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Forensic Frontiers in India's Wildlife and Narcotics Crime: Challenges and Legal Perspectives

DRISHTI BANERJEE[1]

ABSTRACT

The introduction of the Bharatiya Sakshya Adhiniyam (BSA) has significantly transformed court proceedings related to expert evidence, broadening the scope of the term "experts". It is no longer constrained to specific fields, a long-overdue acknowledgment of scientific and technological advancements. Nevertheless, such evidence, including forensics, is not conclusive proof and has a high corroborative threshold. This paper engages in a doctrinal analysis of the laws and controversies regarding the two most lucrative areas of illegal trade- wildlife crimes and narcotics, emphasizing the Indian scenario. In both cases, forensics plays an important role. DNA-based wildlife forensics has progressed, seemingly, facilitating the process of species/herd identification in wildlife crimes like poaching. Even developing countries like India have incorporated such methods. However, have the Wildlife Protection Act, 1972, and other procedural laws evolved accordingly? Are the State's policies and infrastructural facilities advanced enough to collect, culture, profile, and detail delicate DNA evidence, susceptible to sample contamination and degradation? Does the present wildlife database provide sufficient reference data for the authorities to proceed and prosecute with this not-so-nascent yet globally accepted scientific technology? Narcotics forensics is another evolving field contributing to establishing guilt, dismantling drug trade networks, evaluating drug abuse, etc. Who qualifies as an expert in such cases, to minimize wrongful convictions? What are the admissibility standards where evidence tampering is prevalent but uniform protocols are absent? How can complex forensic evidence be made comprehensible to judges? These are some questions this paper endeavours to answer while providing legal and policy suggestions.

Keywords*: Wildlife crime, Forensic Sciences, Narcotics, Evidence.*

I. INTRODUCTION

Organised crimes refer to those offenses committed by organised groups aiming to profit financially from such activities, including supplying the public with illicit goods and services. These groups essentially cater to public demand, and corruption functions as a driving force

[1] Author is an LL.M. Student at National Law University, Delhi, India.

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behind the trade. Their operations are protected through the use of force, intimidation, and threats. 'The United Nations Convention Against Transnational Organised Crime and the Protocols Thereto' recognise this category of crime as a global challenge, as these, by nature, often operate transnationally. Organised crime groups endeavour to undo what the civil societies have collectively achieved. They take advantage of weak institutions in developing countries, technological advances, open borders, and free markets. In fact, they adapt to socio-political and technological changes with time and a global economy.

Organised crimes are also related to gross human rights violations, especially those of vulnerable groups. Fragmented efforts can do little to address these offences, having an international character, violating the dignity and safety of individuals. Legal and policy implications further the issue of accountability and State responsibility in a global setup. Further, the shadow global economy functioning through anonymous transfers and investments adds to the complex financial frameworks within the system. Such complexities are enhanced through urbanization and migration, creating the basis for the fourth generation of crime.

Human trafficking, narcotics, trafficking of arms and ammunition, terrorism, etc., are some common examples of organised crimes. This paper has chosen two organised crimes: narcotics and wildlife crimes for analysis, where forensics and expert evidence play a defining role. While forensics has developed to a significant extent for drug trafficking, it is still at a very nascent stage for the latter. The intricacies of the same shall be elucidated later.

Forensic science is an integral part of the criminal justice system. Procurement of evidence and its analysis in the laboratory are the two elements of forensics. Forensics is a category of scientific method that endeavours to discover the truth behind a crime by applying both deductive and inductive logic. Mostly, objective results from separate forensic tests are combined, and the examiners' objective results are analysed together to build a criminal case. Criminalistics is a branch of forensic science that includes the analysis of physical evidence to reconstruct events. Forensic Biology, fingerprint analysis, ballistic reports, odontology, toxicology, etc., are also included within the discipline. Therefore, the scope of the discipline is quite vast and is ever-evolving.

In the court of law, forensic evidence is recognised as expert evidence. The provisions of the new evidence law in this regard have seen some changes since 2024. Section 39 of the *Bharatiya Sakshya Adhiniyam* is no longer limited to specific fields but may include experts from any area whatsoever.[·] Further, for the admissibility of electronic records, certification by experts is necessary. This is a long overdue acknowledgment of the advancement of science

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and technology.

In an adversarial system of justice where the legal fraternity possesses limited knowledge in scientific matters, forensic sciences face significant challenges. Human error is yet another limitation, as this discipline is also reliant on subjective interpretations. In a developing country like India, scientific advancement itself is also prone to several limitations. These include over-bureaucratisation, lack of infrastructural facilities, budgetary problems, etc. Further, there is the problem of data inadequacy. The Courts have to be considerate of the same.

II. ROLE OF FORENSIC SCIENCE IN THE CRIMINAL JUSTICE SYSTEM

Forensic science is an evolving field, adapting continually to the changing nature of crimes (Gupta and Bhaduria, *Role of Forensic Science in Criminal Investigation,* 2024). However, in India, it is in serious need for standardization, especially with regard to collecting, preserving, and analysing evidence. Credible forensic evidence furthers the goal of delivery of justice (Kothari, *Exploring the Role of Forensic Science in Indian Criminal Justice System,* 2023). The perspectives of forensic experts, and that of law enforcement officials and the legal fraternity related to the crime scene often differ. This is premised on the understanding of the subfields based on training and established procedures. Despite the overlap, forensics never has the social or societal angle of crime prevention (Becker, *Criminal Justice vs. Forensic Science,* 2018).

There are various databases that further authenticate forensic findings. For instance, the National DNA Index System (NDIS), Combined Data Index System (CDIS), *et al*. Besides these, logic and rationality play an important role in getting definitive outcomes (Mack and Chatterjee, *Role of Forensic Evidence in Criminal Justice Delivery System in India,* 2021). Locard's "Principle of Interchange of 1910 still forms the premise of criminal investigations: the offender always leaves a trace behind (Sawant, *Analysis on the Use of Forensic Science Techniques in the Criminal Justice System of India*, 2024). Police examination therefore becomes significant, as it forms the basis of the criminal justice system (Barman, Kumar, *Judicial interpretation of forensic evidence in criminal justice delivery system in India,* 2024). The interplay between forensic evidence and the legal procedure may be further elucidated through fingerprint analysis, DNA sampling, ballistic reports, etc., which have now become household terms. The Supreme Court on Criminal Law and Procedure has highlighted the transformative role played by forensics in criminal justice administration (Chawla, *The Role of Forensic Evidence in Criminal Investigations in India,* 2023).

