



# 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. Dharmपाल, 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 **271<sup>st</sup> 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)**