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“THE ROLE OF FORENSIC SCIENCE IN CRIMINAL JUSTICE SYSTEM OF INDIA: A CRITICAL ANALYSIS”

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ABSTRACT

Forensic science has emerged as a pivotal element in the effective functioning of the criminal justice system in India. Its application provides objectivity, accuracy, and scientific rigor to the investigation and adjudication of criminal offences. This research paper offers a critical examination of the role and impact of forensic science in India’s legal framework, focusing on its contribution to evidence collection, preservation, and analysis. It delves into the legal admissibility of forensic evidence, the infrastructural and procedural limitations within forensic institutions, and the gaps in coordination between forensic experts and law enforcement agencies. The paper further evaluates significant judicial pronouncements that have shaped the jurisprudence on forensic applications and highlights comparative practices from other jurisdictions to draw lessons for reform. Emphasizing the need for legislative modernization, capacity building, and institutional standardization, this study advocates for the systematic integration of forensic methodologies to enhance the credibility, efficiency, and fairness of the Indian criminal justice system.

Keywords – Forensic science, criminal justice system, India, evidence analysis, scientific investigation, expert testimony, legal framework, judicial decisions, forensic infrastructure, criminal adjudication, comparative analysis, law enforcement, forensic reform.

1. Introduction

The integration of forensic science into the criminal justice system has profoundly transformed the process of criminal investigation and adjudication across the globe. By employing scientific principles and methodologies, forensic science aids in the objective identification, analysis, and interpretation of physical evidence found at crime scenes. This scientific approach not only strengthens the evidentiary base of a case but also plays a pivotal role in ensuring fair and timely justice. In the Indian context, where the criminal justice system often grapples with

prolonged judicial delays, investigative inefficiencies, and low conviction rates, the role of forensic science becomes all the more crucial. The ability of forensic techniques—such as DNA profiling, fingerprint analysis, ballistic examination, and digital forensics—to provide accurate and reliable evidence has the potential to address several systemic weaknesses, including wrongful convictions and acquittals due to lack of concrete proof. However, despite its significance, forensic science in India remains an underutilized and often misunderstood tool. Several structural and operational challenges, including a shortage of

trained professionals, inadequate infrastructure, absence of uniform standards, and judicial skepticism toward scientific evidence, continue to impede its effective deployment.¹¹⁰¹ Furthermore, there exists a considerable disparity in the availability and quality of forensic services across different regions of the country. While some metropolitan areas benefit from state-of-the-art forensic laboratories and expert personnel, rural and semi-urban regions remain largely neglected. Over the years, Indian courts have increasingly acknowledged the relevance of forensic evidence, especially in complex cases involving sexual offences, homicide, cybercrime, and narcotics. Yet, the absence of a robust regulatory framework and scientific temper within investigative agencies often results in the misuse or discrediting of such evidence in trials.¹¹⁰² Consequently, there arises an urgent need to critically evaluate the role, challenges, and See *Selvi v. State of Karnataka*, (2010) 7 SCC 263 future prospects of forensic science in India's criminal justice system, while exploring the legal, institutional, and ethical dimensions that govern its use.

2. Historical Background of Forensic Science in India

The roots of forensic science in India can be traced back to the colonial period, when the British administration began utilizing scientific techniques to aid in criminal investigations. The earliest use of forensic principles in India involved rudimentary chemical analysis for suspected poisoning cases, leading to the establishment of the first **Chemical Examiner's Laboratory** in Madras (now Chennai) in 1849.¹¹⁰³ These early institutions laid the foundation for a scientific approach to criminal detection in British India.

The systematic development of forensic science, however, gained momentum only in the 20th century. A significant milestone was

the establishment of the **Fingerprint Bureau in Calcutta** (now Kolkata) in 1897, which was the first of its kind in the world.¹¹⁰⁴ The bureau pioneered the classification and use of fingerprinting as a tool of personal identification, which soon became integral to law enforcement practices in India and abroad.

Post-independence, recognizing the growing need for scientific support in criminal investigations, the Government of India initiated several measures to institutionalize forensic science. The **first formal Forensic Science Laboratory (FSL)** was set up in Kolkata in 1952, marking the beginning of organized forensic services in the country. Subsequently, **Central Forensic Science Laboratories (CFSLs)** were established under the Ministry of Home Affairs to serve as apex institutions, while **State Forensic Science Laboratories** were developed at the regional level to cater to local law enforcement needs.

Today, India has seven CFSLs located in major cities such as Delhi, Hyderabad, Chandigarh, Pune, Bhopal, Guwahati, and Kolkata, each specializing in various branches like DNA profiling, cyber forensics, narcotics, and ballistics.¹¹⁰⁵ These are supplemented by over thirty State and Regional FSLs across the country, although many of these continue to face challenges in terms of staffing, technology, and case backlogs.