III. EXPERT TESTIMONY AS INTERPRETED BY THE JUDICIARY

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Previously, there has been a lot of confusion regarding the definition of the term expert under section 45 of the Indian Evidence Act, 1872.[2] In most cases, it is given advisory or corroborative value. Conflicts have also arisen from the opinions of two experts. Had the professional qualifications of the expert been clearly stated, it would have been more appropriate (Jiyauddin, *An Examination of the Acceptability of Expert Testimony under The Indian Evidence Act,* 2024). Expert evidence may be testimony evidence (for instance, when the expert is asked to testify before the Court), documentary evidence (for instance, handwriting on a document), and physical evidence (for instance, the ones developed in forensic laboratories). Various branches of forensics involved in a case must act together in a synchronized manner (Jainand Jain, *Expert Evidence,* 2018).

Historically, this practice of expert witnesses arose from a custom existing among merchants, where experts were a part of the jury during trial. In Folkes v. Chadd,[3] Smeaton emerged as the first expert to give evidence. Such evidence was first considered to be an opinion, which later was institutionalised to become a part of the trial. In today's time, even ChatGPT and other AI tools are being considered to be recognised as expert witnesses (Keegan, *Evaluating the Expert Witness in the Modern Legal Landscape*, 2024). In the USA, certain tests have evolved to establish the reliability of the expert witnesses. These include the "general acceptance" test, the "Kelly-Fyre" test, the "Daubert" test, etc., all of which endeavour to eliminate "junk sciences" from the Courtroom. These tests, however, are not free from their frailties, and often give in to subjective interpretations (Lopez, *Satisfying the Judicial Gatekeeper: Assessing Legal Standards for the Reliability of Expert Testimony*, 2004).

To a great extent, the National Academy of Science (NAS) has shaped the reliability of expert evidence. In Indian Courts, Expert evidence is an exception to the rule against opinion evidence, but its reliability has to be adjudged very carefully. An expert is not solely determined by her academic qualifications, but she may acquire special skills from experience, informal training, observation, etc. The provisions of evidence law are substantiated by criminal procedural law, like provisions for the report of chemical analysts, medical certificates, etc. The Motor Vehicles Act and other legislation also mention expert testimony (Bhadra and Aggarwal, *Judicial Gatekeeping of Scientific Evidence and Experts in Criminal Adjudications,* 2021).

Expert opinion may to a great extent be subjective (State of Uttarakhand v. Akhtar Ali, 2019). Indian Courts limit the standard for the admissibility of expert evidence to the expert's

[2] Indian Evidence Act 1872, s 45.
[3] *Folkes v Chad* [1782] 3 Doug 157.

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credibility and qualifications (State of Maharashtra v. Sharma, 2008). Senior government experts may not be summoned always (Malay Kumar Ganguly v. Dr. Sukumar Mukherjee, 2009). Corroboration of expert evidence is extremely essential (Abdul Rajak Murtaza Dafedar v. State of Maharashtra, 1970). Reference to specific data sets is important before arriving at a conclusion (Jaga Arjan Dangar v. State of Gujrat, 2018). Requisite procedures also must be followed (Chellappan v. State of Kerala, 2012). Polygraph tests and narco-analysis also form a category of expert evidence, as held in Selvi v. State of Karnataka, 2010, and other cases (Ramchandra Reddy v. State of Maharashtra, 2004).

IV. NARCOTICS FORENSICS: AN OVERVIEW

Cocaine, heroin, cannabis, etc. are the main types of drugs that are smuggled. There are zones of production, such as the Golden Triangle of South Asia. Through illicit routes, these are then transported to the countries having demand, especially the Western Countries. It is shipped through airline passengers, light aircraft, small boats, vehicle traffic, etc. (NCA, *Drug Trafficking*, 2023). Drugs are also made available in prisons (Norman, *A global review of prison drug smuggling routes and trends in the usage of drugs in prisons,* 2022).

States having weak governments often fall prey to drug trafficking, which also is an intersection point of transnational crimes and terrorism. Further, drugs are related to one very crucial aspect of State concern: public health. Therefore, it becomes pertinent to formulate appropriate drug policies that aim at not only prohibition but also alternatives like selective decriminalisation and regulated markets. Drug trafficking, therefore, has a significant impact on international relations and State security (Global Diplomatic Forum, *Drugs and Organised Crime: Exploring Illicit Drugs, International Security, Policy Reform, and their Impact on International Relations,* 2023).

The Narcotic Drugs and Psychotropic Substances Act, 1985 (hereinafter referred to as the NDPS Act, 1985) is India's central legislation on drugs and psychotropic substances. Intention is immaterial under this Act. Attempt, criminal conspiracy, or even abetment are punishable under it. The offences are non-bailable. However, the recent amendment in 2014 carved out certain exemptions for Essential Narcotic Drugs including Methadone and Fentanyl. The NDPS Act was a result of the ratification of three Conventions: the United Nations Convention Against Illicit Traffic in Narcotic Drugs and Psychotropic Substances, 1988, the Convention on Psychotropic Substances, 1971, and the Single Convention on Narcotic Drugs, 1961 (Law Commission of India, *One Hundred and Fifty Fifth Report on Narcotic Drugs and Psychotropic Substances Act, 1985,* 1997).

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The Central Bureau of Narcotics is a body established under the Act. It envisages to strengthen the global efforts against drug abuse. The theme for the International Day against Drug Abuse and Illicit Trafficking, 2024 is *evidence is clear, invest in prevention* (Central Bureau of Narcotics, 2024).

Rug geopolitics is a reality of the twenty first century. The economic benefits arising from this illicit trade are used to destabilise societies by attacking the territorial integrity of States. Drug trafficking forms 8% of the total world's exports, according to UNIDCP World Drug Report. Various underdeveloped countries have different strategies for dealing with this crime. Institutionally, three strata are related to drug trafficking: the growing of illicit crops, the contribution of commercial networks, and the involvement of international networks (Alessandro, *transnational Organised Crime and Drug Trafficking,* 1997). To combat transnational crimes like drug trafficking, multilateralism needs to be reinvigorated. The development of political will is crucial in this regard, as drug trafficking is a threat to peace and security to the world's vulnerable population (Caparini, *Transnational organized crime: A threat to global public goods,* 2022).

