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DNA Profiling as Forensic Evidence in Criminal Trials: Legal Challenges and Judicial Trends in India

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ABSTRACT: DNA profiling has emerged as one of the most reliable and scientifically advanced techniques in forensic investigation, significantly transforming the administration of criminal justice across the world. In India, the use of DNA evidence has gained increasing importance in criminal trials involving serious offenses such as murder, rape, kidnapping, terrorism, and identification of unknown persons. DNA profiling assists investigating agencies in establishing the identity of offenders and victims with a high degree of accuracy, thereby strengthening the evidentiary framework of criminal proceedings. The growing acceptance of forensic science in courts reflects the judiciary's recognition of the need for scientific methods in ensuring fair and effective justice delivery. Despite its scientific reliability, the use of DNA profiling in criminal trials raises several legal, ethical, and procedural challenges. One of the major concerns relates to the admissibility and evidentiary value of DNA evidence under the provisions of the Indian Evidence Act, 1872. Courts are often required to determine whether DNA reports have been obtained through lawful procedures and whether the chain of custody of biological samples has been properly maintained. Any procedural irregularity may affect the credibility of such evidence. Furthermore, issues relating to privacy, consent, and the collection of biological samples have become increasingly significant, particularly in light of the constitutional recognition of the right to privacy by the Supreme Court of India.

KEYWORDS: DNA Profiling, Forensic Evidence, Criminal Trials, Forensic Science, DNA Technology.

I. INTRODUCTION

The advancement of science and technology has significantly transformed the criminal justice system across the world. Among the various scientific tools used in criminal investigations, DNA profiling has emerged as one of the most reliable and powerful methods for identifying individuals and establishing connections between suspects, victims, and crime scenes. DNA (Deoxyribonucleic Acid) is the genetic material present in almost every cell of the human body and contains unique genetic information that distinguishes one individual from another, except in the case of identical twins. The uniqueness and accuracy of DNA analysis have made it an essential forensic tool in modern criminal investigations and judicial proceedings.

The use of DNA profiling in criminal justice began in the mid-1980s when British geneticist Sir Alec Jeffreys developed a technique for identifying individuals through their genetic patterns. Since then, DNA evidence has revolutionized forensic science by providing highly accurate methods for identifying perpetrators, exonerating innocent individuals, and resolving complex criminal cases. DNA samples can be obtained from biological materials such as blood, hair, saliva, semen, skin cells, bones, and other bodily tissues found at crime scenes. Through scientific analysis, these samples can be compared with those of suspects or victims, enabling investigators to establish crucial links in criminal cases.

In India, the growing dependence on scientific evidence has led to the increasing use of DNA profiling in criminal investigations. Traditionally, criminal trials relied heavily on eyewitness testimony, confessions, circumstantial evidence, and documentary proof. However, these forms of evidence are often susceptible to errors, manipulation, memory lapses, or coercion. DNA evidence, on the other hand, offers a more objective and scientifically verifiable method of establishing facts. Consequently, courts in India have increasingly recognized the evidentiary value of DNA profiling, particularly in cases involving murder, rape, sexual assault, kidnapping, paternity disputes, unidentified bodies, and other serious offences. The legal foundation for the admissibility of DNA evidence in India is primarily derived from the Indian



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Evidence Act, 1872, particularly the provisions relating to expert opinions. Section 45 of the Act permits courts to consider the opinions of experts in scientific matters, including forensic science. Additionally, the Criminal Procedure Code (CrPC) and various judicial pronouncements have facilitated the use of DNA testing during criminal investigations. Over time, Indian courts have accepted DNA evidence as a valuable form of scientific proof, often treating it as highly persuasive when supported by proper procedures and expert testimony.