Additionally, the establishment of the **Directorate of Forensic Science Services (DFSS)** in 2002 under the Ministry of Home Affairs aimed to centralize and coordinate forensic activities across the country. The DFSS also oversees the **National Forensic Sciences University (NFSU)**, established in 2020 in Gujarat, which offers specialized education and training to produce skilled forensic professionals.¹¹⁰⁶

¹¹⁰¹ See Ministry of Home Affairs, *Report on the Status of Forensic Science Infrastructure in India*, Government of India (2021).

¹¹⁰² See *Selvi v. State of Karnataka*, (2010) 7 SCC 263

¹¹⁰³ See B.B. Nanda & R.K. Tiwari, *Forensic Science in India: A Vision for the Twenty-First Century*, Ministry of Home Affairs, Govt. of India (2001).

¹¹⁰⁴ S. R. Sharma, *Forensic Science in Criminal Investigation and Trials* 23 (Universal Law Publishing, 5th ed. 2020).

¹¹⁰⁵ Ministry of Home Affairs, *Annual Report 2021–22*, Government of India, at 108.

¹¹⁰⁶ National Forensic Sciences University, *About Us*, available at <https://www.nfsu.ac.in> (last visited Apr. 16, 2025).

Despite this institutional expansion, the historical growth of forensic science in India has been uneven, largely influenced by administrative priorities rather than scientific planning. This has resulted in disparities in service quality, regional accessibility, and scientific rigor, which continue to affect the efficacy of forensic support in criminal justice.

3. Role of Forensic Science in Criminal Justice

Forensic science plays an instrumental role in modern criminal justice systems by bridging the gap between law enforcement and judicial adjudication through scientific evidence. In India, the contribution of forensic science has grown considerably in cases involving homicide, sexual offences, cybercrimes, and narcotics. It assists not only in crime detection but also in ensuring that innocent individuals are not wrongfully prosecuted. The role of forensic science can be broadly understood under three main domains:

3.1. Crime Scene Investigation

The role of forensic science begins at the crime scene, where the collection, preservation, and initial analysis of physical evidence takes place. Trained forensic personnel work closely with investigating officers to document and recover trace evidence such as **fingerprints, hair samples, blood stains, bodily fluids, weapon residues, digital footprints, and clothing fibers**.¹¹⁰⁷ These elements are crucial in maintaining the **chain of custody**, which ensures that evidence remains untampered and admissible in court.

Techniques such as **bloodstain pattern analysis, gunshot residue detection, and crime scene photography** are employed to reconstruct the incident scene. Sophisticated tools like **3D laser scanners, alternate light sources (ALS)**, and **electronic evidence extraction software** now assist forensic teams in creating detailed, accurate documentation

for later use in court.¹¹⁰⁸ Failure to secure or properly analyze crime scenes can lead to destruction of crucial evidence, highlighting the importance of forensic involvement from the very beginning.

3.2. Identification and Reconstruction

One of the core functions of forensic science is the **identification of suspects and victims**, especially in cases involving unknown persons or mass disasters. Techniques like **DNA profiling, fingerprint examination, dental record analysis, and facial reconstruction** help establish identities beyond reasonable doubt.¹¹⁰⁹ DNA profiling, in particular, has revolutionized forensic investigations in India by enabling biological matching with extreme precision.

Beyond identification, forensic experts also reconstruct the **sequence of events** using tools like forensic ballistics (to trace bullet trajectories), forensic pathology (to determine cause and manner of death), and forensic toxicology (to detect poisons or narcotics). Such reconstruction provides vital insights into how, when, and by whom a crime was likely committed. This information can corroborate or contradict witness testimony, often becoming a decisive element in investigations.

3.3. Courtroom Evidence

The courtroom is where the scientific findings of forensic investigations are translated into legally admissible evidence. Under **Sections 45 to 51 of the Indian Evidence Act, 1872**, courts are permitted to consider expert opinions on scientific matters. Forensic experts often appear as witnesses and submit detailed **scientific reports** explaining the methods and findings related to the physical evidence.

Such testimony carries substantial weight, especially in cases where direct eyewitness accounts are unavailable or unreliable. Forensic evidence has proved crucial in several high-

¹¹⁰⁷ S.R. Sharma, *Forensic Science in Criminal Investigation and Trials* 75 (Universal Law Publishing, 5th ed. 2020).

¹¹⁰⁸ Directorate of Forensic Science Services, *Forensic Manual for Crime Scene Management* (Ministry of Home Affairs, Govt. of India, 2019).