Forensics plays a crucial role in the identification and classification of drugs through chemical analysis, field testing, etc., linking drugs to trafficking through geographical tracing, chemical fingerprinting, etc., forensic toxicology, Nanotechnology and Forensic Chemistry and forensic DNA analysis, etc. (Gialamas, *Drug Analysis,* 2000).

V. A FOCUS ON WILDLIFE CRIMES

Poaching and trafficking of wildlife species are categories of environmental crimes and are punishable under the Wildlife Protection Act, 1972. The States of Uttar Pradesh, Karnataka, West Bengal, Madhya Pradesh, Rajasthan, and Assam function as transit routes for illegal wildlife trafficking. There is an urgent need to increase the number of endangered species so as to effectively safeguard them under the legal framework. Wildlife crimes are also linked intricately with destruction of habitat destruction and harming natural ecosystems. These are thereafter brought to the open market for selling after cautiously converting their parts into finished products (Rana, Kumar, *Current wildlife crime (Indian scenario): major challenges and prevention approaches,* 2023).

The Magistrates lack specialization while dealing with wildlife crimes. Effective training and capacity building, therefore, become important. Given the huge amount of paperwork associated with wildlife cries, an omission of even minor technical terms may weaken the case (Variyar, *Wildlife Crime and Punishment*, 2023). Murder, extortion, money laundering, illicit

drugs, and arms to aid the poaching network, etc. are all linked to this network of organised crime. It is also linked with other illegal activities like sand mining. Therefore, a holistic approach has to be undertaken to investigate wildlife crimes (Wildlife Justice Commission, *Convergence of wildlife crime with other forms of organised crime,* 2021). Data-driven approaches, monitoring and evaluation are absent in the current system, which is mostly focused on conventional approaches. Therefore, a Problem Oriented Wildlife Protection (POWP) is suggested (Mendiratta, *Tackling Illegal Wildlife Hunting and Trade in India: Problem-oriented Wildlife Protection Case Studies,* 2023). Modernization of Wildlife laboratories becomes important for accurate monitoring of exotic species. Sensors, telemetry, and biologging can aid this purpose (Lahoz-Monfort and Magrath, *A Comprehensive Overview of Technologies for Species and Habitat Monitoring and Conservation,* 2021).

The Forest Department and the Wildlife Crime Control Bureau are the two agencies vested with maximum power under the Wildlife Protection Act, 1972. Further, wildlife advisory boards and wildlife wardens play important functions in law enforcement. Hunting of scheduled animals is prohibited across India. The National Board for Wildlife also serves the purpose of conservation of forests and wildlife. The statute also provides for various categories of Protected Areas Including Sanctuaries, National Parks, Community Reserves, and Conservation Reserves, e*t al.* (Sinha, *Handbook on Wildlife Law Enforcement in India,* 2009).

The usage of forensics in wildlife crimes is a relatively novel concept but has been gaining popularity. It involves assessment of DNA, trace evidence, sample recognition, etc. (UNDOC, *Wildlife forensics: how science is helping to combat a billion-dollar organized crime industry, 2024).* DNA analysis can help in locating the geographical origin of the species, and thereby facilitate criminal justice (Iyengar, *Forensic DNA analysis for animal protection and biodiversity conservation: A review,* 2013). DNA tracking, storage, and sequencing are all parts of the system, and this category of DNA is also called environmental DNA or eDNA (Greenwood, *Using DNA in Biodiversity Conservation,* 2014). However, it is not free from flaws. Discrimination, authenticity, proper handling storage, and reliability pose serious challenges to its veracity (Kumar, Neelkamal, *Wildlife DNA Evidence: Recognition, Collection and Preservation*, 2015).

(A) Research Methodology

This paper has adopted a predominantly interpretive and analytical research methodology. Doctrinal resources have been referred to, including books, journals, Law Commission reports, websites, government publications, articles, blogs, *et al.* that relate to the vast subject area have

been referred to. Further, several statutes have been referred to, including the Narcotic Drugs and Psychotropic Substances Act, 1985, the Wildlife Protection Act, 1972, the Indian Evidence Act, 1872, the *Bharatiya Sakshya Adhiniyam*, 2023, etc. International instruments like Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), The United Nations Convention Against Transnational Organised Crime and the Protocols Thereto, etc. have also been cited. This paper has further cited the ratio of relevant precedents and their obiter dicta that emanated from the Hon'ble Supreme Court of India and other judicial bodies. This analysis is extremely important in common law countries like India. Broadly, the following methodology has been followed—

Conducting a review of existing literature

An extensive review of existing literature on the relevant topics has been conducted so as to get a conceptual clarity regarding the subject. This also gives clarity on the jurisprudence. However, since the paper is also focussed on a scientific discipline, the researcher has endeavoured to analyse certain technical aspects of the discipline. The subject area is global, yet with intricacies at the national level. Therefore, national legislations as well as international documents had to be considered.

Analysis of the law and precedents

The functioning of several law enforcement bodies established under national law and international frameworks has been analysed. The researcher has also cited a limited number of relevant case laws. Provisions of various substantive and procedural laws have been specified.

Compilation of data and final conclusion

Data from all the above sources have been analysed and interpreted to reach a conclusion to answer the research questions and prove the research hypothesis. While forensics is well developed for one aspect of the topic, the other is yet at a premature stage. Resources have been analysed accordingly.

(B) Research Questions

1. Whether the new evidence law has broadened the scope for admissibility of expert evidence, especially forensic evidence?
2. Whether Forensics can accurately contribute to identifying and prosecuting offenses under the NDPS Act?
3. Whether forensic science in India in its current stage of development is equipped to deal with wildlife crimes?

(C) Hypothesis

Forensic science has progressed. Its applicability may now penetrate nascent fields and advance in existing areas to facilitate the criminal justice system. It is hypothesised that the omission of specifications for "experts" under the *Bharatiya Sakshya Adhiniyam* has widened the scope for the admissibility of such evidence. Forensic science in India faces several limitations. In order to reform it, standardising protocols in consonance with international best practices would prove beneficial. Undeniably, the methods in effective use form the backbone for narcotics-related investigation and prosecution. India definitely faces technological hindrances in the field of wildlife forensics. However, with the changing nature of wildlife crimes, the country needs to adapt to this unconventional methodology. This will help to not only prevent and check wildlife-related crimes but also facilitate justice delivery in a wide array of related organised crimes.