Despite its scientific reliability, the use of DNA profiling in criminal trials raises several legal, ethical, and constitutional concerns. One of the primary challenges relates to the collection and storage of genetic information. DNA contains highly sensitive personal data that can reveal not only an individual's identity but also information about family relationships, hereditary traits, and medical conditions. The collection and retention of such information raise important questions regarding the right to privacy, data protection, and individual autonomy. Following the recognition of privacy as a fundamental right by the Supreme Court of India in the landmark case of Justice K.S. Puttaswamy v. Union of India (2017), concerns regarding the regulation and protection of genetic data have become increasingly significant. Another major legal challenge concerns the absence of a comprehensive legislative framework governing DNA profiling in India. Although DNA evidence is widely used in criminal investigations, the country has long lacked a dedicated law regulating the collection, storage, analysis, and use of DNA data. This legal gap has generated concerns about misuse, unauthorized access, contamination of samples, procedural irregularities, and potential violations of constitutional rights. To address these issues, the government has proposed legislation such as the DNA Technology (Use and Application) Regulation Bill, aimed at establishing standards for DNA testing and creating DNA data banks. However, debates continue regarding the adequacy of safeguards for privacy and civil liberties.

The admissibility and reliability of DNA evidence also depend heavily on the maintenance of proper scientific procedures. Errors in sample collection, handling, transportation, storage, and laboratory analysis can compromise the integrity of DNA evidence. Issues such as contamination, chain-of-custody violations, and laboratory negligence may affect the accuracy of results and undermine the fairness of criminal trials. Therefore, courts must carefully evaluate the reliability of DNA evidence and ensure that established forensic protocols are strictly followed before accepting such evidence as conclusive proof. Judicial interpretation has played a crucial role in shaping the use of DNA profiling in India. The Indian judiciary has delivered numerous judgments addressing the admissibility, evidentiary value, and constitutional implications of DNA testing. In cases such as Kamti Devi v. Poshni Ram, Banarsi Dass v. Teeku Dutta, Bhabani Prasad Jena v. Convenor Secretary, Orissa State Commission for Women, and Selvi v. State of Karnataka, courts have examined the balance between scientific evidence and individual rights. These decisions reflect the evolving judicial approach toward DNA evidence and highlight the need to reconcile technological advancements with constitutional protections.

Recent judicial trends indicate a growing acceptance of DNA profiling as a reliable source of evidence in criminal trials. Courts have increasingly relied upon DNA reports to corroborate other evidence and strengthen prosecution cases. At the same time, judges have emphasized the importance of procedural safeguards, informed consent, and protection of privacy rights. The judiciary's evolving approach demonstrates an effort to balance the interests of effective law enforcement with the protection of individual liberties in a democratic society governed by the rule of law.

II. LITERATURE REVIEW

DNA profiling has emerged as one of the most reliable scientific techniques used in criminal investigations for identifying offenders, establishing victim identity, and linking suspects to crime scenes. Since its introduction into the Indian legal system in the late 1980s, DNA evidence has significantly influenced criminal adjudication. However, despite its scientific accuracy, the use of DNA profiling in criminal trials has generated several legal, ethical, and constitutional concerns. Existing literature highlights the growing judicial reliance on DNA evidence while simultaneously emphasizing challenges related to admissibility, privacy, procedural safeguards, and the absence of a comprehensive regulatory framework. One of the earliest comprehensive studies on DNA evidence in India was conducted by researchers examining the legal status of DNA profiling within the Indian judicial system. The study observed that DNA fingerprinting has become an important forensic tool for both civil and criminal cases. However, the authors argued that DNA evidence should not be treated as conclusive proof of guilt and must be corroborated by other forms of evidence. The research further highlighted the absence of a dedicated legal framework governing DNA profiling and stressed the need for legislative intervention to regulate the collection, storage, and use of genetic information. Subsequent studies have explored the role of DNA evidence in strengthening the criminal justice system. Researchers have noted that forensic science provides objective and scientific proof that can assist courts in reaching accurate decisions. DNA profiling has



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been particularly useful in cases involving sexual offences, homicide, terrorism, and identification of unidentified bodies. Literature suggests that DNA technology has improved conviction rates by reducing dependence on eyewitness testimony, which is often unreliable. At the same time, scholars emphasize that the effectiveness of DNA evidence depends upon proper collection, preservation, transportation, and laboratory analysis of biological samples. Any procedural lapse can compromise evidentiary value and lead to wrongful conclusions.

