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# **“THE ROLE OF FORENSIC EVIDENCE IN CRIMINAL INVESTIGATIONS IN INDIA”**

AUTHORED BY - GURMANPREET SINGH

## **Abstract**

Modern criminal investigations rely on forensic science to establish facts, confirm evidence, and improve the criminal justice system. DNA profiling, fingerprint analysis, ballistics, and digital forensics have helped resolve difficult criminal cases and provide justice in India. This paper explores the legal framework governing forensic evidence in India, highlighting key provisions under “the Indian Evidence Act, Code of Criminal Procedure (CrPC), and the Information Technology Act.” It discusses the application of forensic techniques in high-profile cases, such as the Nirbhaya Gang Rape Case and the Priyadarshini Mattoo Case, showcasing their significance in securing convictions.

However, the effective utilization of forensic science in India faces challenges, including inadequate infrastructure, shortage of skilled professionals, and delays in evidence processing. These obstacles hinder timely justice and compromise the credibility of investigations. The paper underscores the transformative impact of forensic evidence on criminal investigations, advocating for reforms to address systemic challenges. By enhancing infrastructure, training law enforcement, and streamlining forensic processes, India can strengthen its criminal justice system, ensuring fairness, transparency, and public trust. This analysis reaffirms the critical role of forensic science in advancing justice and resolving crimes with scientific precision.

**Keywords:** IPC, CrPC, DNA, forensic evidence, IT Act.

## **Introduction**

Forensic science is a cornerstone of modern criminal investigations, offering objective and scientific methodologies to uncover the truth and uphold justice. By utilizing tools such as DNA profiling, fingerprint analysis, ballistic examinations, and digital forensics, forensic science provides law enforcement agencies with critical evidence that is grounded in facts rather than subjective testimonies or conjecture.<sup>1</sup> The application of forensic science has been

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<sup>1</sup> Palmer, J. E. (2005). Identifying traces: Technologies of the forensic narrative. Michigan State University.

instrumental in solving some of the most complex criminal cases, ranging from violent crimes such as murder and sexual assault to intricate economic frauds. The importance of forensic evidence lies in its ability to corroborate witness statements, establish timelines, link suspects to crime scenes, and, in some cases, absolve the innocent. In India, forensic science has steadily integrated into the criminal justice system, enhancing the investigative process's accuracy and transparency. Landmark cases, such as the Nirbhaya Gang Rape Case and the Aarushi Talwar double murder case, have underscored the importance of forensic evidence in providing closure and delivering justice.<sup>2</sup> Techniques like DNA analysis and digital forensics have gained prominence, especially in an era where technology often intersects with criminal activities.<sup>3</sup> Nevertheless, forensic science's potential to revolutionize criminal investigations remains underutilized due to systemic challenges. One of the most pressing issues is the inadequacy of forensic infrastructure in India. The country's forensic laboratories are often underfunded and overburdened, resulting in significant delays in processing evidence. This backlog not only slows down investigations but also impedes the judicial process, causing prolonged suffering for victims and delays in justice for the accused. For instance, reports indicate that several state forensic laboratories take months, or even years, to process DNA samples, undermining the timely resolution of cases. Another critical challenge is the shortage of trained forensic professionals. India faces a dire lack of experts in key areas such as toxicology, pathology, and digital forensics. This shortage leads to errors in evidence analysis, chain-of-custody breaches, and, in some cases, evidence contamination. Additionally, law enforcement personnel, including police officers and investigators, often lack adequate training in collecting and preserving forensic evidence.<sup>4</sup> This lack of awareness can result in the mishandling of critical evidence, rendering it inadmissible in court. Furthermore, the legal framework governing forensic evidence in India, while robust in certain areas, has gaps that hinder its effective application. The “Indian Evidence Act, 1872”, provides the foundation for the admissibility of forensic evidence, particularly under sections like 45 (expert opinions) and 65B (electronic records). However, the implementation of these provisions is inconsistent, particularly in cases involving digital forensics. The absence of standardized protocols for collecting and preserving electronic evidence often leads to its rejection in court.