(D) Objectives of Research

The research does not analyse in-depth the intricate scientific nuances of forensic science, but rather presents a broad overview of its role in criminal trials. The researcher intends to highlight the practicality of usage of advanced technologies in a country that is not only underdeveloped, but also faces legal complexities, lack of expertise, and a technological backlog. Under its limited scope, this paper provides suggestions for addressing the drawbacks under the current system.

(E) Scope of Research

This research intends to explore the contribution of forensics in dealing with two significant categories of organised crime: narcotics trafficking and wildlife trade, with a special focus on India. Consequently, it sheds light on the current forensic practices related to evidence handling in the abovementioned fields. Broadly speaking, this paper focuses on the following areas—

a. Integration of forensic sciences in the current legal framework.

b. Analysis of laws including the Wildlife Protection Act, 1972, and the Narcotic Drugs and Psychotropic Substances Act, 1985 to identify provisions for incorporating forensic evidence.

c. Overview of important policies related to the research area.

d. An overview of organised crimes as a whole, with focus on India.

e. Analysis of the function of narcotics forensics including methods such as forensic toxicology, drug profiling, chemical fingerprinting, chemical analysis, etc.

f. Examination of wildlife forensics, including methods like eDNA, and trace evidence

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analysis and the role they play in investigating poaching and wildlife trafficking.

g. Assessment of standards for admissibility of forensic evidence in Indian Courts, especially in light of poor infrastructure and chance of human error.

h. Evaluation of the corroborative threshold for forensic evidence.

i. Lack of standardised protocols and resource constraints are the two major limitations in this discipline, and the paper shall refer to both.

j. Suggestion regarding functionality of proper databases that could be beneficial for the abovenamed crimes.

k. A comparative analysis of practices worldwide, especially in light of existing treaties and conventions.

l. A reference to the role of the judges and the lawyers in appropriately dealing with forensic evidence and the need for specialization and training therein.

(F) Limitations of the research

Resource constraints and the vastness of the subject area are two major limitations of this study. Further, it lacks empirical analysis of any sort, despite the issues being of practical importance. Further, the study is geographically restricted to India, with a limited engagement with other jurisdictions. The study also focusses on current practices, and the historical overview or future foundations shall not be ventured into. The Hon'ble Courts have laid down quite a lot of precedents in this matter, but only a restricted number of them shall be specified in this study. This paper also suggests policy recommendations, but they are devoid of empirical research.

(G)Relevance and Expected Contribution of the Study

India is an important transit route for organised crime like drug trafficking and wildlife crimes. The criminal networks are interconnected, and deeply embedded in corruption among the government officials. India is closely situated to the Golden Crescent and the Golden Triangle and is thus more vulnerable to organised criminal networks. Therefore, a thorough understanding of these crimes, their investigation, as well as justice delivery, is extremely essential.

The *Bharatiya Nyaya Sanhita*, 2023 has introduced new provisions for organised crimes. The *Bharatiya Sakshya Adhiniyam,* 2023 has become more amenable to new technology and innovation. The Narcotic Drugs and Psychotropic Substances (Seizure, Storage, Sampling and Disposal) Rules, 2022 is a recent development. The Centre for Wildlife Forensics and Conservation Genomics has been inaugurated by the Zoological Survey of India since 2024.

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Further, India has set up the CCMB-LaCONES in Hyderabad, another landmark development in wildlife forensics. Together, these indicate a shift in the investigation and trial of organised crimes. Therefore, this study becomes extremely relevant, both theoretically and practically addressing the subject.

This paper is expected to contribute in the following regard—

a. Analysis of the intersection of forensics and law.

b. Addressing the gaps in forensic infrastructure, suggesting infrastructural reforms and training needs.

c. Recommendation of policies to standardise forensic protocols.

d. Understanding admissibility and interpretation of forensic evidence in the Court of law.

e. Analysis of the legal discourse, both nationally and globally.

VI. Analysis and Discussion

(A) Illegal Trade Rackets: A Transnational Crime

Organised crimes and corruption are closely linked. Organised crimes have infiltrated businesses and the government. These are subject matters of international crime and justice.[4] As distinct from criminology, the subject- matter of criminal justice is to determine the response of society to crimes. Crime essentially is a social phenomenon, with its administration and organisation being embedded in social structures.[5] The offenders, too, are stratified, belonging to various classes and categories. These crimes may affect a locality or neighbourhood, to nations at large. Naturally, they have jurisdictional impact. As distinct from international crimes, transnational crimes involve criminal groups active in different States. State cooperation, therefore, is essential to combat these criminal networks.[6]

This paper, however, is more focussed on how forensics, as an emerging science, helps in courtroom procedures. Forensic sciences support both the phase of evaluation and crime detection, as well as the investigation and trial after the crime has been committed. Therefore, it is crucial to understand and analyse how these subject-areas are mutually related.

[4] Fromiti. (n.d.). *Organized Crime Module 4 Core Reading*. https://www.unodc.org/e4j/en/organized-crime/module-4/core-readings.html

[5] Allum, F., Gilmour, S., & Hemmings, C. (2019). *Introduction to the handbook of organised crime and politics*. In F. Allum (Ed.), *The handbook of organised crime and politics*. Edward Elgar Publishing. https://doi.org/10.4337/9781786434579.00009

[6] Wiener, A., & Schmitter, P. C. (2019). *Theories of international relations: Approaches and debates*. Cambridge University Press. https://assets.cambridge.org/97811084/97879/frontmatter/9781108497879_frontmatter.pdf

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Changes Introduced by the *Bharatiya Sakshya Adhiniyam,* 2023

Generally, opinions of third persons, as hearsay evidence, are not considered to be relevant under criminal trials, barring certain exceptions.[7] The provisions related to expert opinions are under Chapter II of the *Bharatiya Sakshya Adhiniyam,* 2023, which deals with the relevancy of facts. It falls under the heading "opinions of third persons when relevant". Section 39 specifies certain fields where opinions of persons having specialised knowledge become relevant: foreign law, science, art, and handwriting.[8] The term "any other field" makes this an inclusive provision. A closer look at the illustrations reveals that expert opinions regarding poisoning, adjudging the unsoundness of mind, handwriting, or information stored in a computer are relevant.

