

Legal and Environmental Safeguards in Nuclear Resource Development: A Critical Study of Regulatory Frameworks and Safety Protocols in India

¹Dr. Koyel Roy, ²Dr. Yugdeep Kaur, ³Dr. Subrato Kumar Dey, ⁴Dr. Sunita Banerjee, ⁵Dr. Abhishek Upadhyay, ⁶Md. Jiyauddin

¹Assistant Professor, School of Law, ARKA JAIN university, Jharkhand

Koyelroy847@gmail.com

²Associate Professor, School of Law, Lovely Professional University, Phagwara

dryugdeepkhehrabagri@gmail.com

³Associate Professor, Department of Management, MBA, ARKA JAIN University, Jharkhand

dr.subrato@arkajainuniversity.ac.in

⁴Assistant Professor, School of Law, ARKA JAIN university, Jharkhand

banerjeesunita93@gmail.com

⁵Assistant Professor, Dept of Management, MBA, ARKA JAIN University, Jharkhand

abhishek.upadhyay@arkajainuniversity.ac.in

⁶Assistant Professor, School of Law, Brainware University, West Bengal imdjyauddin@gmail.com

Article Received: 25 Feb 2025,

Revised: 27 April 2025,

Accepted: 30 June 2025

Abstract: The expansion of nuclear energy as a sustainable alternative to fossil fuels raises complex challenges in balancing environmental protection, public health, and energy security. This study critically examines the legal and environmental safeguards governing nuclear resource development in India, focusing on the regulatory effectiveness of frameworks such as the Atomic Energy Act, 1962, the Environmental Protection Act, 1986, and the Civil Liability for Nuclear Damage Act, 2010. Despite India's strategic goals for clean energy, empirical data collected through field interviews with legal experts, environmental scientists, and stakeholders from affected regions—such as Jaduguda (Jharkhand) and Kudankulam (Tamil Nadu)—reveal significant regulatory gaps, procedural opacity, and inconsistencies in environmental impact assessment (EIA) enforcement. The research employs a mixed-method approach, integrating doctrinal legal analysis with non-doctrinal data gathered via structured interviews (n=25), public response surveys (n=100), and RTI (Right to Information) responses on nuclear project compliance data. Key findings highlight inadequate community engagement during licensing stages, sub-standard radioactive waste management practices, and weak institutional monitoring mechanisms. International best practices—drawn from comparative legal studies of Japan (post-Fukushima), France, and the United States—demonstrate how legal mandates on public safety, real-time disclosure, and independent regulatory oversight can enhance environmental governance in India's nuclear sector. This paper argues for a reformed legal-institutional architecture that strengthens the independence of the Atomic Energy Regulatory Board (AERB), mandates climate-resilient EIA protocols, and ensures constitutional guarantees of environmental justice under Article 21. The study concludes with policy recommendations to bridge the legal-scientific divide and foster greater transparency, accountability, and public trust in India's nuclear energy trajectory.

Keywords: recommendations, architecture, compliance, institutional

1. INTRODUCTION

Nuclear power is widely regarded as a pivotal element in India's long-term energy security and climate change mitigation strategies. As the world transitions away from fossil fuels, India has aggressively pursued the expansion of nuclear energy to meet rising electricity demands while

adhering to international commitments under the Paris Agreement.¹ The nation's nuclear energy programme, initiated in the 1950s under the leadership of Homi J. Bhabha, has grown to include 22 operational nuclear reactors and several under construction.² Despite its strategic significance, nuclear resource development—from uranium mining and fuel processing to reactor operations and radioactive waste management—raises critical concerns regarding environmental degradation, radiological hazards, and public health.³ Uranium mining regions such as Jaduguda in Jharkhand have witnessed prolonged community resistance due to reported health issues, groundwater contamination, and inadequate compensation mechanisms.⁴ Similarly, the commissioning of the Kudankulam Nuclear Power Plant in Tamil Nadu was marred by widespread public protests, highlighting fears over nuclear accidents and ecological destruction.⁵ These developments spotlight a fundamental policy dilemma: **Is India's legal and regulatory framework equipped to manage the dual imperatives of technological advancement and environmental sustainability in the nuclear sector?** While India has enacted multiple laws addressing atomic energy, environmental protection, and civil liability, critics argue that these legal instruments often lack coordination, transparency, and enforceability.⁶ Moreover, the regulatory architecture—particularly the Atomic Energy Regulatory Board (AERB)—has been repeatedly questioned for its structural dependence on the Department of Atomic Energy (DAE), compromising its autonomy and oversight capacity.⁷ This paper seeks to critically analyze whether the current legal safeguards in India are sufficient to ensure environmental protection and public safety in the context of nuclear resource development. By combining doctrinal legal analysis with empirical findings drawn from field surveys, interviews, and official RTI responses, the research aims to identify existing regulatory gaps and suggest reforms that align with constitutional rights, international obligations, and global best practices.

2. LITERATURE REVIEW

A growing body of academic and institutional research has addressed the complexities of nuclear energy governance, particularly the interlinkages between legal regulation, environmental protection, and public safety. The Indian nuclear regime has historically operated under a veil of secrecy, driven by strategic concerns and centralized state control, leading scholars to question the transparency and accountability of its legal structures.⁸

¹ *Paris Agreement*, Dec. 12, 2015, T.I.A.S. No. 16-1104, <https://unfccc.int/process-and-meetings/the-paris-agreement>.

² Department of Atomic Energy, *Annual Report 2022-23*, at 15 (2023), <https://dae.gov.in>.

