** The Madras High Court and the **Law Commission of India** have highlighted that a **DNA match does not conclusively prove identity.**
    - The "**random occurrence ratio**" indicates how frequently a particular DNA profile might appear in the population, which **may not be sufficient to establish guilt beyond a reasonable doubt.**

What are the Legal Provisions Regarding DNA Profiling in India?

- **Legal Framework:**
    - **Indian Constitution: Article 20(3)** protects individuals from being forced to testify against themselves, ensuring **protection against self-incrimination.**
        - **Article 21** safeguards the right to life and personal liberty, prohibiting unauthorised interference.
    - **Code of Criminal Procedure, 1973 (CrPC):** Section 53 authorises DNA profiling of suspects at the investigation agency's request. **Section 53A specifically allows DNA profiling for rape suspects.**
        - The **Bharatiya Nagarik Suraksha Sanhita (BNSS) 2023** replaced the Code of Criminal Procedure (CrPC) of 1973.
    - **Indian Evidence Act, 1872: Sections 45-51 pertains to the admissibility of expert testimony, including DNA evidence, in court.**
- **Judicial Precedents:**
    - ***Pattu Rajan v. State of T.N. 2019:*** **Supreme Court** considered that the **probative value of DNA evidence varies depending on the facts and circumstances of the case,** and the weight accorded to other evidence on record, whether contrary or corroborative.
        - **They emphasised that DNA evidence, though increasingly accurate and reliable, is not infallible, and the absence of such evidence should not lead to an adverse inference against a party, especially in the presence of other cogent and reliable evidence.**
    - ***Sharda vs. Dharmpal, 2003*:** The Supreme Court upheld the authority of marital courts to **mandate medical examinations including DNA profiling,** without violating Article 21.

- ***Das @ Anu v. State of Kerala, 2022:*** The Kerala High Court held that the right against self-incrimination under **Article 20(3) applies only to testimonial evidence**, and drawing DNA samples in a criminal case, **especially a sexual offence, does not violate this right.**
    - The court also noted that Section 53A of the CrPC empowers the police to send the accused to a medical practitioner for collecting samples.
- **Law Commission Recommendations:**
    - The **271st report (2017) by the Indian Law Commission** proposed comprehensive legislation for DNA profiling, leading to the **DNA Technology (Use and Application) Regulation Bill, 2019.** Urged for a unique regulatory framework to prevent misuse and restrict DNA profiling to legal uses only.

What are the Limitations of DNA Profiling?

- **Environmental Stress and Sample Degradation:** DNA can be compromised by **environmental factors, leading to incomplete or degraded samples.**
    - Techniques like **miniSTRs and mtDNA analysis are used in these cases**, but they still come with limitations.
- **Complexity and Reliability:** DNA profiling is a complex process that requires precise techniques and conditions. Issues such as **contamination, improper handling, or delays in testing can affect the reliability of the results.**
- **Cost:** DNA analysis can be **expensive, limiting its accessibility in some cases.**
- **Legal Interpretation:** While DNA evidence is a powerful tool, it should not be viewed as infallible (always effective). Courts must consider DNA evidence alongside other corroborating or contradicting evidence to ensure a fair and just verdict.
    - The existing legal framework recognizes DNA evidence but lacks a **comprehensive regulatory structure.**
    - The **DNA Technology (Use and Application) Regulation Bill, 2019**, aims to address these gaps. The DNA Bill, introduced in **Parliament** multiple times, faced opposition on grounds of the accuracy of DNA technology, potential threats to individual privacy, and the possibility of abuse.

Way Forward

- **Enhancing Accuracy and Reliability**: Invest in research and development to improve DNA profiling techniques and address issues related to sample degradation and contamination. Standardise procedures and ensure quality control in forensic labs.
- **Ensuring Fair Legal Practices:** Emphasise the importance of corroborating evidence in convictions. Develop guidelines for the admissibility and weight of DNA evidence in court to ensure just and fair outcomes.
- **DNA Technology Bill:** The DNA Technology Bill, 2019, aims to create a regulatory framework to **prevent misuse and ensure DNA profiling is used appropriately**. This bill needs to be revisited and potentially revised to address privacy concerns and ensure robust safeguards.
- **Transparency in Legal Processes:** Ensure transparency in how DNA evidence is collected, analysed, and presented in court to maintain public confidence.

Drishti Mains Question:

Q. What are the potential issues with relying solely on DNA Profiling for convictions, and how can these issues be mitigated to ensure justice in the judicial process?

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. Consider the following statements: DNA Barcoding can be a tool to:(2022)

1. assess the age of a plant or animal.
2. distinguish among species that look alike.
3. identify undesirable animal or plant materials in processed foods.

Which of the statements given above is/are correct?

(a) 1 only

(b) 3 only

(c) 1 and 2

(d) 2 and 3

Ans: (B)

Q: With reference to the recent developments in science, which one of the following statements is not correct? (2019)

(a) Functional chromosomes can be created by joining segments of DNA taken from cells of different species.

(b) Pieces of artificial functional DNA can be created in laboratories.

(c) A piece of DNA taken out from an animal cell can be made to replicate outside a living cell in a laboratory.

(d) Cells taken out from plants and animals can be made to undergo cell division in laboratory petri dishes.

Ans: (A)