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<sup>2</sup> Jain, A. IV. AN ANALYSIS OF LANDMARK CASE OF HARIDAS VS USHA RANI BANIK (2007) 14 SCC. EDUNATIONAL SERVICES ALL RIGHTS RESERVED, 43.

<sup>3</sup> Thakur, R., Kumar, S., Singh, S. K., Singla, K., Sharma, S. K., & Arya, V. (2025). Cyber Synergy: Unlocking the Potential Use of Biometric Systems and Multimedia Forensics in Cybercrime Investigations. In *Digital Forensics and Cyber Crime Investigation* (pp. 241-267). CRC Press.

<sup>4</sup> Ibid.

The lack of a centralized database for forensic information is another significant shortcoming. Unlike many developed countries, India does not have a comprehensive national database for fingerprints, DNA profiles, or ballistic records. This limitation hampers the ability of law enforcement agencies to cross-reference data, track repeat offenders, or link multiple crimes to a single perpetrator. Efforts like the DNA Technology (Use and Application) Regulation Bill, 2019, aim to address this gap, but its enactment remains pending.<sup>5</sup> The role of forensic science in criminal investigations goes beyond solving cases; it ensures the integrity of the justice system. By providing scientifically validated evidence, forensic science minimizes the risk of wrongful convictions based on unreliable witness testimonies or circumstantial evidence. It also bolsters public trust in the judicial process, as cases resolved with the aid of forensic evidence demonstrate the system's commitment to impartiality and accuracy. Despite its transformative potential, forensic science's impact in India is often diminished by systemic inefficiencies, legal hurdles, and insufficient resources. Addressing these issues requires a multi-pronged approach, including investments in infrastructure, training for law enforcement personnel, and legislative reforms to streamline the use of forensic evidence. Moreover, fostering public awareness about the importance of forensic science can lead to greater support for its integration into the criminal justice system.

This paper aims to delve deeper into the legal framework that governs forensic evidence in India, analyze its application in criminal investigations, explore the challenges faced by the forensic science ecosystem, and evaluate its overall impact on the criminal justice process. By examining these aspects, it seeks to highlight the potential of forensic science as a tool for achieving timely and equitable justice while identifying actionable steps to overcome existing barriers.

### **Legal Framework Governing Forensic Evidence in India**

The legal framework governing forensic evidence in India encompasses multiple statutes, including the “**Indian Evidence Act, 1872**, the **Code of Criminal Procedure (CrPC), 1973**”, and other specific laws addressing DNA profiling and digital forensics. These laws collectively ensure that forensic evidence is admissible in court, guiding the processes of collection, preservation, and presentation of such evidence during criminal proceedings. Below is a detailed examination of these legal provisions:

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<sup>5</sup> Refer to: <https://prsindia.org/billtrack/the-dna-technology-use-and-application-regulation-bill-2019>



## 1. Indian Evidence Act, 1872

The “**Indian Evidence Act, 1872**” forms the foundation for the admissibility of all forms of evidence, including forensic evidence, in Indian courts.

- **Section 45: Expert Opinion**

Section 45 recognizes the role of experts in presenting evidence that requires specialized knowledge. Courts often rely on expert opinions in forensic domains such as fingerprint analysis, handwriting examination, ballistics, and DNA profiling. For example, in the landmark case of *Kishan Chand v. State of Haryana*<sup>6</sup>, the SC emphasized the need for expert opinion when analyzing scientific evidence to ensure impartiality and precision.

- **Section 73: Handwriting and Signature Comparisons**

This provision allows the court to compare disputed handwriting, signatures, or seals with authentic samples to verify their genuineness. Courts may utilize forensic handwriting experts to assist in such comparisons. In cases involving forged documents, such as *State of Maharashtra v. Sukhdeo Singh*<sup>7</sup>, handwriting experts have played a pivotal role in establishing authenticity.