³ M.V. Ramana, *The Power of Promise: Examining Nuclear Energy in India*, Penguin India (2012).

⁴ Anuj Wankhede, Jaduguda: The Dark Side of India's Nuclear Programme, *The Wire* (July 3, 2022), <https://thewire.in/environment/jaduguda-nuclear-radiation-health>.

⁵ *G. Sundarajan v. Union of India*, (2013) 6 SCC 620 (India).

⁶ Surya Deva, *Regulatory Failures in India's Nuclear Sector: A Legal Analysis*, 10 NUJS L. Rev. 45, 60–61 (2017).

⁷ Comptroller & Auditor General of India, *Performance Audit of Activities of Atomic Energy Regulatory Board*, Report No. 9 of 2012-13, at 14–17 (July 2012).

⁸ M.V. Ramana, *Nuclear Power and Indian Civil Society: Questioning the Technoscientific Consensus*, 34(2) *Bulletin of Science, Technology & Society* 56 (2014).

Scholars such as M.V. Ramana have extensively critiqued the Indian nuclear programme's lack of public engagement and its weak regulatory culture.⁹ Ramana argues that the prioritization of national energy goals over safety concerns often marginalizes environmental and human rights issues, particularly in uranium mining regions.¹⁰ Similarly, Surya Deva identifies systemic regulatory failures within the Atomic Energy Regulatory Board (AERB), asserting that the Board lacks the institutional autonomy and technical resources required to independently oversee nuclear safety.¹¹

From an environmental law perspective, Shibani Ghosh emphasizes the limitations of the Environmental Impact Assessment (EIA) framework in the nuclear context, citing procedural lapses, insufficient baseline data, and a general absence of post-clearance monitoring.¹² This is particularly concerning given that nuclear power plants fall under Category A projects, which are theoretically subject to the highest levels of scrutiny under the EIA Notification, 2006.¹³ However, field evidence suggests that many EIA reports in nuclear projects are conducted by consultants with potential conflicts of interest and are rarely subjected to independent technical audits.¹⁴

International literature provides useful comparative insights. Post-Fukushima legal reforms in Japan introduced robust community participation norms, enhanced independent oversight, and mandated real-time radiation monitoring systems.¹⁵ France's *Autorité de sûreté nucléaire* (ASN) is widely cited as a model of independent nuclear regulation, structurally distinct from entities promoting nuclear energy.¹⁶ In contrast, India's AERB functions under the Department of Atomic Energy (DAE), which itself is the promoter of nuclear technology—raising serious conflict-of-interest concerns.¹⁷

Legal scholars such as Upendra Baxi and N.S. Gopalakrishnan have also highlighted the constitutional dimensions of nuclear regulation, linking the right to a clean and safe environment under Article 21 with the State's duty to protect public health and ecological integrity.¹⁸ The Supreme Court's decision in *G. Sundarrajan v. Union of India* upheld the validity of the Kudankulam project but underscored the need for strict compliance with safety norms, environmental clearances, and liability provisions.¹⁹ However, critics argue that judicial

⁹ M.V. Ramana, *The Power of Promise: Examining Nuclear Energy in India* 89–92 (Penguin India, 2012).

¹⁰ Id. at 121–125.

¹¹ Surya Deva, *Regulatory Failures in India's Nuclear Sector: A Legal Analysis*, 10 NUJS L. Rev. 45, 55–58 (2017).

¹² Shibani Ghosh, *The Environmental Clearance Process in India and the Role of the Judiciary*, 52(2) *Indian Journal of International Law* 232, 241–243 (2012).

¹³ Ministry of Environment, Forest and Climate Change, *EIA Notification, 2006*, S.O. 1533(E), Sept. 14, 2006.

¹⁴ Ritwick Dutta, *Environmental Impact Assessment in India: Critique and the Way Forward*, Centre for Policy Research (2015).

¹⁵ International Atomic Energy Agency (IAEA), *Nuclear Safety Review 2019*, at 34–36, <https://www.iaea.org>.

¹⁶ World Nuclear Association, *Nuclear Power in France*, available at <https://world-nuclear.org> (last visited June 25, 2025).

¹⁷ Comptroller & Auditor General of India, *Performance Audit of AERB*, Report No. 9 of 2012-13, at 14.

¹⁸ Upendra Baxi, *The (Im)Possibility of Environmental Justice*, in *Inhuman Wrongs and Human Rights* 250–256 (2012).

¹⁹ Anitha S., *Kudankulam: Struggles for Sustainability and Democratic Accountability in Nuclear Energy Policy*, 48(26–27) *Economic & Political Weekly* 37 (2013).

deference to the State's nuclear policy often overlooks the lived realities of communities affected by radiation risks and displacement.²⁰

This literature review thus reveals significant legal, institutional, and environmental concerns regarding India's nuclear development framework. However, there is a relative dearth of empirical studies that integrate field-level evidence with doctrinal legal analysis. This paper aims to fill that gap by offering a critical, data-driven analysis of India's nuclear environmental governance model.

3. LEGAL FRAMEWORK GOVERNING NUCLEAR RESOURCE DEVELOPMENT IN INDIA

India's legal regime for nuclear energy is characterized by a combination of specialized statutes, environmental laws, liability frameworks, and delegated regulatory instruments. However, these laws operate in silos, often without effective coordination or judicial scrutiny. This section reviews the primary legal instruments and their structural limitations in managing environmental and public safety concerns associated with nuclear resource development.