The second sub-section of Section 39 deals with the opinion of the examiner of electronic evidence.[9] This has to be read with Section 79A of the Information Technology Act, 2000.[10] This provision deals with the Central Government notifying the examiner of electronic evidence through a notification in the Official Gazette. Thereby, any Government Department, body, or agency becomes competent to be an examiner for the purposes of section 39 of the *Bharatiya Sakshya Adhiniyam,* 2023 to provide expert opinion on electronic form of evidence before any court of law. Subsequently, a Scheme called *Scheme for Notifying Examiner of Electronic Evidence*[11] has been formulated by MeITY, which lays down the procedure for application, evaluation, and recommendation for that purpose. The Scheme is in consonance with international standards.[12] The scope of the Scheme is related to digital forensics, including branches like Digital Video / Image & CCTV Forensics, Computer (Media) Forensics, etc.[13]

Section 40 further makes facts supporting or contradicting expert opinions to be relevant.[14] This further corroborates or negates the conclusions reached by the expert. This is in furtherance of

[7] Bhubaneswar District Court. (2023). *Document of legal proceedings and related matters*. https://cdnbbsr.s3waas.gov.in/s3ec03333cb763facc6ce398ff83845f22/uploads/2023/12/2023120165.pdf.
[8] Bharatiya Sakshya Adhiniyam, § 39.
[9] Bharatiya Sakshya Adhiniyam, § 39(1).
[10] Information Technology Act, § 79A (2000).
[11] Ministry of Electronics and Information Technology. (2021). *Pilot scheme for notifying examiner of electronic evidence under Section 79A of the Information Technology Act, 2000*. https://www.meity.gov.in/writereaddata/files/annexure-i-pilot-scheme-for-notifying-examiner-of-electronic-evidence-under-section-79a-of-the-information-technology-act-2000.pdf.
[12] International Organization for Standardization. (2017). *ISO/IEC 17025:2017 – General requirements for the competence of testing and calibration laboratories*; International Organization for Standardization. (2012). *ISO/IEC 27037:2012 – Information technology – Security techniques – Guidelines for identification, collection, acquisition and preservation of digital evidence*.
[13] Ministry of Electronics and Information Technology. (2024) *Notification: Pilot scheme for notifying examiner of electronic evidence under Section 79A of the Information Technology Act, 2000*. https://www.meity.gov.in/notification-pilot-scheme-notifying-examiner-electronic-evidence-under-section-79a-information.
[14] Bharatiya Sakshya Adhiniyam, § 40.

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the Doctrine of *res Inter Alia Acter.*[15] Under Section 41, the Court further verifies signatures (that includes electronic signatures) and handwriting through expert opinions.[16] The new evidence law of India has brought many provisions related to electronic evidence under its purview, which is a step ahead of the amendments in the Indian Evidence Act, 1872.[17]

The provisions facilitate the Hon'ble Courts to make informed decisions on complex issues. This inculcates scientific advancements in the system of delivery of justice.[18]

Facilitating provisions in the *Bharatiya Nagarik Surakshya Sanhita*, 2023

The *Bharatiya Nagrik Surakshya Sanhita,* 2023 has provisions to incorporate forensic evidence during criminal investigation and trial. Section 176 of BNSS, which deals with investigation and occurrence reports, has incorporated sub-section 3 for the collection of forensic evidence.[19] For offenses the punishment for which exceed imprisonment of seven years, the investigating officer is obligated to cause the forensic expert to visit the crime scene to collect forensic evidence and videograph the process on a mobile phone or any other device. In States where forensic facilities are not available, the authorities may use the facilities of any other State.[20]

Section 349 of the BNSS authorises the Magistrate to order collection of signatures, fingerprints, handwriting, or voice samples, *et al.* to facilitate the investigation. This applies to persons arrested during the investigation, as well as to any other person (for which reasons must be recorded in writing).[21]

Under section 329 of the BNSS, reports of certain government scientific experts are considered. Any document considered to be an expert's report under this section shall be admissible in a court of law. Further, the expert preparing the report may be summoned at any time during the trial with regard to the subject matter of the report. If he cannot appear for such a trial personally, he may depute any responsible officer working with him to attend the proceedings.[22]

Section 330 carves out certain exemptions when no formal proof is required for certain

[15] Rachael L. Jones, *Science and Judicial Reasoning* (Cambridge University Press 2024) https://www.cambridge.org/core/books/abs/science-and-judicial-reasoning/techniques-for-judicial-engagement-with-science-in-the-practice-of-international-courts-and-tribunals/1EC9EA2E42F73DF76D445838AFA8EE43 accessed 19 October 2024.
[16] Bharatiya Sakshya Adhiniyam, § 41.
[17] Sharma, P. (2024). *Admissibility of electronic evidence under the Indian Evidence Act, 1872*. Manupatra. https://articles.manupatra.com/article-details/ADMISSIBILITY-OF-ELECTRONIC-EVIDENCE-UNDER-THE-INDIAN-EVIDENCE-ACT-1872.
[18] Chatterjee, P. (2024). *Expert opinion under Indian Evidence Act*. Lawctopus. https://lawctopus.com/clatalogue/clat-pg/expert-opinion-under-indian-evidence-act/.
[19] Bharatiya Nagrik Suraksha Sanhita, § 176.
[20] Bharatiya Nagrik Suraksha Sanhita, § 176.
[21] Bharatiya Nagrik Suraksha Sanhita, § 349.
[22] Bharatiya Nagarik Suraksha Sanhita, § 329.

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documents.[23] Under this, unless the report of an expert has been disputed before the Court, his report shall not be proved, and he shall be not called for the same. These provisions were not there under the Code of Criminal Procedure, 1973.[24]

(B) Drug Trafficking: A Global Perspective

It is not news that globalisation has posed significant threats to global security. It has led to a significant expansion of illegal trade in narcotic drugs and psychotropic substances. This threat is not in isolation but is linked to other crimes of transnational nature.[25] Synthetic drugs like fentanyl and methamphetamine, as well as other drugs including heroin and cannabis, are trafficked. These illegal networks gain traction from porous international borders. Nations are affected for being the source, transit, and destination of the drug trade.

Global enforcement agencies analyse intelligence on the mode of operation of these crimes, and the involvement of criminal networks. For this purpose, coordinated efforts and extensive training are required.[26] It is a common trend among crime groups to package drugs with metal devices while transporting it. During evidence collection, traces of the packages are looked for at the time of investigation.[27] Various authorities maintain databases for such relief markings in compressors.