- **Section 65B: Admissibility of Electronic Evidence**

Section 65B, introduced by the IT Act, 2000, governs the admissibility of electronic evidence, such as emails, social media records, or surveillance footage. To admit such evidence, a certificate under Section 65B(4) is mandatory to ensure the reliability and authenticity of electronic data. The *Arjun Panditrao Khotkar v. Kailash Kushanrao Gorantyal*<sup>8</sup> ruling clarified that non-compliance with Section 65B(4) could render electronic evidence inadmissible.

## 2. Code of Criminal Procedure (CrPC), 1973

The **CrPC** provides procedural guidelines for the collection, preservation, and use of forensic evidence during criminal investigations and trials.

- **Section 293: Expert Reports**

Section 293 permits reports from designated government scientific experts, such as forensic analysts or medical examiners, to be admitted as evidence without requiring the expert’s physical presence in court. This provision ensures efficiency, particularly

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<sup>6</sup> AIR 2013 SUPREME COURT 357.

<sup>7</sup> AIR 1992 SUPREME COURT 2100.

<sup>8</sup> [2020] 7 S.C.R. 180.

in cases where voluminous scientific reports are involved.

- **Section 164A: Medical Examination in Sexual Offense Cases**

Section 164A mandates the immediate medical examination of the victim in cases involving sexual offenses. This ensures timely collection and preservation of crucial forensic evidence, such as DNA samples and injury reports, which are integral to establishing guilt. In *State of Punjab v. Gurmit Singh*<sup>9</sup>, the SC emphasized the importance of forensic evidence in corroborating victim testimony in rape cases.

- **Section 53A: Medical Examination of Accused**

Section 53A mandates the examination of the accused in cases of sexual assault, particularly to match biological evidence, such as semen samples, with evidence collected from the crime scene or victim. This provision ensures that forensic science plays a decisive role in linking suspects to criminal acts.

### 3. DNA Technology (Use and Application) Regulation Bill, 2019

Though not yet enacted, the DNA Technology (Use and Application) Regulation Bill represents a transformative step in the legal regulation of DNA profiling in India.<sup>10</sup>

- **Key Provisions of the Bill:**

- Establishment of a **National DNA Data Bank** to store DNA profiles for criminal investigations.
- Creation of a **DNA Regulatory Board** to ensure ethical and lawful use of DNA technology.
- Guidelines for collecting, storing, and destroying DNA samples to protect individual privacy.

The Bill aims to streamline the use of DNA evidence in solving crimes such as rape, murder, and human trafficking. Critics, however, have raised concerns about potential misuse of the database and infringement on privacy rights, emphasizing the need for robust safeguards.

### 4. Information Technology Act, 2000

The **Information Technology Act, 2000**, complements the Indian Evidence Act by providing a framework for the admissibility of digital and electronic evidence, which has become increasingly significant in modern investigations.<sup>11</sup>

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<sup>9</sup> 1996 SCC (2) 384.

<sup>10</sup> Supra note 5.

<sup>11</sup> KAUR, G., & DHAWAN, A. (2024). LAWS OF ELECTRONIC EVIDENCE AND DIGITAL FORENSICS. PHI Learning Pvt. Ltd..

- **Section 65B of the Evidence Act**

Aligned with the IT Act, Section 65B governs the admissibility of electronic records. For digital evidence to be admissible, it must be accompanied by a certificate verifying its authenticity and integrity.

- **Section 67C**

This section mandates intermediaries, such as internet service providers and social media platforms, to preserve user data for a specified duration to aid investigations.

- **Cyber Forensics**

Provisions under the IT Act allow law enforcement agencies to use cyber forensics to investigate cybercrimes such as hacking, identity theft, and digital fraud. For instance, cyber forensic techniques were crucial in the *Anoop Mishra v. State of Maharashtra*<sup>12</sup> case, where digital evidence helped secure a conviction.

## **Application of Forensic Evidence in Criminal Investigations**

Forensic evidence is used in a wide range of criminal investigations in India, from violent crimes to white-collar offenses. The application of forensic science helps corroborate witness testimony, confirm or disprove alibis, and ultimately secure convictions based on scientific evidence rather than on the subjective opinions of witnesses.