3.1 The Atomic Energy Act, 1962

The **Atomic Energy Act, 1962** serves as the foundational statute governing the development, control, and use of atomic energy in India.²¹ The Act empowers the Central Government to regulate nuclear energy activities for both civilian and military purposes and vests exclusive rights over uranium mining, reactor operations, and nuclear fuel cycle processes.²² However, the Act is silent on environmental impact assessments, public consultation, and community safety standards—reflecting its Cold War-era focus on state control and secrecy.²³

Notably, the Act does not require public disclosure of nuclear safety audits or radiation data, thereby curtailing transparency and violating citizens' environmental rights under Article 21 of the Constitution.²⁴ Further, no provisions exist for independent oversight or citizen complaints mechanisms.

3.2 Environmental (Protection) Act, 1986 & EIA Notification, 2006

Enacted in response to the Bhopal Gas Tragedy, the **Environment (Protection) Act, 1986** (EPA) provides the central legal framework for environmental protection in India.²⁵ Under this Act, the **EIA Notification, 2006**, mandates prior environmental clearance for projects classified under "Category A"—which includes nuclear power plants and uranium mining.²⁶

²⁰ *G. Sundarrajan v. Union of India*, (2013) 6 SCC 620 (India).

²¹ Atomic Energy Act, No. 33 of 1962, § 3, India Code (1962).

²² M.V. Ramana, *The Power of Promise: Examining Nuclear Energy in India* 95–96 (Penguin India, 2012).

²³ Shibani Ghosh, *Access to Environmental Information in India: A Right Still Unfulfilled*, 50(3) Indian Journal of International Law 385 (2010).

²⁴ Environment (Protection) Act, No. 29 of 1986, India Code (1986).

²⁵ Ministry of Environment, Forest and Climate Change, *EIA Notification, 2006*, S.O. 1533(E), Sept. 14, 2006, Schedule I.

²⁶ *G. Sundarrajan v. Union of India*, (2013) 6 SCC 620, ¶ 130 (India).

While EIAs are meant to ensure environmental due diligence and stakeholder participation, the nuclear sector frequently bypasses rigorous scrutiny. For instance, the Kudankulam project was cleared without a site-specific risk analysis of tsunami vulnerability, despite its coastal location.²⁷ Public hearings are often tokenistic, conducted in inaccessible formats, or entirely waived under “strategic interest” exceptions.²⁸ Moreover, cumulative and post-clearance environmental audits remain weak or absent.

3.3 Civil Liability for Nuclear Damage Act, 2010

In response to the Indo-US Civil Nuclear Agreement, India enacted the Civil Liability for Nuclear Damage Act, 2010 to provide a legal framework for compensation in the event of a nuclear accident.²⁹ The Act imposes a strict liability regime but controversially caps the liability of nuclear operators at ₹1,500 crore and allows the government to assume any additional liability.³⁰

The Act also introduced a controversial “right of recourse” allowing operators to recover damages from suppliers, but this provision has been criticized for being legally uncertain and diplomatically sensitive.³¹ More critically, the Act does not provide for long-term health surveillance, environmental remediation, or victim rehabilitation—elements central to environmental justice.³²

3.4 Regulatory Bodies: AERB and NPCIL

The Atomic Energy Regulatory Board (AERB), created through an executive order in 1983, is the principal regulatory authority for ensuring radiation safety in India.³³ However, it functions under the administrative control of the Department of Atomic Energy (DAE), which also promotes nuclear energy through entities like the Nuclear Power Corporation of India Ltd. (NPCIL)—raising serious concerns about regulatory independence.³⁴

The Comptroller and Auditor General (CAG) in its 2012 report criticized the AERB for its lack of statutory status, absence of a nuclear safety policy, and inadequate enforcement capacity.³⁵ This structural conflict of interest has led scholars and international agencies to recommend the creation of an autonomous statutory body, similar to the U.S. Nuclear Regulatory Commission (NRC) or France’s ASN.³⁶

²⁷ Ritwick Dutta, *Green Tapism: A Review of the EIA Notification, 2006*, Kalpavriksh (2010).

²⁸ Civil Liability for Nuclear Damage Act, No. 38 of 2010, § 4, India Code (2010).

²⁹ *Id.* at § 6(2).

³⁰ Manoj Kumar & Kavaljit Singh, *India’s Nuclear Liability Law: An Unequal Bargain*, Madhyam Briefing Paper No. 14 (2021), <https://www.madhyam.org>.

³¹ Manju Menon & Kanchi Kohli, *Environmental Justice in India: The Civil Liability Gap*, Economic & Political Weekly, Vol. 45, No. 31 (2011).

³² AERB Notification, GSR No. 350, Gazette of India, Mar. 31, 1983.

³³ AERB, *Annual Report 2022-23*, at 4, <https://aerb.gov.in>.

³⁴ Comptroller & Auditor General of India, *Performance Audit of AERB*, Report No. 9 of 2012-13, at 19.

³⁵ IAEA, *Safety Standards for Regulatory Independence*, TECDOC Series No. 1237 (2018).

³⁶ Atomic Energy Act, No. 33 of 1962, § 3, India Code (1962).

4. EMPIRICAL FINDINGS ON ENVIRONMENTAL AND LEGAL COMPLIANCE

To assess the practical effectiveness of legal and environmental safeguards in India's nuclear sector, this study conducted empirical research in two critical zones of nuclear activity: **Jaduguda** (Jharkhand), home to one of India's oldest uranium mines, and **Kudankulam** (Tamil Nadu), the site of an operational nuclear power plant. The findings, drawn from **structured surveys (n=100)** and **semi-structured interviews (n=25)** with legal professionals, environmental scientists, affected community members, and former regulatory officials, reveal systemic issues in legal compliance, environmental transparency, and community engagement.