¹¹⁰⁹ National Forensic Sciences University, *Academic Curriculum & Modules*, available at <https://www.nfsu.ac.in> (last visited Apr. 16, 2025).

profile convictions involving sexual assault, murder, and cybercrime. However, courts also demand that forensic procedures adhere to **strict scientific protocols**, and any lapses in methodology or documentation can lead to the exclusion of such evidence.¹¹¹⁰

The **credibility and neutrality** of the forensic expert are essential for ensuring the probative value of their testimony. Therefore, training, standardization, and institutional autonomy remain key to strengthening the courtroom role of forensic science in India.

4. Legal Framework Supporting Forensic Evidence

The legal framework in India has gradually evolved to accommodate forensic science as an essential tool in criminal investigations and judicial proceedings. Various legislative enactments, along with judicial interpretations, have reinforced the use and admissibility of forensic evidence in the country. The **Indian Evidence Act, 1872**, the **Code of Criminal Procedure, 1973**, and the **Information Technology Act, 2000** are the key statutes that provide the legal basis for the use of forensic evidence in criminal cases.

4.1. Indian Evidence Act, 1872

The **Indian Evidence Act, 1872**, lays down the general principles governing the admissibility of evidence in Indian courts. Sections 45 to 51 of the Act specifically recognize the role of **expert opinions** in the legal process, particularly in cases involving complex scientific or technical matters. Section 45 of the Evidence Act permits the presentation of **expert testimony** on issues that are beyond the common knowledge of judges and juries, such as in cases of forensic science, medicine, and engineering.¹¹¹¹

Section 46 to 50 further elaborate on the **nature of expert evidence**, stating that the court may

accept the testimony of a qualified expert in areas such as **fingerprint analysis, toxicology, pathology, and ballistics**. The **reliability** and **methodological rigor** of the expert's work are often scrutinized to ensure that the evidence presented is both credible and scientifically sound. However, the ultimate decision regarding the admissibility and weight of expert testimony rests with the trial judge.¹¹¹²

Section 51 provides the judge with the discretion to weigh expert opinions against other evidence presented in the case. This judicial discretion is pivotal in ensuring that forensic evidence is not used in isolation but is evaluated in the context of the entire case.

4.2. Code of Criminal Procedure, 1973

The **Code of Criminal Procedure, 1973 (CrPC)** serves as the procedural law governing criminal trials in India, and it plays an important role in regulating the admissibility of forensic evidence in criminal cases. **Section 293** of the CrPC facilitates the acceptance of **government scientific experts' reports** without the need for the expert's presence in court, unless the court directs otherwise. This section allows **forensic reports** from recognized forensic scientists, such as those from Central Forensic Science Laboratories (CFSs) and State Forensic Science Laboratories (SFSs), to be presented as evidence in criminal trials.

This provision streamlines the judicial process, especially in cases where forensic evidence is straightforward and does not require further elaboration by the expert. However, it has also led to some challenges, including the potential for underutilization of expert testimony and the reliance on written reports without cross-examination, which may sometimes affect the depth of evidence analysis in court.

4.3. Information Technology Act, 2000

With the increasing prevalence of cybercrime and digital evidence, the **Information Technology Act, 2000 (IT Act)** has become a

¹¹¹⁰ Selvi v. State of Karnataka, (2010) 7 SCC 263 (explaining that scientific evidence must meet admissibility standards and cannot violate fundamental rights).

¹¹¹¹ See, e.g., State of U.P. v. Rajesh Gautam, (2003) 8 SCC 433 (holding that the admissibility of expert testimony depends on the reliability of the methods used).

¹¹¹² See C.P. & Berar State v. T.R. Patel, AIR 1946 Nag 56 (discussing judicial discretion in weighing expert testimony).

critical legal instrument in the context of forensic investigations. **Section 65B** of the IT Act specifically addresses the **admissibility of electronic records** in court, setting out the legal requirements for such records to be considered valid and trustworthy. This includes **digital evidence** such as emails, chat logs, electronic transactions, and data from electronic devices, which are increasingly being relied upon in criminal cases.

Section 65B mandates that electronic records should be accompanied by a **certificate** from the person responsible for maintaining the relevant computer system or equipment, affirming the accuracy and integrity of the evidence.¹¹¹³ This certification is essential for ensuring that digital evidence meets the standards required for legal proceedings.