### **1. DNA Profiling**

DNA profiling is one of the most powerful forensic tools available today. It is used to establish the identity of individuals involved in criminal acts, such as murder, rape, and even paternity disputes. DNA analysis has a high degree of reliability, making it a crucial piece of evidence in cases where other forms of identification may not be available.

In *Manoj v. State of Madhya Pradesh*<sup>13</sup>, DNA evidence was pivotal in confirming the identity of the accused in a sexual assault case. The Supreme Court relied on DNA profiling to link the accused to the crime scene, which led to the conviction of the offenders.

### **2. Ballistics and Firearm Analysis**

Ballistics tests are crucial in cases involving firearms. This form of forensic analysis helps determine the trajectory of a bullet, the type of firearm used, and can link a suspect to the

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<sup>12</sup> MISC. CRIMINAL CASE No. 27463 of 2022.

<sup>13</sup> CRIMINAL APPEAL NOS. 248-250 OF 2015.

weapon used in a crime. In *Prithipal Singh v. State of Punjab*<sup>14</sup>, Ballistics analysis was crucial in determining the origin of bullets and reconstructing the sequence of events in this high-profile mass murder case. The ballistic evidence presented in court helped secure the conviction of the accused.

### **3. Fingerprint and Handwriting Analysis**

Fingerprint identification has long been a reliable forensic method for linking a suspect to a crime scene. Fingerprints, being unique to every individual, can be used to confirm the presence of a person at a crime scene or on an object. Handwriting analysis can also be critical in verifying the authenticity of documents or confessions. In *State of Maharashtra v. Suresh*<sup>15</sup>, fingerprint evidence played a significant role in securing the conviction of the accused. The court upheld the admissibility of fingerprints as key evidence in linking the suspect to the crime.

### **4. Toxicology Reports**

Toxicology is used to identify the presence of drugs, alcohol, or poisons in a victim's body. It is particularly useful in cases of unnatural deaths, overdose deaths, and drug-related crimes. In *Arushi Talwar & Hemraj Double Murder Case (2013)*, toxicological evidence was instrumental in analyzing the cause of death. Though controversial, the toxicological reports played a role in determining the sequence of events and the nature of the crime.<sup>16</sup>

## **Challenges in Forensic Science in India**

Despite the advancements in forensic science, several challenges prevent India from fully utilizing forensic evidence in criminal investigations.

### **1. Inadequate Infrastructure**

India's forensic laboratories often suffer from a lack of modern equipment, underfunding, and outdated technology. Many forensic departments are overburdened with a large volume of cases, leading to delays in processing evidence and delivering results.

### **2. Shortage of Trained Professionals**

India faces a significant shortage of skilled forensic professionals, including forensic scientists,

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<sup>14</sup> 2012 (2) AIR JHAR R 630.

<sup>15</sup> AIR ONLINE 1999 SC 169.

<sup>16</sup> Anand, B., & Das, L. (2022). Forensic Criminology: A Revolutionary Parameter for Legal Fraternity. *Supremo Amicus*, 28, 173.

pathologists, and technicians. This shortage leads to errors in evidence handling, contamination, or delays in analysis, which compromises the integrity of forensic evidence.

### **3. Issues of Admissibility**

The admissibility of forensic evidence can be challenged in court, particularly when the chain of custody is not maintained or when there are concerns about the authenticity of the evidence. Inconsistent application of laws, such as Section 65B of the Indian Evidence Act, for electronic evidence can complicate matters further.

### **4. Limited Awareness and Sensitization**

There is limited awareness among law enforcement agencies about the importance of forensic evidence, and in many instances, traditional methods of investigation are still prioritized. Moreover, police officers often lack the necessary training in handling and collecting forensic evidence, which results in contamination or destruction of crucial evidence.

### **5. Delayed Processing and Reporting**

The backlog of cases and delays in forensic analysis are persistent issues. This delay not only hampers investigations but also denies timely justice to victims and the accused.

## **Impact of Forensic Evidence on Criminal Investigations**

Forensic evidence has had a transformative effect on criminal investigations in India. Its introduction into the investigative process has brought significant improvements in accuracy, transparency, and the overall effectiveness of criminal justice.<sup>17</sup>

### **1. Enhanced Accuracy**

Forensic evidence eliminates human bias and provides objective, scientifically verifiable facts. This has significantly reduced the risk of wrongful convictions or acquittals based on unreliable witness testimonies.