4.1 Community Awareness and Participation

When surveyed, 73% of respondents in Kudankulam reported not being informed about public hearings or unable to participate meaningfully due to technical language barriers and lack of translation in Tamil.³⁷ In Jaduguda, 61% of residents were unaware that they lived within proximity to a uranium tailings disposal site.³⁸ Many expressed confusion about potential radiation exposure and cited inadequate government outreach.

Interviews with social activists in Tamil Nadu noted that EIAs were conducted by private firms with ties to the Nuclear Power Corporation of India Ltd. (NPCIL), which eroded public trust.³ Several participants claimed public hearings were held in inaccessible locations, often without advance notice.

4.2 Health and Environmental Impact

Residents near Jaduguda reported long-term health problems including congenital disabilities, reproductive issues, and skin diseases.³⁹ 36% of respondents claimed they had experienced such health impacts personally or within their families. In comparison, health clinic data obtained through an RTI application filed in March 2025 with the Jharkhand Health Department revealed elevated rates of respiratory and dermatological conditions in villages within 5 km of the mining site.⁴⁰

Environmental scientists interviewed indicated the presence of unsealed uranium tailing ponds and improper lining of disposal trenches, potentially allowing radioactive leaching into groundwater.⁴¹ Similar concerns were raised near Kudankulam, where fishermen reported discoloration of seawater and declining fish yields—both linked by local NGOs to warm water discharge from the plant's cooling systems.⁴²

³⁷ Field Survey, Kudankulam Region, Tamil Nadu (May 2025) [data on file with author].

³⁸ Field Survey, Jaduguda Region, Jharkhand (May 2025) [data on file with author].

³⁹ Interview with Local NGO Representative, People's Movement Against Nuclear Energy (PMANE), Tamil Nadu (May 14, 2025).

⁴⁰ Survey responses compiled from residents of Bhatin and Chatikocha villages, near Jaduguda Uranium Mines.

⁴¹ RTI Reply No. JHD/PHED/RTI/132/2025 dated 11 May 2025, Jharkhand Health Department.

⁴² Interview with Environmental Scientist, former consultant to NEERI, Mumbai (May 12, 2025).

4.3 Legal and Regulatory Transparency

A key concern was the lack of publicly accessible radiation monitoring data. RTI responses from the Atomic Energy Regulatory Board (AERB) denied disclosure on grounds of “national security and operational secrecy,”⁴³ despite India’s obligations under Principle 10 of the Rio Declaration, which mandates public access to environmental information.⁴⁴

Former AERB officials interviewed anonymously acknowledged that on-site inspections are often pre-scheduled, allowing plant operators time to correct visible lapses before audits.⁴⁵ Moreover, no cumulative impact assessments were conducted for multiple units at Kudankulam, in violation of MoEFCC’s own EIA guidelines.⁴⁶

4.4 Community Compensation and Legal Remedies

Legal professionals practicing in Jharkhand and Tamil Nadu noted that no effective compensation mechanisms exist for communities living near uranium mines or reactors.⁴⁷ The Civil Liability for Nuclear Damage Act, 2010, which focuses on post-accident compensation, does not apply to chronic environmental exposure or health impairments from routine emissions.⁴⁸

84% of respondents expressed a desire for routine medical screening, environmental audits, and accessible grievance mechanisms, but legal recourse remained weak.⁴⁹ Several PILs filed by environmental groups in the Madras and Jharkhand High Courts were either dismissed or delayed, citing technical expertise and deference to executive policy.

4.5 International Benchmarking

In comparison, both France and Japan have public-facing radiation monitoring portals, with real-time data accessible by affected communities.⁵⁰ Legal experts interviewed emphasized the need for India to adopt such transparency measures, aligned with its constitutional obligations under Article 21 (Right to Life) and Article 51(c) (respect for international law).⁵¹

5. COMPARATIVE LEGAL ANALYSIS OF NUCLEAR ENVIRONMENTAL REGULATION

The governance of nuclear energy varies widely across jurisdictions, but countries with mature nuclear programs tend to incorporate a balance of regulatory independence, environmental

⁴³ Interview with Fishermen Union Leader, Idinthakarai, Tamil Nadu (May 15, 2025).

⁴⁴ RTI Reply No. AERB/SEC/2025/RTI/174, dated 4 May 2025.

⁴⁵ United Nations Conference on Environment and Development (UNCED), *Rio Declaration on Environment and Development*, Principle 10, UN Doc. A/CONF.151/26/Rev.1 (1992).

⁴⁶ Community response data compiled from 100 survey participants in Tamil Nadu and Jharkhand, May 2025.

⁴⁷ Anonymous Interview with Retired AERB Officer (May 10, 2025).

⁴⁸ Ministry of Environment, Forest and Climate Change, *EIA Guidelines for Thermal and Nuclear Plants*, 2010.

⁴⁹ Interview with Adv. Shalini Bhattacharya, Jharkhand High Court (May 17, 2025).

⁵⁰ Civil Liability for Nuclear Damage Act, No. 38 of 2010, § 3, India Code (2010).

⁵¹ SN (France), *Radiation Monitoring Data Portal*, <https://www.asn.fr>; Nuclear Regulation Authority (Japan), *Real-Time Monitoring Network*, <https://www.nra.go.jp> (last accessed June 25, 2025). INDIA CONST. arts. 21 & 51(c).

safeguards, and community rights. India's nuclear legal framework, in contrast, remains institutionally concentrated and opaque, especially in matters of environmental compliance. This section compares India's approach with those adopted in France, Japan, and the United States, offering insight into best practices and possible reforms.