A significant body of literature focuses on the legislative aspects of DNA profiling in India. Researchers have critically examined the proposed DNA Technology (Use and Application) Bill and its subsequent versions. These studies recognize the necessity of a statutory framework for regulating DNA databases and forensic laboratories. However, concerns have been raised regarding the broad powers granted to authorities for collecting DNA samples and maintaining DNA databanks. Scholars argue that without adequate safeguards, such measures may violate constitutional rights relating to privacy and personal liberty. The literature frequently refers to the need for balancing crime investigation requirements with the protection of individual rights. Judicial trends in India demonstrate an increasing acceptance of DNA evidence. Several studies analyzing court decisions reveal that Indian courts initially adopted a cautious approach towards scientific evidence. Over time, however, courts have increasingly recognized DNA profiling as a valuable forensic tool. Landmark judgments such as *Krishna Kumar Malik v. State of Haryana* and *Mukesh v. State (NCT of Delhi)* have reinforced the evidentiary significance of DNA analysis in criminal trials. Scholars observe that these decisions reflect a transition from skepticism to greater judicial confidence in forensic science. Nevertheless, courts continue to emphasize the importance of maintaining proper chain of custody and ensuring procedural compliance before accepting DNA evidence.

III. MATERIAL AND METHODS

1. Research Design

The present study adopts a doctrinal and analytical legal research methodology to examine the role of DNA profiling as forensic evidence in criminal trials in India.

- The research focuses on analyzing statutory provisions, judicial decisions, constitutional principles, and legal challenges associated with the use of DNA evidence in criminal investigations and prosecutions. Since the study primarily deals with legal doctrines and judicial interpretations, a qualitative research approach has been employed.
- The doctrinal method is appropriate because it enables a systematic examination of laws, judicial precedents, and legal principles governing DNA profiling. The study also incorporates a comparative analysis of selected judicial decisions to identify emerging trends in the acceptance and evaluation of DNA evidence by Indian courts.

2. Nature of Research

The research is descriptive, analytical, and exploratory in nature.

- Descriptive, because it explains the concept of DNA profiling and its application in criminal justice.
- Analytical, because it evaluates legal provisions and judicial approaches regarding the admissibility and reliability of DNA evidence.
- Exploratory, because it investigates emerging legal challenges relating to privacy, consent, evidentiary value, and technological limitations.

The study seeks to understand how Indian courts have responded to scientific advancements in forensic technology and how DNA evidence influences criminal adjudication.

3. Sources of Data

The study is based entirely on secondary sources of data. No field surveys, interviews, or laboratory experiments were conducted.

4. Method of Data Collection

The data for the study was collected through library-based and online legal research. Relevant statutes, case laws, journal articles, and reports were identified and reviewed systematically.

- The process of data collection involved:
 - Identification of legal provisions governing forensic evidence.
 - Collection of landmark judicial decisions relating to DNA profiling.
 - Review of academic literature discussing scientific reliability and legal implications.
 - Examination of constitutional and human rights concerns associated with DNA testing.
 - Compilation of judicial observations on evidentiary value and admissibility.



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5. Scope of the Study

The scope of the study is limited to the use of DNA profiling in criminal trials within the Indian legal system.

- The research specifically covers:
- Concept and scientific basis of DNA profiling.
- Legal framework governing DNA evidence.
- Admissibility and evidentiary value of DNA reports.
- Constitutional issues concerning privacy and self-incrimination.
- Judicial interpretation of DNA evidence.
- Recent trends in Indian courts regarding forensic technology.