Drug Trafficking in India

India is the world's largest hub of drug-driven HIV/AIDS. It is now a generalised epidemic in India. This is also linked to the illegal sex trade. Further, India is one of the largest manufacturers of pharmaceutical products. Further, in the belt of Kashmir-Uttarakhand-Himachal Pradesh, illegal opium cultivation takes place. Drug networks and drug abuse are facilitated by the absence of proper implementation of existing legal frameworks.[28]

The Narcotics Drugs and Psychotropic Substances Act, 1985[29] has stringent provisions to control and regulate the use of such substances, including production, possession, sale, and transport. Addictive narcotics cause insensibility or numbness. Psychotropic substances affect

[23] Bharatiya Nagarik Suraksha Sanhita, § 330.
[24] P39A Blog. (2023). *Criminal law bills 2023 decoded: 17 forensic evidence*. https://p39ablog.com/2023/11/criminal-law-bills-2023-decoded-17-forensic-evidence/.
[25] D'Auria, D. C. (2020). *The discourse of drug trafficking from global perspective*. SSRN. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3704693.
[26] Insight Crime. (2024) *Contemporary issues on drugs*. https://insightcrime.org/wp-content/uploads/2024/06/WDR24_Contemporary_issues.pdf.
[27] Interpol. (n.d.). *Drugs analysis and intelligence*. https://www.interpol.int/en/Crimes/Drug-trafficking/Drugs-analysis-and-intelligence.
[28] Swain, P., Das, J. K., Jha, S., & Sharnngadharan, G. K. (2017). Determinants of HIV positivity among injecting drug users in Delhi and Punjab. *Indian Journal of Sexually Transmitted Diseases and AIDS, 38*(2), 121–127. https://pmc.ncbi.nlm.nih.gov/articles/PMC6085938/.
[29] The Narcotics Drugs and Psychotropic Substances Act, 1985

the brain and alter cognition. Together, they are harmful to society as a whole, and thereby need to be stringently regulated. India's drug laws also comply with India's treaty obligations.[30] While the International Narcotics Control Board functions at a global level under the United Nations and provides regulatory standards, the impugned Act caters to the needs at the national level. It must be noted that medical and scientific usage of drugs is well recognised and it is therefore that drugs are categorised into Schedules for regulation. Usage of psychoactive drugs is prohibited.[31]

Forensic Science as a Facilitator to Investigating NDPS Crimes

Legal mechanisms to enforce drug control laws and treaties are extremely vital. The function of the Customs Department thereby becomes important. The nodal agency for drug laws in India is the Narcotics Control Bureau established under the Ministry of Home Affairs. It works in close association with the Financial Intelligence Unit (FIU), the National Intelligence Grid (NATGRID), and the National Forensic Science University (NFSU) to meet its objectives. Further, there are Bilateral Agreements and Memoranda of Understanding with various nations to comprehensively approach this crime.[32]

However, these are not free from limitations. There are ethical concerns like misuse of forensics data, operational challenges like inadequate facilities, lack of modernization and adequate infrastructure, and possibility of human error. Nonetheless, advancements in forensics like digital forensics and portable drug testing kits need to be acknowledged.[33]

Examples of Forensic Techniques Used in NDPS Cases

Forensic science plays an important role in these investigations and legal proceedings. While forensic chemists may analyse toxic chemicals and drugs, digital forensics may help in procuring data from electronic devices. Interdisciplinary collaboration with experts from the fields of biology, toxicology, chemistry, and digital forensics enhances the accuracy of such investigations.

(C) Forensics is important for substance identification:

Fourier Transform Infrared Spectroscopy

This method measures the infrared spectra of absorption and emission of a sample to identify

[30] Single Convention on Narcotic Drugs, 1961, United Nations, Treaty Series.
[31] Insight Crime. (2024). *Contemporary issues on drugs*. https://insightcrime.org/wp-content/uploads/2024/06/WDR24_Contemporary_issues.pdf.
[32] Government of India. (2023, March 28). *Prevention of narcotic drug* (Lok Sabha Unstarred Question No. 4522). Ministry of Home Affairs. https://www.mha.gov.in/MHA1/Par2017/pdfs/par2023-pdfs/LS28032023/4522.pdf.
[33] Drug Enforcement Administration. (2023). *Drug enforcement field officer's handbook*. https://narcoticsindia.nic.in/DLEA/1.pdf.

chemical compounds. For instance, if an unidentified suspicious powder is seized by the authorities, and its exact chemical structure is unknown, this method may be of help. Forensic experts would identify the chemical fingerprint of the sample and compare it to known databases to identify if it is a banned psychoactive substance under the NDPS Act.[34]

Gas Chromatography-Mass Spectrometry (GS-MS)

Gas Chromatography separates the components of a mixture based on their interaction with the column inside a chromatograph. It makes use of the retention time of the products to identify their chemical properties. Mass spectrometry is a method to break down the separated compounds into smaller fragments by ionization in a mass spectrometer. Through analysis of the mass-to-charge ratio, the chemical fingerprint of the substance is identified.

For example, the GC-MS method can be used to identify even trace amounts of drugs by analysing the blood sample of the suspect for drugs like methamphetamine. This could be a crucial evidence for a case of drug-impaired driving.[35]

High-Performance Liquid Chromatography (HPLC)

HPLC is a method used in analytical chemistry to segregate, identify, and determine the quantity of each of the components in a mixture. For instance, it may help in identifying the purity of seized heroin, which impacts the conviction and sentencing as per the law. This can help in identifying big drug trafficking operations and their legal repercussions.[36]

Discussion Through Case Laws

Several case laws were facilitated by forensics. For instance, in *State of Uttar Pradesh v. Anil Kumar Sharma, 2020*[37] forensic toxicology was used to prove driving under impairment. The GS-MS method was used in *State of Maharashtra v. Ramesh Kumar, 2015*[38] to corroborate the prosecution's claims in convicting the accused. In *State of Maharashtra v. Santosh M. Zende, 2017*[39] forensics was used to identify the nature of the drugs seized from the drug bust.

[34] Alkhuder, K. (2022). Attenuated total reflection–fourier transform infrared spectroscopy: A universal analytical technique with promising applications in forensic analyses. *International Journal of Legal Medicine, 136*(6), 1717–1736. https://doi.org/10.1007/s00414-022-02882-2.

[35] Turner, D. (2024). GC-MS: Principle, instrument, analyses, and GC-MS/MS. *Technology Networks*. https://www.technologynetworks.com/analysis/articles/gc-ms-principle-instrument-and-analyses-and-gc-msms-362513.