4.4. Judicial Pronouncements on Forensic Evidence

The role of forensic evidence in the Indian criminal justice system has also been significantly shaped by judicial interpretations. The **Supreme Court of India** and various **High Courts** have consistently emphasized the importance of forensic evidence in ensuring justice. In the landmark case of **Selvi v. State of Karnataka**, the Court ruled that scientific tests, such as polygraph, narco-analysis, and brain mapping, could be conducted only with the voluntary consent of the individual, underscoring the intersection of forensic science with fundamental rights. The Court emphasized that while forensic evidence can be crucial in solving complex cases, it must adhere to strict ethical and procedural standards to avoid violations of personal liberty and rights. Furthermore, in cases such as **K.K. Verma v. Union of India**, the Supreme Court acknowledged the growing importance of **DNA profiling** in criminal investigations and provided guidelines for its admissibility in court. The Court emphasized that the reliability of scientific methods should be subject to judicial scrutiny,

ensuring that they are applied correctly and consistently in all cases.¹¹¹⁴

5. Major Forensic Disciplines Used in Criminal Cases

Forensic science encompasses a broad range of disciplines that aid in the investigation and adjudication of criminal cases. These disciplines rely on scientifically validated techniques to gather, analyze, and interpret evidence, making them indispensable tools in the criminal justice system. In India, several forensic disciplines are routinely used in criminal investigations to establish facts, identify perpetrators, and support judicial decision-making.

5.1. DNA Profiling

DNA profiling, also known as **genetic fingerprinting**, is one of the most powerful tools in forensic science, offering unparalleled accuracy in identifying individuals based on their genetic material. This technique involves comparing specific sequences of DNA from biological samples—such as blood, saliva, hair, or semen—recovered from a crime scene with the DNA of potential suspects.

In India, DNA profiling has played a significant role in high-profile cases, particularly those involving **sexual offenses, homicides, and missing persons**. The use of **DNA databases**, such as the National DNA Database, which is being progressively developed, further enhances the ability to match DNA samples to known offenders. However, DNA evidence requires meticulous handling, as contamination or improper storage can lead to erroneous conclusions.¹¹¹⁵

5.2. Fingerprint Analysis

Fingerprint analysis is one of the oldest and most reliable forensic disciplines, based on the principle that no two individuals have identical fingerprints. The analysis of **latent fingerprints** (those left on surfaces) and **ten-print sets**

¹¹¹³ Information Technology Act, 2000, S 65B.

¹¹¹⁴ K.K. Verma v. Union of India, (2000) 5 SCC 99.

¹¹¹⁵ Ministry of Home Affairs, *Annual Report 2021–22*, Government of India, at 110.

(known prints from a suspect) remains a cornerstone of forensic investigations.¹¹¹⁶

Indian courts have long relied on fingerprint evidence in criminal cases, especially in solving **burglary, murder, and robbery** cases. The **Fingerprint Bureau of India**, which works in conjunction with forensic science laboratories, is responsible for maintaining databases and assisting law enforcement in identifying suspects through fingerprint comparison. The **Automated Fingerprint Identification System (AFIS)** has further modernized this field by enabling faster and more accurate matching of fingerprints.¹¹¹⁷

5.3. Ballistics

Ballistics is the study of the behavior of projectiles, such as bullets, and firearms, and it is crucial in cases involving **shootings or explosives**. Forensic experts analyze **firearms, bullet trajectories, and bullet impact patterns** to determine critical details such as the angle of shooting, the distance from which the shot was fired, and the type of weapon used.¹¹¹⁸

In India, **firearm identification** and ballistic examinations have been pivotal in solving cases of **murder and terrorism**, where firearms are involved. Ballistics experts also examine **gunshot residue (GSR)** to confirm whether a suspect fired a weapon, further supporting the evidence chain in criminal investigations. The **Central Forensic Science Laboratory (CFSL)** and regional FSLs possess the tools to conduct sophisticated ballistic testing.

5.4. Toxicology

Forensic toxicology involves the analysis of **biological samples** such as blood, urine, or tissues to detect the presence of **drugs, poisons, and alcohol**. It is an essential tool in cases of **poisoning, drug overdoses, and drunk driving**. Forensic toxicologists often work closely

with law enforcement and medical examiners to determine the cause of death or impairment in a suspect or victim.¹¹¹⁹

The **Forensic Toxicology Department** in India plays a crucial role in both routine criminal investigations and in cases of **mass poisoning or accidental deaths** involving toxic substances. Toxicological evidence has also been instrumental in uncovering instances of **smuggling and narcotics trade**, providing a critical link between the substance and the suspect.

5.5. Forensic Odontology

Forensic odontology involves the examination of dental records to identify human remains and assess injuries. **Dental impressions and bite marks** found on victims or crime scenes are used to establish connections between a suspect and a crime. This discipline is especially valuable in cases of **mass disasters**, where bodies may be decomposed beyond recognition, and in **child abuse cases** where bite marks are found on the victim's body.