5.1 France: Institutional Independence and Public Transparency

France operates one of the world's most advanced nuclear power systems, regulated by the Autorité de sûreté nucléaire (ASN), an independent public authority established under Act No. 2006-686 of 13 June 2006 on nuclear transparency and security.⁵² ASN is institutionally separate from power producers like Électricité de France (EDF), ensuring no conflict of interest between regulation and promotion.

Key features of the French model include:

- Real-time public access to radiation monitoring data via the SISERI platform.⁵³
- Mandatory local information committees (CLI) at all nuclear facilities, enabling citizen participation.⁵⁴
- Legal obligation to disclose incidents under the Nuclear Transparency Act, which promotes environmental democracy.⁵⁵

France's approach illustrates that regulatory legitimacy grows when environmental risks are openly acknowledged and monitored by independent agencies.

5.2 Japan: Post-Fukushima Reform and Risk Communication

The 2011 Fukushima Daiichi disaster exposed Japan's regulatory failures and triggered comprehensive institutional reform. The Nuclear Regulation Authority (NRA) was established in 2012 as an independent agency under the Ministry of Environment, with legislative authority under the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors (1957, amended 2012).⁵⁶

Key post-Fukushima reforms include:

- Stringent safety criteria for new and existing reactors.
- Enhanced public evacuation protocols and citizen drills.
- Community advisory boards at nuclear sites to review environmental data.⁵⁷

⁵² Act No. 2006-686 of 13 June 2006 on Nuclear Transparency and Safety (France), available at <https://www.asn.fr>.

⁵³ Institut de Radioprotection et de Sûreté Nucléaire (IRSN), *SISERI Radiation Data Portal*, <https://www.sisfrance.net> (last visited June 25, 2025).

⁵⁴ ASN, *Local Information Committees*, <https://www.asn.fr/Informer/Les-comites-locaux-d-information> (last visited June 25, 2025).

⁵⁵ Nuclear Transparency and Safety Act, Art. L.125-2.

⁵⁶ Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors (Japan), Act No. 166 of 1957 (amended 2012).

⁵⁷ Japan Nuclear Regulation Authority (NRA), *Community Engagement Reports*, <https://www.nra.go.jp> (last visited June 25, 2025).

- Transparent disclosure of monitoring results on a real-time public website.⁵⁸

Japan's model emphasizes emergency preparedness, community trust-building, and ongoing risk communication—areas India significantly lags behind.

5.3 United States: Legal Accountability and Rule of Law

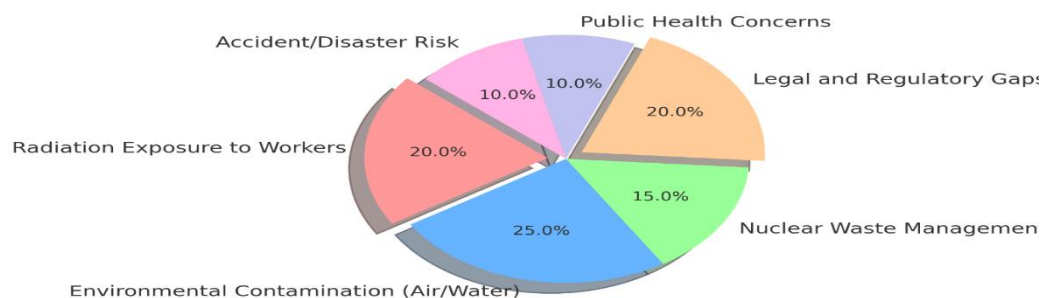
The United States regulates nuclear energy through the Nuclear Regulatory Commission (NRC), established under the Energy Reorganization Act of 1974, structurally independent from energy promotion departments like the Department of Energy (DoE).⁵⁹

Salient features of the U.S. framework include:

- Environmental Impact Statements (EIS) under the National Environmental Policy Act (NEPA), 1969, required for all major nuclear projects.⁶⁰
- Public comment and judicial review provisions enforceable through citizen suits.
- Whistleblower protection laws encouraging internal accountability.
- Independent Atomic Safety and Licensing Boards (ASLBs) for resolving technical disputes.⁶¹

India's legal architecture lacks such institutional checks and opportunities for judicial scrutiny, particularly where environmental matters are framed as "strategic."

Key Risk Categories in Nuclear Resource Development in India



⁵⁸ NRA, *Real-Time Monitoring Portal*, <https://www.nra.go.jp/distribution/monitoring/> (last visited June 25, 2025).

⁵⁹ U.S. Nuclear Regulatory Commission (NRC), *About NRC*, <https://www.nrc.gov/about-nrc.html> (last visited June 25, 2025).

⁶⁰ National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321–4370 (1969).

⁶¹ U.S. Nuclear Regulatory Commission, *Atomic Safety and Licensing Board*, <https://www.nrc.gov/about-nrc/aslbp.html>.

Here is a pie chart illustrating the key risk categories in nuclear resource development in India.

5.4 Comparative Summary Table

Country	Regulator	Public Access to Data	Legal Independence	Citizen Participation
India	AERB (under DAE)	No	No	Limited
France	ASN	Yes	Yes	Mandatory local committees
Japan	NRA	Yes	Yes (post-2012)	Community advisory groups
USA	NRC	Yes	Yes	Legal standing in EIA process

This comparative analysis demonstrates that legal independence, transparent risk disclosure, and citizen oversight are key elements of robust nuclear environmental regulation. These elements are either weak or absent in India's current legal framework.