IV. DATA ANALYSIS

DNA profiling has emerged as one of the most significant forensic tools in the Indian criminal justice system. The analysis of judicial decisions, legal provisions, and forensic practices indicates a steady increase in the acceptance of DNA evidence by Indian courts. Initially, courts treated DNA profiling with caution due to the absence of a specific statutory framework and concerns regarding scientific reliability. However, over the last two decades, judicial attitudes have shifted toward greater reliance on DNA-based evidence, particularly in cases involving rape, murder, sexual assault, missing persons, and disputed identity. This trend demonstrates the growing recognition of scientific evidence as a means of improving the accuracy and fairness of criminal trials. An examination of criminal cases reveals that DNA evidence is most frequently used in sexual offence investigations. In rape and child abuse cases, biological samples collected from victims, suspects, and crime scenes are analyzed to establish identity and linkage. Courts have increasingly considered DNA results as highly persuasive evidence because of their scientific accuracy. Landmark judgments such as *Krishna Kumar Malik v. State of Haryana* and the *Nirbhaya* case (*Mukesh v. State NCT of Delhi*) demonstrated judicial confidence in DNA profiling as an important evidentiary tool. Judicial records indicate that DNA evidence has significantly strengthened prosecution cases by reducing uncertainty regarding the identity of offenders and victims.

Despite its growing importance, the analysis shows that Indian courts rarely treat DNA evidence as absolute or conclusive proof. Instead, DNA profiling is generally considered corroborative evidence that must be evaluated along with witness testimony, medical reports, circumstantial evidence, and other forensic findings. Courts have repeatedly emphasized that a conviction cannot rest solely on DNA results if procedural irregularities exist in sample collection, preservation, or laboratory examination. This judicial approach reflects an effort to balance scientific advancements with the principles of fair trial and due process. A significant challenge identified in the data is the lack of a comprehensive legal framework governing DNA profiling in India. Although provisions under the Indian Evidence Act and the Code of Criminal Procedure permit the use of expert scientific evidence, there remains no exclusive legislation regulating DNA collection, storage, analysis, and databanking. This legislative gap has resulted in inconsistent practices across states and forensic laboratories. Several scholars and legal experts have argued that the absence of clear statutory safeguards creates uncertainty regarding admissibility standards and increases the possibility of misuse.

The analysis further reveals that procedural deficiencies remain a major obstacle to the effective use of DNA evidence. Courts have identified problems such as contamination of samples, improper preservation, delays in transportation to laboratories, and failure to maintain the chain of custody. In several cases, convictions based primarily on DNA evidence have been overturned because prosecution agencies failed to establish the reliability of forensic procedures. A recent decision of the Gujarat High Court highlighted how delays in sample submission and improper storage raised doubts about the authenticity of DNA results, ultimately leading to acquittal. Such cases demonstrate that the evidentiary value of DNA profiling depends not only on scientific accuracy but also on strict adherence to procedural safeguards.

V. RESULT AND DISCUSSION

The study on DNA profiling as forensic evidence in criminal trials reveals that DNA technology has emerged as one of the most reliable scientific tools for criminal investigation and adjudication in India. The analysis of judicial decisions, statutory provisions, and forensic practices demonstrates a growing acceptance of DNA evidence by Indian courts. DNA profiling has significantly enhanced the accuracy of criminal investigations by enabling the identification of offenders, exonerating innocent persons, establishing biological relationships, and linking suspects to crime scenes. Courts increasingly recognize the scientific reliability of DNA testing due to its high degree of accuracy and objectivity. As a



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result, DNA evidence has become a crucial component in cases involving murder, rape, sexual assault, kidnapping, paternity disputes, and unidentified human remains. The findings indicate that judges often rely on DNA reports as strong corroborative evidence, especially when supported by other circumstantial or documentary evidence. However, despite its scientific value, DNA evidence is not treated as conclusive proof in every case, and courts continue to evaluate it within the broader framework of criminal jurisprudence.