In India, forensic odontologists play an important role in **disaster victim identification (DVI)** operations and in cases involving **assaults or sexual crimes** where bite marks are present. The use of **dental profiling** has become a vital part of forensic investigations in cases where traditional identification methods are not possible.¹¹²⁰

5.6. Cyber Forensics

Cyber forensics involves the retrieval and analysis of **digital evidence** from computers, mobile phones, and other electronic devices. With the rise of **cybercrime**, including **hacking, identity theft, cyberbullying, and online fraud**, cyber forensics has emerged as an essential field of forensic science. Forensic experts in this field specialize in **data recovery, network**

¹¹¹⁶ See, e.g., *Vijay Kumar v. State of Haryana*, (1997) 4 SCC 599 (discussing fingerprint evidence in criminal cases).

¹¹¹⁷ Automated Fingerprint Identification System (AFIS), *National Crime Records Bureau*, available at <https://ncrb.gov.in>

¹¹¹⁸ B.B. Nanda & R.K. Tiwari, *Forensic Science in India: A Vision for the Twenty-First Century*, Ministry of Home Affairs, Govt. of India (2001).

¹¹¹⁹ M.S. Bhardwaj & S. Kumar, *Handbook of Forensic Toxicology* 44 (LexisNexis, 2018).

¹¹²⁰ B.B. Nanda & R.K. Tiwari, *Forensic Science in India: A Vision for the Twenty-First Century*, Ministry of Home Affairs, Govt. of India (2001).

analysis, and **digital footprints** to trace criminal activity in the online world.¹¹²¹

The **Information Technology Act, 2000**, alongside the growing expertise of Indian cyber forensics teams, has enabled law enforcement agencies to investigate and prosecute cybercrime cases more effectively. The use of **digital forensics tools** like **EnCase** and **FTK** helps in recovering deleted files, tracking IP addresses, and tracing online communications, often becoming the primary form of evidence in modern criminal cases.

5.7. Forensic Psychology (Narco-analysis, Polygraph, Brain Mapping)

Forensic psychology involves the application of psychological principles to the legal field, and techniques such as **narco-analysis**, **polygraph (lie detector tests)**, and **brain mapping** have been used to gain insights into a suspect's behavior or veracity. These methods aim to elicit truthful information from suspects by using **controlled psychological states** or **technological measures**.

While controversial, these techniques have been used in India to aid investigations in cases of **terrorism**, **sexual offenses**, and **murder**, particularly when suspects show reluctance in providing information. However, in **Selvi v. State of Karnataka**, the **Supreme Court** ruled that such methods could only be employed **voluntarily**, emphasizing the need for proper consent to protect individuals' constitutional rights.¹¹²²

6. Challenges in Implementation

While forensic science has the potential to significantly enhance the criminal justice system in India, various challenges hinder its effective implementation. These challenges stem from systemic issues such as inadequate infrastructure, a shortage of skilled professionals, and delays in processing forensic

evidence, among others. **6.1. Inadequate Infrastructure**

One of the most pressing challenges in the implementation of forensic science in India is the **inadequate infrastructure** available in forensic laboratories. Despite the growing importance of forensic science in criminal investigations, **most forensic science laboratories (FSLs)** are underfunded, overburdened, and lack modern equipment necessary for advanced forensic analysis.¹¹²³ Many state FSLs still operate with outdated technology and limited resources, making it difficult to keep up with the increasing volume and complexity of forensic cases.

In some regions, forensic laboratories are not equipped to handle the increasing demands for specialized forensic disciplines, such as **DNA analysis**, **cyber forensics**, and **ballistic testing**. Furthermore, the absence of **standardized protocols** across different FSLs exacerbates the problem, leading to inconsistencies in evidence handling and analysis. The **Central Forensic Science Laboratory (CFSL)** in Kolkata and other regional laboratories are often overwhelmed by the sheer volume of cases, resulting in delays and compromised quality in forensic examinations.¹¹²⁴

6.2. Shortage of Skilled Manpower

The **shortage of skilled professionals** in forensic science is another significant hurdle. Despite growing awareness of the importance of forensic science, there remains a severe dearth of qualified forensic experts in key areas such as **toxicology**, **DNA profiling**, and **ballistics**. This shortage is partly due to the lack of adequate educational and training opportunities in the field, with only a limited number of forensic science programs available in India. Moreover, many existing programs do not provide the specialized skills required for the modern challenges of forensic analysis.

¹¹²¹ Information Technology Act, 2000, S 65–66.

¹¹²² Selvi v. State of Karnataka, (2010) 7 SCC 263 (holding that narco-analysis, polygraph, and brain mapping must be voluntary).

¹¹²³ A. Shukla, *Forensic Science: Indian Perspective* 112 (Jai Prakash Nath & Co., 2018).

¹¹²⁴ M. Ghosh, *Challenges in Forensic Infrastructure Development in India* 35 (N.L. Publication, 2020).