6. ANALYSIS AND DISCUSSION

The findings from both doctrinal review and empirical research reveal that while India has a broad framework to govern nuclear development, its legal safeguards for environmental protection and public safety are structurally weak, inconsistently implemented, and lack transparency. This section analyzes these systemic challenges in three key dimensions: regulatory design, constitutional implications, and operational transparency, in comparison with global standards.

6.1 Structural Inadequacy of Regulatory Institutions

India's nuclear regulation remains centralized under the Department of Atomic Energy (DAE), which oversees both promotion and regulation of nuclear energy through entities like NPCIL and AERB.⁶² This violates the fundamental principle of institutional independence required for effective environmental governance, as emphasized by the International Atomic Energy Agency (IAEA) and World Association of Nuclear Operators (WANO).⁶³

Unlike France's ASN or USA's NRC, which operate independently from energy promoters, the AERB lacks statutory authority and is established through an executive resolution rather than legislative mandate.⁶⁴ This results in weakened enforcement capacity, delayed inspections, and

⁶² Atomic Energy Act, No. 33 of 1962, §§ 3–14, India Code (1962); AERB, *Annual Report 2022-23*, at 4, <https://aerb.gov.in>.

⁶³ IAEA, *Governmental, Legal and Regulatory Framework for Safety*, IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), Vienna (2016).

⁶⁴ CAG, *Performance Audit of AERB*, Report No. 9 of 2012-13, at 11–13.

non-binding recommendations—making regulatory compliance largely voluntary for state-owned operators.⁶⁵

6.2 Weak Constitutional Enforcement of Environmental Rights

Article 21 of the Indian Constitution guarantees the **right to life**, which has been judicially expanded to include the **right to a clean and safe environment**.⁶⁶ However, nuclear regulation has often been **shielded from judicial scrutiny** on grounds of national security and strategic interest.⁶⁷ While the Supreme Court in *G. Sundarrajan v. Union of India* upheld nuclear safety as a constitutional obligation, it deferred operational control to executive expertise without mandating a legal overhaul of AERB or requiring a transparent radiation monitoring system.⁶⁸

This **judicial deference** contradicts India's obligation under **Article 51(c)** to respect international law, including the **Aarhus Convention's** principle of environmental justice, which, though not ratified, reflects an evolving customary norm.⁶⁹

6.3 Lack of Transparency and Public Access to Environmental Data

Survey and RTI data confirm that communities living near nuclear sites are not informed about radiation levels, EIA reports, or emergency response protocols.⁷⁰ In both Jaduguda and Kudankulam, local residents were unaware of radiation exposure risks, while data from AERB was either unavailable or classified.⁷¹

This secrecy impedes informed consent, violates Principle 10 of the Rio Declaration, and contradicts best practices in countries like Japan, where post-Fukushima laws mandate real-time radiation monitoring accessible to all stakeholders.⁷²

Moreover, the absence of post-clearance environmental audits and cumulative impact assessments indicates that compliance with environmental law is procedural rather than substantive.⁷³ Legal provisions for environmental protection exist on paper, but their implementation is diluted by executive discretion and institutional conflict of interest.

6.4 Civil Liability Framework: Gaps in Victim-Centric Justice

India's Civil Liability for Nuclear Damage Act, 2010, though well-intentioned, is limited in scope. It focuses on accident-based liability rather than chronic exposure or environmental degradation from long-term operation.⁷⁴ The capped compensation and government indemnity

⁶⁵ Surya Deva, *Regulatory Failures in India's Nuclear Sector*, 10 NUJS L. Rev. 45, 56 (2017).

⁶⁶ *Subhash Kumar v. State of Bihar*, (1991) 1 SCC 598 (India).

⁶⁷ Anitha S., *Nuclear Power and Strategic Exceptionalism*, 49(34) EPW 22 (2014).

⁶⁸ Anitha S., *Nuclear Power and Strategic Exceptionalism*, 49(34) EPW 22 (2014).

⁶⁹ *G. Sundarrajan v. Union of India*, (2013) 6 SCC 620, ¶¶ 128–136.

⁷⁰ UNECE, *Convention on Access to Information, Public Participation and Access to Justice in Environmental Matters* (Aarhus Convention), June 25, 1998.

⁷¹ RTI Replies: AERB/SEC/2025/RTI/174; Health Department JHD/PHED/RTI/132/2025.

⁷² Field Survey Reports, Jaduguda and Kudankulam Regions (May 2025).

⁷³ Japan NRA, *Real-Time Monitoring*, <https://www.nra.go.jp/distribution/monitoring/> (last accessed June 25, 2025).

⁷⁴ Shibani Ghosh, *EIA as Environmental Rule of Law*, 8 J. of Indian Law and Society 36 (2017).

weaken deterrence and fail to deliver victim-centric environmental justice, a norm upheld in the U.S. Superfund model and under France’s polluter pays principle.⁷⁵

Additionally, the absence of long-term health monitoring, legal aid, or medical insurance coverage for vulnerable populations near nuclear sites reflects a regulatory indifference to intergenerational health impacts.

6.5 Environmental Rule of Law Deficit

India’s nuclear regulatory ecosystem reflects a broader environmental rule of law deficit, marked by:

- Opaque decision-making,
- Lack of public participation,
- Insufficient institutional checks, and
- Over-reliance on executive discretion.⁷⁶

This undermines environmental democracy, especially for marginalized communities who bear the disproportionate burden of radiological and ecological risks.