[36] Nikolin, B., Imamović, B., Medanhodzić-Vuk, S., & Sober, M. (2004). High performance liquid chromatography in pharmaceutical analyses. *Bosnian Journal of Basic Medical Sciences, 4*(2), 5–9. https://doi.org/10.17305/bjbms.2004.3405.

[37] State of Uttar Pradesh v. Anil Kumar Sharma, [2020] (5) AWC 4662, Allahabad High Court.

[38] State of Maharashtra v. Ramesh Kumar S/o. Sohanlal Tiwari and Anr., [2015] Case No. CR No. 123/2015, Mumbai Sessions Court, 2015.

[39] State of Maharashtra v. Santosh M. Zende, [2017] (2) Bom. C.R. (Cri.) 367, Bombay High Court.

(D) Wildlife Forensics: An Emerging Field

Wildlife forensics could be beneficial in tackling a wide array of wildlife crimes including trade in exotic species, persecution of protected species, poaching, etc. Despite these crimes involving billions of dollars and affecting several countries, not enough machinery is involved in combating them. As a discipline, wildlife forensics involves the identification of species, tracking down the site of origin of wildlife products, identification of the cause of death, and providing evidence to link the accused with the crime. Since the poachers now use extremely sophisticated methods for both the killings and the traffic, forensic science needs to advance in step with it.[40]

Technologies Employed In Wildlife Forensics

Key techniques employed in wildlife crimes include different biological, digital, and chemical forensic techniques that are equipped to face the challenges posed by these activities. They include—

Analysis of the DNA

a. Identifying Species

When transformed into finished products, the morphological features of the species (like the claws, skin, feathers, bones, etc.) are often degraded. Herein, DNA analysis helps in species identification. Such DNA is extracted from the processed products, and there are ways to identify the categories of DNA—

i. *Nuclear DNA:* Nuclear DNA can help in species identification through microsatellite markers. It can even determine the familial relationships among the species.

ii. *Mitochondrial DNA (mtDNA):* Unlike nuclear DNA, mitochondrial DNA is found abundantly in cells. It is inherited maternally and therefore is easier to retrieve. Gene sequencing using genes like the cytochrome oxidise I (COI) or cytochrome b gene can help in species identification.

b. DNA Barcoding

A segment of the cytochrome oxidise I (COI) gene or other genes can be barcoded to aid in detecting illegally traded species, or to monitor biodiversity. Essentially, this involves

[40] University of Florida. (2024). *The importance of forensic science in wildlife investigations*. Online Forensics. https://online.forensics.med.ufl.edu/online-graduate-programs/certificate-programs/wildlife-forensic-sciences-and-conservation/the-importance-of-forensic-science-in-wildlife-investigations/.

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sequencing a short, standardised region of the DNA.[41]

c. Identifying the Geographical origin

The geographical origin of the species can be traced through phylogeographic studies that help in tracking the intra-species genetic variations across regions. This can help to locate the specimen to its origin, and in the process, identify the poaching hotspot.

Single Nucleotide Polymorphisms (SNP) Analysis refers to the specific variations in the DNA that help link the finished product to the area or country of poaching.

d. Determining the sex of the species

In certain cases, the sex of the species becomes an important factor. For instance, the laws are protective of certain female species during the breeding season. Thereby, sex determination through DNA markers is important.[42]

Analysis of Ballistics and Toolmarks

The arrows, bullets, and other weapons are used for poaching activities. The trajectory, impact patterns, type of ammunition, etc. aid the investigation and trial to a great extent.[43]

Entomology

This scientific process helps to identify the age of the specimen through analysis of the life stages of the insect that colonizes the carcass' body. It can also hint toward the circumstances that led to the animal's death.[44]

Toxicology

Forensic toxicology is used to detect and analyse the chemical substances in the animal's system, and is especially important in cases of poisoning. It employs techniques like liquid chromatography-mass spectrometry (LC-MS) or gas chromatography-mass spectrometry (GC-MS) to accurately identify the contaminants in the specimen. Further, methods like Fourier-transform infrared spectroscopy (FTIR) are used in ivory and horn analysis, especially to analyse the chemical composition.[45]

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[41] Rodríguez-Riveiro, R., Velasco, A., & Sotelo, C. G. (2022). The influence of DNA extraction methods on species identification results of seafood products. *Foods, 11*(12), 1739. https://doi.org/10.3390/foods11121739.

[42] Latham, K. E., & Miller, J. J. (2018). DNA recovery and analysis from skeletal material in modern forensic contexts. *Forensic Science Research, 4*(1), 51–59. https://doi.org/10.1080/20961790.2018.1515594.

[43] United Nations Office on Drugs and Crime. (n.d.). *Firearms as evidence*. https://www.unodc.org/e4j/en/firearms/module-8/key-issues/firearms-as-evidence.html.

[44] Anderson, G. S. (n.d.). *Forensic entomology: The use of insects in death investigations*. Simon Fraser University. https://www.sfu.ca/~ganderso/forensicentomology.htm.

[45] Mbughuni, M. M., Jannetto, P. J., & Langman, L. J. (2016). Mass spectrometry applications for toxicology. *EJIFCC, 27*(4), 272–287. https://doi.org/10.1515/ejifcc-2016-0006.

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Geolocation and Image Matching Algorithms under Digital Forensics

Illicit online forums used for online wildlife trade can be tracked through digital forensics. Metadata can be extracted from images, which can in turn lead to the respective wildlife networks.[46]

Analysing Stable Isotopes

Isotopes are influenced by the environment of the animal's habitat. Thereby, it can be found whether the animal was bred in captivity or the wild.

Morphological Analysis

Osteological analysis of the procured skull, bones, teeth, and claws can help determine the species. Hair and fur identification are also parts of morphological analysis and facilitate the purpose.[47]

CITES and the Licensing System

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was established to ensure that international trade in wildlife products does not become detrimental to wild species. It has introduced a licensing system to aid the purpose. Under the system, export permits and re-export certificates may be issued, that bear evidence of abidance to the protocols under the Convention. Such certificates are issued by the CITES Management Authority, and the process is advised by the national CITES Scientific Authority.[48]

In India, this function is carried on by the Director of Wildlife Preservation at the Ministry of Environment, Forest, and Climate Change. The Wildlife Crime Control Bureau also plays an important role in this regard.[49] Established under Section 38 (Z) of the Wild Life (Protection) Act, 1972,[50] it functions to manage intelligence related to organised wildlife crimes and coordinate the various State enforcement agencies. All in all, it functions to ensure that all the provisions of statutes including the Wildlife Protection Act, 1972 are upheld.