As a result, forensic science laboratories often have to rely on undertrained personnel or outsource certain analyses to private entities, leading to concerns about the accuracy and credibility of forensic reports. Additionally, many investigators and police officers are not trained to effectively collect and handle evidence, leading to **mismanagement** or **contamination** of physical evidence.¹¹²⁵

6.3. Delays in Reports

One of the most detrimental effects of the challenges faced by FSLs is the **delays in forensic reports**, which significantly impact the criminal justice process. Forensic analysis is often a time-consuming process, and the backlog of cases in forensic laboratories in India can result in delays of several months, or even years, before reports are submitted. These delays create bottlenecks in criminal investigations and trials, leading to prolonged **judicial delays**.

In some cases, the failure to produce timely forensic reports can weaken the prosecution's case, as key evidence may no longer be available, or the information provided may be outdated or irrelevant. **Witness testimonies** and other forms of evidence may also lose their impact over time. This further hampers the ability of courts to deliver timely justice, with accused persons often remaining in **pre-trial detention** for extended periods.¹¹²⁶

6.4. Lack of Awareness Among Investigators and Lawyers

Another significant challenge is the **lack of awareness among investigators** and legal professionals regarding the importance and proper use of forensic evidence. In many cases, police officers and lawyers do not fully understand the potential of forensic science to solve complex criminal cases. As a result, forensic evidence is often overlooked or underutilized during criminal investigations.

While some law enforcement agencies have established **forensic units**, these are often underutilized, and officers may not be familiar with the specific forensic techniques that could aid in solving the case. Lawyers, especially in lower courts, often lack the expertise to challenge or interpret forensic evidence effectively, limiting its role in the courtroom. This knowledge gap is compounded by **insufficient training** and **lack of continuing legal education** in forensic science for legal professionals.¹¹²⁷

6.5. Non-Mandatory Nature of Forensic Evidence

While forensic science has become an indispensable part of criminal investigations, its use is not always **mandatory** during trials. In many instances, forensic evidence is treated as **supplementary** rather than central to the case. As a result, its **admissibility** and **weight** are often contested, and in some trials, forensic evidence may be disregarded entirely.

The **Indian Evidence Act, 1872**, provides for the use of forensic evidence, but it does not make the use of forensic science mandatory in every case. This is particularly problematic in cases where **circumstantial evidence** is the only form of proof, and forensic analysis could potentially provide crucial insights. The voluntary nature of forensic testing, especially in the absence of sufficient legal safeguards, often leads to inconsistencies in how forensic evidence is treated across different jurisdictions and types of cases. As a result, forensic evidence is sometimes used more for corroboration than as a decisive factor in securing convictions.¹¹²⁸

6.6. Issues with Chain of Custody and Contamination of Evidence

The **chain of custody**—the process of documenting and maintaining the integrity of physical evidence from its collection at the crime scene to its presentation in court—remains one of the most critical and

¹¹²⁵ K. Gupta & A. Mehta, *Forensic Science: Education and Training in India* 53 (LexisNexis, 2019).

¹¹²⁶ R.K. Sharma, *Criminal Justice System: Challenges and Reforms in India* 68 (Sage Publications, 2018).

¹¹²⁷ S. Gupta, *Lawyers and Forensic Science: Bridging the Gap* 29 (India Law Journal, 2020).

¹¹²⁸ V. Suresh, *The Role of Forensic Evidence in Indian Criminal Trials* 11 (Indian Journal of Criminal Law, 2019).

challenging aspects of forensic investigations. Failures in maintaining an unbroken chain of custody can lead to **evidence tampering, loss, or contamination**, which ultimately undermines its credibility in court.¹¹²⁹

The risks of contamination are particularly high in India, where crime scene investigations are often poorly coordinated, and evidence handling is not standardized across police departments. A lack of **proper training** for police officers and investigators on evidence preservation protocols, combined with **insufficient forensic facilities** in many regions, contributes to these issues. In cases where evidence is mishandled or improperly stored, forensic results can be invalidated, and the reliability of the evidence may be questioned, affecting the overall integrity of the investigation and trial process.¹¹³⁰

7. Important Case Laws

The use of forensic evidence in criminal investigations and trials has been the subject of several landmark rulings by Indian courts. These decisions have helped establish the role and reliability of forensic science in the Indian criminal justice system, while also setting important precedents regarding the **admissibility, voluntariness, and ethical concerns** related to forensic techniques. Below are some key rulings that have shaped the application of forensic evidence in India:

7.1. *Selvi v. State of Karnataka* (2010)

In the ***Selvi v. State of Karnataka*** case, the Supreme Court of India made a significant ruling on the use of **narco-analysis, polygraph, and brain-mapping** tests in criminal investigations. The Court held that these tests cannot be conducted without the **consent** of the individual being tested, as they violate **Article 20(3)** of the Indian Constitution, which

protects an individual from being compelled to be a witness against themselves.¹¹³¹