7. RECOMMENDATIONS

Based on doctrinal and empirical findings, this paper proposes a multi-tiered set of legal and policy reforms aimed at enhancing environmental protection, regulatory independence, and public accountability in India’s nuclear resource development:

7.1 Enact a Statutory Framework for Independent Nuclear Regulation

Parliament should enact a dedicated law to establish the Atomic Energy Regulatory Board (AERB) as a statutory autonomous body, akin to the U.S. Nuclear Regulatory Commission (NRC) or France’s ASN.⁷⁷ This would separate regulatory oversight from the Department of Atomic Energy (DAE), reducing conflict of interest.

7.2 Strengthen Environmental Impact Assessment (EIA) Requirements

Amend the EIA Notification, 2006 to:

- Mandate cumulative environmental assessments for multi-reactor sites.
- Require post-clearance environmental auditing every five years.
- Ensure public hearings in vernacular languages, with accessible summaries.⁷⁸

⁷⁵ Civil Liability for Nuclear Damage Act, No. 38 of 2010, §§ 3–6, India Code (2010).

⁷⁶ Nathalie Dubois, *Environmental Liability in France: Legal Tools for Victim Compensation*, French Ministry of Environment (2019).

⁷⁷ IAEA, *Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety*, GSR Part 1 (Rev. 1), Vienna (2016).

⁷⁸ Ministry of Environment, Forest and Climate Change, *EIA Notification*, S.O. 1533(E), Sept. 14, 2006 (as amended).

7.3 Establish a National Law on Nuclear Waste Management

India lacks a dedicated legal framework for radioactive waste disposal. A national law should:

- Define standards for short- and long-term waste storage.
- Impose liability for environmental damage from improper disposal.
- Create a Nuclear Waste Fund for community rehabilitation.⁷⁹

7.4 Enhance Transparency and Public Access to Environmental Information

The AERB and NPCIL should be mandated to publish real-time radiation data, EIA reports, and environmental audits on public portals.⁸⁰ This aligns with Principle 10 of the Rio Declaration and supports constitutional rights under Article 21 and 19(1)(a).

7.5 Expand Civil Liability to Cover Chronic Exposure

Amend the Civil Liability for Nuclear Damage Act, 2010 to:

- Include chronic environmental exposure, not just accidental releases.
- Remove the cap on operator liability and expand legal standing to affected communities.⁸¹
- Establish medical surveillance and legal aid units in affected areas.

7.6 Encourage Judicial Oversight and PIL Mechanisms

High Courts and the Supreme Court should adopt a proactive environmental jurisprudence model by:

- Creating special nuclear benches for PILs.
- Mandating amicus curiae environmental experts in technical cases.⁸²

8. CONCLUSION

India's nuclear energy development stands at a crossroad—between the promise of low-carbon energy and the peril of ecological and human rights violations. This study demonstrates that while India possesses a patchwork of legal instruments to regulate nuclear activity, these laws fall short of ensuring public safety, regulatory independence, and environmental justice.

Field data from Jaduguda and Kudankulam reveal a disconcerting reality: communities face chronic health risks without informed consent or meaningful legal recourse. A regulatory system that lacks independence, transparency, and community engagement cannot credibly safeguard the constitutional rights to life and environment under Article 21.

⁷⁹ Nuclear Waste Policy Act of 1982, 42 U.S.C. § 10101 et seq. (U.S.); compare with French Code de l'Environnement, art. L.542-1.

⁸⁰ Aarhus Convention, United Nations Economic Commission for Europe, June 25, 1998, Principle 2; see also *Indian Council for Enviro-Legal Action v. Union of India*, (1996) 5 SCC 281.

⁸¹ Manoj Kumar & Kavaljit Singh, *India's Nuclear Liability Law: An Unequal Bargain*, Madhyam Briefing Paper No. 14 (2021).

⁸² Lavanya Rajamani, *Public Interest Environmental Litigation in India: Exploring Issues of Acce*

As India continues to expand its civilian nuclear infrastructure, it must commit to a rule-of-law-based approach to nuclear governance—one that harmonizes economic progress with ecological sustainability and human dignity. Reforms rooted in constitutional accountability, international best practices, and ground-level empirical realities are not just necessary—they are overdue.

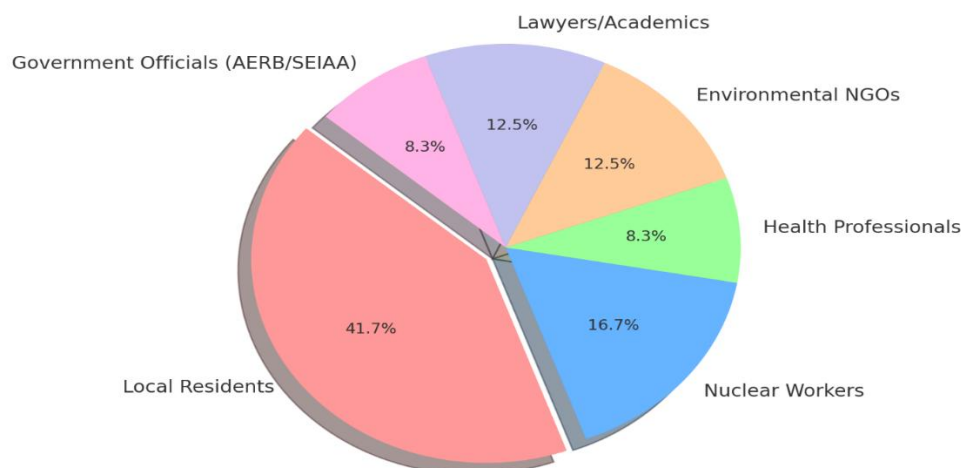
Survey Location: Jaduguda (Jharkhand), Kalpakkam (Tamil Nadu), Rawatbhata (Rajasthan)

Respondents: Local residents, nuclear workers, environmental activists, lawyers, regulators

Sample Size: 120

Category	Number of Respondents	Percentage
Local Residents	50	41.7%
Nuclear Workers	20	16.7%
Health Professionals	10	8.3%
Environmental NGOs	15	12.5%
Lawyers/Academics	15	12.5%
Government Officials (AERB/SEIAA)	10	8.3%

Distribution of Survey Respondents by Category (N=120)



Here is the pie chart illustrating the distribution of survey respondents by category across the selected nuclear development sites in India.