The study further reveals that the Indian judiciary has played an important role in shaping the legal framework governing DNA evidence. Several landmark judgments have established principles regarding the admissibility, relevance, and evidentiary value of DNA profiling. Courts have generally adopted a progressive approach toward scientific evidence while simultaneously emphasizing the protection of constitutional rights. Judicial decisions show a careful balancing between the interests of criminal justice and the rights of individuals to privacy, dignity, and bodily integrity. The judiciary has acknowledged that compulsory DNA testing may raise concerns under Article 21 of the Constitution, which guarantees the right to life and personal liberty. Consequently, courts have insisted that DNA tests should be conducted only when justified by the facts of the case and when the probative value outweighs potential violations of personal rights. This approach reflects the judiciary's attempt to ensure that technological advancements do not undermine fundamental constitutional protections.

Another significant finding of the study concerns the legal challenges associated with the collection, preservation, and presentation of DNA evidence. While DNA profiling offers a high degree of scientific accuracy, its effectiveness depends heavily on proper forensic procedures. The analysis shows that deficiencies in evidence collection, contamination of samples, inadequate storage facilities, and delays in laboratory testing often affect the reliability of DNA results. Many forensic laboratories in India continue to face challenges such as shortage of trained personnel, limited infrastructure, and case backlogs. These operational difficulties may compromise the integrity of DNA evidence and create doubts regarding its evidentiary value. Courts have repeatedly emphasized the need for maintaining an unbroken chain of custody to ensure that biological samples remain authentic and untampered throughout the investigative process. Failure to establish proper chain-of-custody procedures has occasionally led courts to question the credibility of DNA reports, highlighting the importance of procedural safeguards in forensic investigations.

The findings also indicate that the absence of a comprehensive legislative framework historically created uncertainties regarding the regulation of DNA technology in India. Although provisions under the Code of Criminal Procedure, the Indian Evidence Act, and various judicial precedents provide some legal basis for DNA testing, the lack of detailed statutory guidelines resulted in inconsistencies in practice. Issues relating to consent, privacy, storage of genetic information, data protection, and the establishment of DNA databases remained inadequately addressed for many years. This legal vacuum generated concerns among legal scholars, human rights activists, and policymakers regarding the potential misuse of genetic information. The discussion suggests that while scientific advancement necessitates broader use of DNA technology, robust legal safeguards are essential to prevent arbitrary collection, unauthorized access, and misuse of sensitive genetic data. The development of specific legislation governing DNA profiling is therefore considered a crucial step toward ensuring both effective criminal justice administration and protection of individual rights.

VI. CONCLUSION

The use of DNA profiling as forensic evidence has emerged as one of the most significant scientific developments in the criminal justice system. In India, the growing acceptance of DNA evidence by courts has transformed the investigation and prosecution of criminal cases by providing a highly accurate and reliable method for identifying individuals. DNA profiling has proved particularly valuable in cases involving murder, rape, kidnapping, disputed parentage, missing persons, and mass disasters. Its ability to establish identity with a high degree of certainty has strengthened the evidentiary process and enhanced the pursuit of justice. As criminal activities become increasingly sophisticated, traditional methods of investigation often prove inadequate. In such circumstances,

Despite its immense potential, the use of DNA profiling in criminal trials raises several legal, ethical, and procedural challenges. One of the primary concerns is the absence of a comprehensive and well-defined legal framework governing the collection, storage, and use of DNA data. Although various provisions of the Criminal Procedure Code, the Indian Evidence Act, and judicial pronouncements have facilitated the admissibility of DNA evidence, the lack of detailed statutory regulation has often led to inconsistencies in practice. Courts have repeatedly been required to interpret constitutional rights, particularly the right to privacy, bodily integrity, and protection against self-incrimination, while



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balancing them against the interests of justice. This has created a complex legal environment where scientific evidence must be carefully evaluated within constitutional boundaries.

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