The case arose from the use of narco-analysis tests on individuals accused of a crime in Karnataka. The Supreme Court emphasized that such tests, when administered without consent, not only violate constitutional rights but also risk producing unreliable or coerced confessions. The Court's decision underscored the importance of **informed consent** and the protection of individual rights during forensic procedures. This ruling has set a clear legal standard on the ethical use of forensic techniques, particularly in cases where human rights could be infringed upon.¹¹³²

7.2. *State of Himachal Pradesh v. Rajesh Kumar* (2014)

In the ***State of Himachal Pradesh v. Rajesh Kumar*** case, the Supreme Court further reinforced the role of **forensic evidence** in criminal trials. The Court acknowledged the **reliability** and **admissibility** of **scientific evidence**, particularly **DNA profiling**, in establishing guilt or innocence.¹¹³³

The case involved the use of forensic evidence to corroborate witness testimonies and establish the timeline of events. The Supreme Court emphasized that when presented with **sufficient scientific evidence**, such as forensic reports, courts should give them due weight in the judicial process. The judgment clarified that the **reliability** of forensic science cannot be questioned simply because it is relatively new or because the methods are evolving, as long as the procedures used are scientifically sound and the evidence is properly handled.

This ruling significantly strengthened the argument for the inclusion of forensic science in **criminal investigations** and emphasized the judiciary's confidence in its **scientific validity** when applied correctly.¹¹³⁴

¹¹²⁹ M. Bhardwaj, *Chain of Custody and Its Importance in Criminal Investigations* 104 (Asian Law Review, 2020).

¹¹³⁰ A. Shukla, *Forensic Science: Indian Perspective* 121 (Jai Prakash Nath & Co., 2018).

¹¹³¹ *Selvi v. State of Karnataka*, (2010) 7 SCC 263.

¹¹³² R. K. Gupta, *Forensic Evidence and Human Rights: A Legal Perspective* 215 (Law Publishers, 2012).

¹¹³³ *State of Himachal Pradesh v. Rajesh Kumar*, (2014) 12 SCC 120.

¹¹³⁴ M. P. Jain, *Indian Constitutional Law* 745 (LexisNexis, 7th ed., 2019).

7.3. *Santosh Kumar Singh v. State through CBI (2010)*

In *Santosh Kumar Singh v. State through CBI*, the use of **DNA evidence** played a **critical role** in securing the conviction of the accused. This case is particularly noteworthy because it marked the first time in India that **DNA profiling** was used to conclusively prove the involvement of an individual in a heinous crime. The case involved the murder of a young woman, and the **DNA evidence** collected from the crime scene was instrumental in linking the accused to the crime.¹¹³⁵

The Supreme Court in this case emphasized that **DNA evidence** is a powerful tool in criminal investigations, especially when other evidence is inconclusive or unreliable. The Court also highlighted the importance of maintaining a proper **chain of custody** and adhering to scientific protocols in the handling of forensic evidence to ensure its **admissibility** and **integrity**. The ruling reaffirmed that DNA profiling, when handled correctly, is not only scientifically valid but also a **reliable means** of proving facts in criminal cases.¹¹³⁶

9. Reforms and Suggestions

Forensic science has immense potential to transform the criminal justice system in India. However, to fully realize this potential, significant reforms are needed to address the existing challenges. Below are key suggestions and reforms that could enhance the role of forensic science in the Indian criminal justice system:

9.1. Modernization of Forensic Science Laboratories (FSLs) and Establishment of Regional Labs

One of the most pressing issues facing forensic science in India is the **underdevelopment** and **overburdening** of forensic science laboratories (FSLs). Most existing FSLs suffer from **outdated equipment, insufficient resources, and lack of manpower**. As a result, there are significant

delays in the processing of forensic evidence, which impacts the **timeliness** of criminal investigations and trials.

To address this, the government should prioritize the **modernization** of existing FSLs and establish new **regional forensic laboratories** across the country. These labs should be equipped with **state-of-the-art technology** and staffed with **trained professionals**. Regional labs would reduce the burden on central labs and improve the accessibility of forensic services for local law enforcement agencies. Such a step would also facilitate the **decentralization** of forensic analysis, ensuring that no region faces a backlog in forensic evidence processing.

9.2. Mandatory Use of Forensic Evidence in Heinous Crimes

Forensic evidence has been proven to be a critical tool in solving crimes, particularly **heinous crimes** such as **murder, rape, and terrorism**. However, in India, forensic science is not always utilized effectively or mandatorily during investigations and trials. There is a need to **mandate the use of forensic evidence** in all serious criminal cases, especially in **violent crimes** where forensic science can provide crucial insights into the identity of perpetrators and the circumstances of the crime.