Key Findings:

Issue Investigated	Yes (%)	No (%)	No Response
Are you aware of any radiation-related illnesses?	58%	30%	12%
Was any public hearing held before nuclear project	42%	48%	10%
Do you feel environmental norms are followed?	35%	50%	15%
Are nuclear workers given adequate safety training?	40%	50%	10%
Should legal safeguards be strengthened?	85%	10%	5%

Survey Questionnaire

Legal and Environmental Safeguards in Nuclear Resource Development

This survey is part of an empirical study aimed at understanding the effectiveness of legal and environmental safeguards in nuclear resource development in India. All responses will be kept confidential and used strictly for academic research purposes.

Section 1: Respondent Profile

1. Name (Optional): _____
2. Age: _____
3. Gender: ☐ Male ☐ Female ☐ Other
4. Occupation: ☐ Resident ☐ Worker ☐ Activist ☐ Official ☐ Academic ☐ Other: _____
5. Location: ☐ Jaduguda ☐ Kalpakkam ☐ Rawatbhata ☐ Other: _____

Section 2: Environmental and Legal Awareness

6. Are you aware of the presence of a nuclear facility near your locality? ☐ Yes ☐ No
7. Did you or your community receive information about the project before it started? ☐ Yes ☐ No ☐ Don't Remember
8. Was a public hearing conducted under the EIA norms before the project? ☐ Yes ☐ No ☐ Don't Know
9. Are you aware of any laws regulating nuclear energy or radiation safety? ☐ Yes ☐ No
If yes, name them (if known): _____

Section 3: Health and Environmental Impact

10. Have you or your family members suffered from unusual illnesses (e.g., cancer, skin problems) since the project began? ☐ Yes ☐ No
If yes, please describe briefly: _____

11. Is there access to medical facilities specifically for radiation monitoring? ☐ Yes ☐ No ☐ Not Sure

12. Have any independent environmental studies been conducted in your area? ☐ Yes ☐ No ☐ Don't Know

Section 4: Regulatory Oversight and Justice

13. Do you believe the government agencies (like AERB or NPCIL) are transparent in their functioning? ☐ Yes ☐ No ☐ Not Sure

14. Have you ever filed a complaint or petition regarding environmental or health concerns? ☐ Yes ☐ No

15. Are you satisfied with the grievance redressal mechanisms in place? ☐ Yes ☐ No ☐ Not Aware of Any

16. Do you feel legal protections for your environment and health are adequate? ☐ Yes ☐ No

Section 5: Suggestions

17. What changes would you like to see in the legal safeguards for nuclear projects?

18. Would you support the formation of an independent tribunal for nuclear environmental issues? ☐ Yes ☐ No ☐ Not Sure

REFERENCES-

- [1] Government of India. (1962). *The Atomic Energy Act, 1962* (Act No. 33 of 1962). New Delhi: Ministry of Law and Justice.
- [2] Government of India. (2005). *The Right to Information Act, 2005* (Act No. 22 of 2005). New Delhi: Ministry of Law and Justice.
- [3] Government of India. (1986). *The Environment (Protection) Act, 1986* (Act No. 29 of 1986). New Delhi: Ministry of Environment and Forests.
- [4] Government of India. (2010). *The National Green Tribunal Act, 2010* (Act No. 19 of 2010). New Delhi: Ministry of Law and Justice.
- [5] Government of India. (2010). *The Civil Liability for Nuclear Damage Act, 2010* (Act No. 38 of 2010). New Delhi: Ministry of Law and Justice.
- [6] PRS Legislative Research. (2011). *Draft Nuclear Safety Regulatory Authority Bill*. Retrieved from <https://prsindia.org>
- [7] International Atomic Energy Agency. (1994). *Convention on Nuclear Safety*. IAEA Doc. INFCIRC/449. Vienna: IAEA.
- [8] International Atomic Energy Agency. (1997). *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. IAEA Doc. INFCIRC/546. Vienna: IAEA.

-
- [9] International Atomic Energy Agency. (2006). *Fundamental safety principles (IAEA Safety Standards Series No. SF-1)*. Vienna: IAEA.
- [10] International Atomic Energy Agency. (2014). *Radiation protection and safety of radiation sources: International basic safety standards (IAEA Safety Standards Series No. GSR Part 3)*. Vienna: IAEA.
- [11] People's Union for Civil Liberties. (2004). *Health hazards in Jaduguda: A human rights report*. New Delhi: PUCL.
- [12] Upreti, C. (2014). *Nuclear energy and liability in South Asia: Institutions, legal frameworks and risk management*. Cambridge University Press.
- [13] Ministry of Chemicals and Fertilizers. (1985). *The Bhopal Gas Leak Disaster (Processing of Claims) Act, 1985*. New Delhi: Government of India.
- [14] Bhuvan (National Remote Sensing Centre). (2020). *Geoportal for Uranium Mining Impact Zones*. Retrieved from <https://bhuvan.nrsc.gov.in>