### **2. Speedier Resolution of Cases**

The efficient use of forensic evidence accelerates the investigative process, helping to reduce case backlogs and bring closure to investigations in a timely manner.

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<sup>17</sup> Peterson, J., Sommers, I., Baskin, D., & Johnson, D. (2010). The role and impact of forensic evidence in the criminal justice process. *National Institute of Justice*, 1(10), 1-151.



### 3. Strengthening Prosecution and Defense

Forensic evidence helps both the prosecution and defense in presenting stronger cases. The use of scientific evidence supports the case by establishing facts in a way that cannot be easily refuted.

### 4. Bolstering Public Trust

By demonstrating transparency and accuracy in criminal investigations, forensic evidence helps restore public confidence in law enforcement and the judiciary, ensuring that justice is not only done but seen to be done.

## Notable Case Studies

### 1. Nirbhaya Gang Rape Case (2012)<sup>18</sup>

Forensic evidence, including DNA profiling, semen analysis, and other techniques, played a pivotal role in identifying and convicting the perpetrators of this brutal crime. The case highlighted the critical role of forensic science in modern criminal investigations.

### 2. Priyadarshini Mattoo Case (1996)<sup>19</sup>

In this case, forensic evidence including DNA analysis helped in convicting the accused. It demonstrated the importance of forensic science in delivering justice, even in cases that initially seemed unsolvable.

## Conclusion

Forensic science has emerged as an indispensable tool in India's criminal justice system, bridging the gap between scientific methods and legal processes. It plays a critical role in ensuring that investigations are grounded in factual evidence, thereby reducing the reliance on circumstantial or biased testimonies. Techniques like DNA profiling, fingerprint analysis, ballistics, and digital forensics provide objective and reliable data, aiding in establishing guilt or innocence with precision. Over the years, these scientific advancements have contributed significantly to solving complex criminal cases, securing convictions, and exonerating the wrongly accused. Despite its transformative potential, the application of forensic science in

<sup>18</sup> Alketbi, S. K. (2023). The role of DNA in forensic science: A comprehensive review. *International Journal of Science and Research Archive*, 9(02), 814-829.

<sup>19</sup> Anand, N. N. (2022). Media Trial in India and Case Analysis of Priyadarshini Mattoo Case with Respect to Media Trial. Part 1 *Indian J. Integrated Rsch. L.*, 2, 1.

India faces considerable challenges. The country's forensic infrastructure is plagued by insufficient funding and inadequate resources. A significant shortage of trained forensic experts often delays the processing of evidence, which can lead to prolonged investigations and trials. Laboratories across the country are often burdened with a backlog of cases, which compromises the timely delivery of justice. Furthermore, the lack of standardized procedures for evidence collection and preservation sometimes results in contamination or inadmissibility of crucial forensic evidence in court. The legal framework governing forensic science in India, while robust, requires continuous updates to align with evolving technological advancements. For instance, the DNA Technology (Use and Application) Regulation Bill, 2019, is a promising step toward formalizing DNA profiling. However, its implementation must ensure safeguards to protect individual privacy and prevent misuse of sensitive data. Similarly, the proper application of digital forensics laws, such as Section 65B of the Indian Evidence Act, is crucial in an era where cybercrime is on the rise. To fully harness the potential of forensic science, India must invest in modernizing forensic laboratories, expanding training programs for professionals, and ensuring adequate staffing in forensic departments. Additionally, fostering collaboration between law enforcement agencies, forensic experts, and the judiciary can streamline processes and enhance the use of forensic evidence in criminal investigations.

In conclusion, while forensic science has revolutionized criminal investigations in India, addressing its systemic challenges is imperative. By strengthening infrastructure, promoting capacity building, and ensuring effective legal and procedural frameworks, India can leverage forensic science to enhance the efficiency, accuracy, and fairness of its criminal justice system, ultimately ensuring justice for all.

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