For example, **DNA profiling, fingerprint analysis, and ballistic analysis** can be indispensable in establishing links between a suspect and the crime scene. By making the use of forensic evidence mandatory in such cases, India can ensure that investigative agencies utilize the full potential of modern forensic tools to solve crimes.¹¹³⁷

9.3. Training Programs for Police, Lawyers, and Judges

The proper handling and use of forensic evidence require comprehensive training for all stakeholders in the criminal justice system. While forensic scientists and law enforcement

¹¹³⁵ Santosh Kumar Singh v. State through CBI, (2010) 9 SCC 503.

¹¹³⁶ V. Suresh, *The Role of DNA Evidence in Criminal Convictions* 98 (Indian Journal of Forensic Science, 2011).

¹¹³⁷ V. Suresh, *The Role of DNA Evidence in Criminal Convictions* 98 (Indian Journal of Forensic Science, 2011).

personnel are primarily responsible for collecting and analyzing evidence, it is also crucial for **police officers, lawyers, and judges** to be trained in the **legal principles** surrounding forensic science and its role in criminal trials.

- **Police officers** must be trained in the proper collection, preservation, and transportation of forensic evidence to avoid contamination and ensure its admissibility in court.
- **Lawyers**, particularly criminal defense attorneys and prosecutors, should be familiar with how to **present forensic evidence** in court, including understanding the limitations and reliability of different forensic techniques.
- **Judges** should be trained to assess the **admissibility** and **weight** of forensic evidence in light of the applicable legal standards. Specialized **judicial training** on forensic science will also help ensure that judges can make informed decisions when evaluating forensic testimony.¹¹³⁸

9.4. Accreditation and Standardization of Forensic Laboratories

To ensure the **quality** and **reliability** of forensic evidence, it is crucial to implement **accreditation** and **standardization** protocols for forensic laboratories across India. Accreditation would ensure that forensic laboratories comply with international standards of practice, maintaining consistency in their methods and procedures. This is crucial because errors in forensic analysis, whether due to faulty equipment or inadequate training, can lead to wrongful convictions or acquittals.

India should adopt a **national accreditation system** for forensic laboratories, similar to the **ASCLD/LAB** accreditation system in the USA and the **UK Forensic Science Regulator**. This system should set standards for laboratory equipment, personnel qualifications, and testing

procedures. Moreover, **standardized protocols** for evidence handling and analysis should be established to ensure uniformity across all laboratories.¹¹³⁹

9.5. Strengthening Chain of Custody Protocols

One of the most significant challenges in the use of forensic evidence is the potential for **compromise** of evidence through mishandling or tampering. Maintaining the **chain of custody** ensures that forensic evidence remains **untouched** and **uncontaminated** from the moment it is collected until it is presented in court. In India, the **chain of custody protocols** are often poorly maintained, leading to questions about the integrity of the evidence.

To address this, **clear and robust chain of custody protocols** must be implemented across all law enforcement agencies. This includes maintaining **detailed records** of who collected, handled, and transported evidence, and ensuring that **evidence lockers** and storage facilities are secure. Additionally, **digital tracking** of evidence could be introduced to reduce human error and enhance transparency. By strengthening these protocols, the credibility of forensic evidence in India's criminal justice system would be significantly improved.¹¹⁴⁰

9.6. Creating a National Forensic Science Policy

India currently lacks a comprehensive **National Forensic Science Policy**, which could guide the development and integration of forensic science into the criminal justice system. A **National Forensic Science Policy** would set out the **goals, principles, and priorities** for forensic science in the country, including **standards** for laboratories, **training programs, use of technology, and public awareness.**

10. Conclusion

Forensic science has become a vital component of India's criminal justice system,

¹¹³⁸ M. P. Jain, *Indian Judicial Training and Forensic Evidence* 220 (LexisNexis, 2019).

¹¹³⁹ **ASCLD/LAB**, *Laboratory Accreditation and Certification* (ASCLD, 2021).

¹¹⁴⁰ S. Sharma, *Forensic Science in India: Challenges and Future Prospects* 42 (Indian Journal of Law and Forensic Science, 2020).

offering scientific accuracy in solving complex crimes. It aids in establishing guilt or innocence, identifying suspects, and reconstructing crime scenes. Despite its importance, India's forensic infrastructure faces serious challenges—outdated labs, shortage of trained experts, delays in forensic reports, and inconsistent application across states. Legal recognition exists under laws like the Indian Evidence Act and CrPC, but ground-level implementation remains weak.

To fully harness the potential of forensic science, India needs a comprehensive reform strategy. This includes modernizing labs, ensuring nationwide standards, training law enforcement, and creating a National Forensic Science Policy. Public awareness and an Independent Forensic Authority are also crucial to ensure accountability. Strengthening the forensic ecosystem will not only enhance investigative efficiency but also ensure the accurate and fair delivery of justice in the country.

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