[46] Di Minin, E., Fink, C., Hiippala, T., & Tenkanen, H. (2019). A framework for investigating illegal wildlife trade on social media with machine learning. *Conservation Biology, 33*(1), 210–213. https://doi.org/10.1111/cobi.13104.
[47] Hopkins, J. B., III, Frederick, C. A., Yorks, D., Pollock, E., & Chatfield, M. W. H. (2022). Forensic application of stable isotopes to distinguish between wild and captive turtles. *Biology, 11*(12), 1728. https://doi.org/10.3390/biology11121728.
[48] Smith, M. J., et al. (2011). Assessing the impacts of international trade on CITES-listed species: Current practices and opportunities for scientific research. *Biological Conservation, 144*(1), 82–91. https://doi.org/10.1016/j.biocon.2010.10.018.
[49] Wildlife Crime Control Bureau. (n.d.). *Home*. Retrieved October 19, 2024, from https://wccb.gov.in/.
[50] Wild Life (Protection) Act, 1972, § 38(Z).

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Analysis of Precedents Related to Wildlife Crimes

In *Sansar Chand v. State of Rajasthan, 2010*,[51] the Hon'ble Supreme Court observed how organised rackets have destroyed substantive parts of wildlife in India. Justice Katju also observed how the rich diversity of fauna has seen a rapid decline due to illegal poaching activities. It was further held that the protection of wild species is a constitutional mandate under Articles 48A[52] and 51A(g)[53] and other statutes. Preservation of these species is essential to maintain ecological balance. Scientific understanding of wildlife crimes, therefore, is very important. Further, the heads of these criminal rackets, if arrested, need to be stringently dealt with.

In *Motilal v. the Central Bureau of Investigation and Anr., 2002*,[54] the authority of the Central Bureau of Investigation to try wildlife crimes was under consideration. The Hon'ble Court considered the provisions of laws including the Wildlife Protection Act, 1972, the Code of Criminal Procedure, 1973, the Delhi Special Police Force Establishment Act, 1946, etc. were analysed. It was submitted that wildlife crimes often inherently included violations of the Foreign Exchange (Regulation) Act, 1973 (the FERA Act),[55] and therefore, the Customs Authorities or any other Central Government Officers must have jurisdiction. Therefore, it cannot be said that section 50 of the Wildlife Protection Act, 1972is a complete Code in itself.

In *T.N. Godavarman Thirumalpad v. Union of India, 2014*[56] dealt with the preparation of a rescue plan to save Asiatic Wild Buffalos. Certain States were asked to take steps to conserve and preserve these endangered species. It was suggested that providing corridors to wild animals is the most effective way to meet these ends. Protected areas like Conservation Reserves and Community Reserves play a crucial role in maintaining the country's geographical integrity. Anthropocentrism is the root cause behind human-animal conflict.

Principal Chief Conservator of Forest and Anr. v. J.K. Johnson & Ors., 2011[57] dealt with the authority of a specified officer empowered under section 54(1) of the Wildlife Protection Act, 1972[58] to order forfeiture of seized articles. The case highlights the structural framework of various law enforcement officials under the Wildlife Protection Act, 1972.

[51] Sansar Chand v. State of Rajasthan, [2010] AIR SCW 372.
[52] Constitution of India, art 48A.
[53] Constitution of India, art 51A(g).
[54] Motilal v. the Central Bureau of Investigation and Anr., [2002] AIR 2002 SUPREME COURT 1691.
[55] Foreign Exchange (Regulation) Act 1973.
[56] T.N. Godavarman Thirumalpad v. Union of India, [2014] AIR 2014 SUPREME COURT 3614.
[57] Principal Chief Conservator of Forest and Anr. v. J.K. Johnson & Ors., [2011] AIR 2012 SUPREME COURT 61.
[58] Wildlife Protection Act 1972, § 54(1).

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Limitations of Wildlife Forensics

It has to be understood that while the actual crimes of killings occur in rural or uninhabited areas, the forensic laboratories are situated in urban localities. India's ex situ facilities are very limited. The officials are untrained and lack proper qualifications. The laboratories are underequipped and the infrastructural facilities are not up to date. Moreover, genetic materials need to be preserved very accurately to get accurate results.[59] Together, these stand to be the biggest drawbacks and challenges that India faces in the domain of wildlife forensics.

The Centre for Cellular and Molecular Biology (CCMB) being established in Hyderabad is a landmark in India's journey of wildlife forensics. The CCMB-LaCONES laboratory is itself a milestone in DNA forensics. However, this does not cater to the wide array of problems and limitations faced by deploying forensic sciences in wildlife crimes.[60]

VII. Conclusion

The hypotheses for all three research questions are proven to be correct. Firstly, it is not only the evidence law but also the other two criminal Acts that have imbibed the notion of forensics and other scientific advancements within their purview. Thereby, the legislative framework of India is conducive to forensics. However, the real challenge lies in the enforcement of these provisions. The limitations: structural, functional, and financial, have already been discussed. It will take some time to overcome these hurdles and follow the law in its letter and spirit.

Regarding the second research question, it can be said that narcotics forensics is a field that effectively serves its purpose in NDPS crimes, but nevertheless needs standardisation. Drug-related crimes are economically compulsive by nature. Money laundering, tax evasion, and illegal income run as parallel illegitimate businesses with drug rackets. Drug abuse may in turn lead to psychopharmacological crimes, and systematic violent crimes. Standardisation of protocols will help to ensure consistency, and accuracy, and maintain the integrity of the legal process.

Regarding the third research question, it is apparent that forensic science in India in its current stage of development is not equipped to deal with wildlife crimes. However, this does not take away from the fact that the legislative framework is in place, and newer institutions are under development. With appropriate funding, appropriate management and administration, and strict

[59] Kumar, N., Yadav, V. K., & Rana, A. K. (2017). Wildlife forensic: Current techniques and their limitations. *Journal of Forensic Science & Criminology, 5*(4). https://www.researchgate.net/publication/329063516_Wildlife_Forensic_Current_Techniques_and_their_limitations.

[60] Centre for Cellular and Molecular Biology. (2020). *Assessment of scientific capacity in India*. https://www.ccmb.res.in/newsfiles/year-2020/CCMB-ASCI-Report.pdf.

adherence to standard operating procedures, wildlife forensics in India can reach great heights.

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